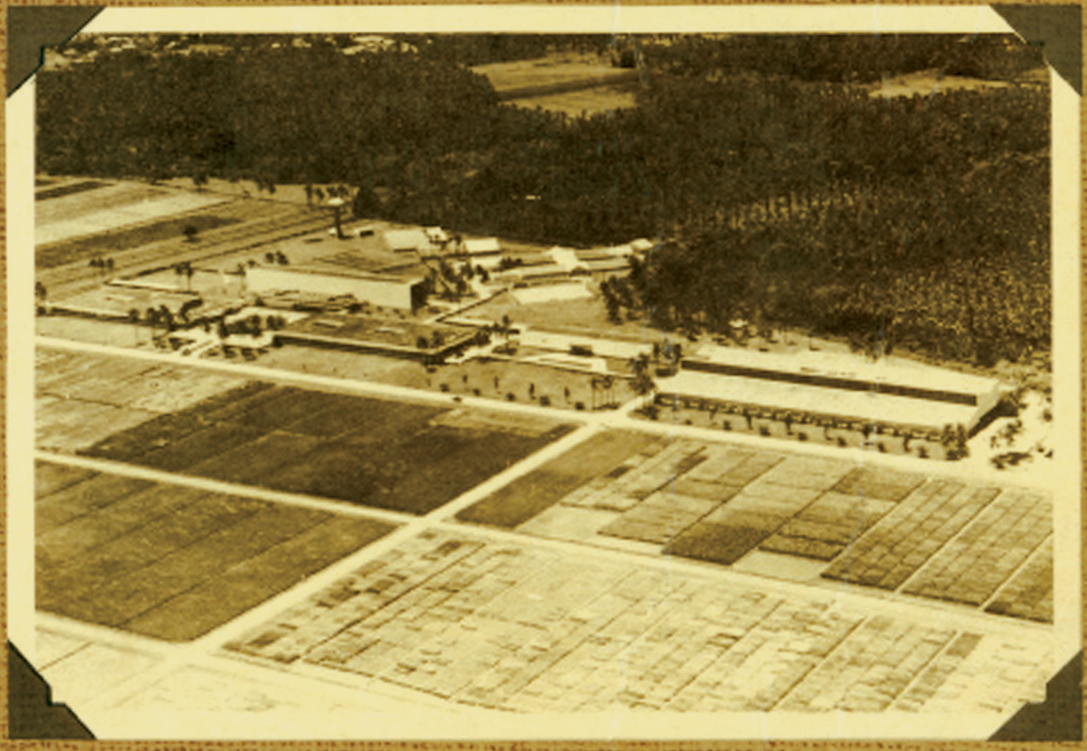
An Adventure in Applied Science:

A History of the International Rice Research Institute

Robert F. Chandler, Jr.



International Rice Research Institute

An Adventure in Applied Science:

A History of the International Rice Research Institute

Robert F. Chandler, Jr.

1992
IRRI
International Rice Research Institute
P.O. Box 933, 1099 Manila, Philippines

The International Rice Research Institute (IRRI) was established in 1960 by the Ford and Rockefeller Foundations with the help and approval of the Government of the Philippines. Today IRRI is one of the 16 nonprofit internationalresearch and training centers supported by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is sponsored by the Food and Agriculture Organization of the United Nations, the International Bank for Reconstruction and Development (World Bank), and the United Nations Development Programme (UNDP). The CGIAR consists of 40 donor countries, International and regional organizations, and private foundations.

IRRI receives support, through the CGIAR, from a number of donors including the Asian Development Bank, the European Economic Community, the Ford Foundation, the International Development Research Centre, the International Fund for Agricultural Development, the OPEC Special Fund, the Rockefeller Foundation, UNDP, the World Bank, and the international aid agencies of the following governments: Australia, Belgium, Brazil, Canada, China, Denmark, Finland, France, Germany, India, Iran, Italy, Japan, Republic of Korea, Mexico, The Netherlands, New Zealand, Norway, the Philippines, Saudi Arabia, Spain, Sweden, Switzerland, United Kingdom, and United States.

The responsibility for this publication rests with the International Rice Research Institute.

The cover shows headquarters of the International Rice Research Institute (IRRI) at Los Baños, Laguna, Philippines, in 1964.

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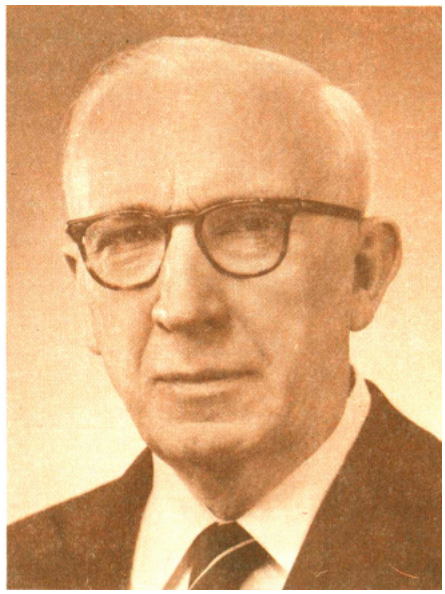
Dedicated to ...

Dr. J. George Harrar



Dr. Forest F. Hill

Dr. J. George Harrar* and Dr. Forrest F. Hill whose talents, experience, and farseeing efforts were largely responsible for the formation and establishment of the International Rice Research Institute (IRRI).

Dr. Harrar of the Rockefeller Foundation developed the concept of an international center in Asia devoted to rice research. He wrote the first outline of such an "international rice research institute" a plan that was followed closely in the building, staffing, and programming of the actual institution. He was one of IRRI's incorporators and served as the first Chairman of the Board of Trustees. His creative leadership during the Institute's formative years was a major factor in its successful beginning. Recognizing his historic contribution, IRRI's Board of Trustees, in 1980, named the training and dormitory complex *Harrar Hall,* for *". . . his* farsighted leadership and creativity in helping conceptualize, organize and obtain financial support for the Institute, and for championing the concept that IRRI's strong research focus should be complemented by an equally strong and effective training program."

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*Dr. Harrar died at his home in Scarsdale, New York, 18 April 1982, at the age of 75.

Dr. Hill of the Ford Foundation, likewise an incorporator and charter member of the Board of Trustees of IRRI, was elected Chairman of the Board in 1963, when Dr. Harrar found it necessary to resign. Dr. Hill's enthusiastic and indefatigable support of IRRI's program influenced the Ford Foundation and other foreign assistance agencies to provide substantial grants to the Institute. He served until 1977 when he was named Chairman Emeritus. The Board of Trustees named the laboratory building the *Forrest F. Hill Laboratory* in recognition of his ". . . wisdom and foresight in helping conceptualize and establish The International Rice Research Institute, of his tireless and selfless devotion to the Institute from its inception in 1960 through 17 years as a member of the Board including 14 years as Board Chairman, and of his warm and personal relationships with the Institute staff creating an atmosphere conducive to productive research and training."

Widely recognized, too, was the advantage to the IRRI venture of having in its leadership two such memorable and complementary personalities. It would be difficult to exaggerate the positive effect on IRRI staff morale and dedication during the early years that resulted from exposure to George Harrar's magnetic personality and Frosty Hill's wise humor.

About this publication . . .

In 20 years the International Rice Research Institute has become the center of a worldwide family of rice scientists. Therefore, IRRI's contributions are difficult to measure in isolation from the achievements of the international community of scientists striving to improve the production and quality of rice.

A small research initiative, born at Los Baños in 1960 through the vision and financial support of the Rockefeller and Ford Foundations and the Philippine Government, was transformed into a global movement for more and better rice for the consumer and greater income and employment for the rice farmer. How did it happen?

Dr. Robert F. Chandler answers that question in *An adventure in applied research: a history of the International Rice Research Institute.*

The author is obviously modest when referring to his own contributions. It is therefore the duty of others who are aware of the history of agricultural progress in developing countries in the last 25 years to chronicle the seminal role of Dr. Chandler.

In 1963, soon after becoming IRRI's first director, Dr. Chandler clearly articulated in an article in the *International Rice Commission Newsletter* the most important goals of rice researchers in the 1960s. Dr. Chandler expressed concern that most rice scientists were not perturbed by the low yields they obtained in their experiments. He wrote:

> "It is disturbing to read paper after paper, from various research and educational organizations experimenting with rice, in which yield data ranging from 1,500 to 3,000 kilograms per hectare are reported and yet no reasons are given for the low yields. The production of grain is obviously the objective of rice growing."

The single-minded devotion of IRRI scientists to the goal of raising the yield ceiling on indica rice led to the development of IR8 by late 1966.

The other significant contribution of IRRI — since its inception — has been toward the development of human resources to strengthen national research systems in developing countries. Dr. Chandler has always strongly believed that the human factor ultimately determines success or failure in meeting well-defined research objectives. The outstanding international team of scientists he assembled at IRRI reflected his emphasis on excellence in human endeavor and his ability to spot the *winners.*

Dr. Chandler is a scientist of vision and conviction, warmth and wisdom, and of great inner strength. The impact of his leadership and dynamism was

widely felt in Asia within a short period. The various honors bestowed upon him in the 1960s are evidence of the sense of gratitude that national governments felt toward him and IRRI for substituting *hope* for *despair* with regard to the potential for rapidly increasing indica rice production. The Government of India, for example, specially recognized him in 1966, the International Rice Year.

The principal architects standing out among many who helped build IRRI include Robert Letort, Sterling Wortman, Joe Drilon, George Harrar, Forrest F. Hill, and Robert Chandler. Among them, only Bob Chandler and Frosty Hill are with us today. I hope this history of IRRI will remind us of the vision, goals and aspirations of these great men and stimulate us to greater efforts in ensuring that no child or woman or man goes to bed hungry.

IRRI's location on the campus of the University of the Philippines at Los Baños (UPLB) has been particularly fortunate. Among IRRI's greatest blessings has been the total and unstinted support of the Chancellor and the staff of UPLB, and of the Philippine Government.

IRRI's thrust in the 1960s was to raise the aspirations for yield potential of the rice plant among farmers, extension workers, developmental administrators, political leaders and above all, rice scientists. Dr. Nyle C. Brady led IRRI during the 1970s, when the challenge was to promote growth with performance stability and to extend the fruits of technology to the ecologically handicapped areas with an excess or deficit of moisture. Dr. Brady's first task was to organize an interdisciplinary Genetic Evaluation and Utilization (GEU) program. He actively promoted the conservation of the vast and invaluable genetic resources of the rice plant. Seeds of more than 50,000 invaluable rice cultivars are now preserved in the germplasm bank of the *N.C. Brady Laboratory*. Those seeds are a contribution to both current and future generations of rice scientists.

A clear example of the impact of IRRI's broad-based breeding program in the 1970s is IR36-which farmers now grow on more than 10 million ha in Asia. Its success shows both the power of a broad and diverse genetic base in breeding, and the growing strength of the international rice research family. The individual strengths of the family members may vary, but their collective strength generated through the International Rice Testing Program and similar worldwide networks is considerable. Rice scientists around the world tested IR36 in their national trials and several countries approved its cultivation by local farmers.

IRRI emphasizes that varietal diversity and multiple resistance to insects and diseases are essential in preventing pest epidemics and insulating small-scale farmers from heavy expenditure on chemical pesticides. Thus, the Philippine Seed Board recently named IR56, which has resistance genes to the brown planthopper and to tungro and blast diseases different from those in IR36.

In 1975 IRRI discontinued its policy of naming and releasing varieties. IRRI now works only in partnership with national research systems that select,

name, and release varieties. Thus, IRRI's success is intimately linked with that of rice research workers everywhere. The *genes for Cooperation* spread by IRRI both in rice material and among rice scientists are the foundation for a bright future for rice farmers.

The Consultative Group on International Agricultural Research (CGIAR)—a consortium of donors organized in 1971 by the Food and Agriculture Organization of the United Nations (FAO), the International Bank for Reconstruction and Development (IBRD) and the UN Development Programme (UNDP)—can be proud of its role in strengthening and stabilizing the financial foundation of IRRI and of the other International Agricultural Research Centers. The Quinquennial Review Mission, which examined for the CGIAR IRRI's work in early 1982, reported "in economic terms, investments in IRRI of about US$20 million/year generate an added value of about $1.5 billion/year in increased rice production."

Such a significant development in human history should be correctly chronicled at a time when the world is permeated with discord rather than harmony, conflict rather than cooperation, and doomsday predictions rather than optimism for human destiny. We owe a debt of gratitude to Bob and Sunny Chandler, both for their labor of love and for their message of hope.

M.S. Swaminathan
Director General, IRRI,
and Independent Chairman,
Food and Agriculture Council

Foreword

The use of the word *adventure* in this book is wholly appropriate. The author brings you into the adventure and makes you feel akin to those who worked together to establish the International Rice Research Institute as the first of, and, today, one of the world's leading international agricultural research centers.

The writing of this adventure was an adventure in itself. Frosty Hill and Bob Chandler were both present at the start of the adventure in the late 1950s and remained an intimate hard-working part of it well into the 1970s. After Hill retired from the IRRI Board in 1978, he agreed to start setting down events and names important to IRRI over its almost 20 years of operation. When his health started to fail in 1979, Hill felt he could not handle the history alone and in 1980 Chandler agreed to join Hill in a joint effort to produce the IRRI story. By 1981, Hill felt he couldn't continue the work and asked Chandler to carry on alone.

Drawing on his keen memory, on a diary that he kept religiously over the years, and on an efficiently organized personal library, Chandler has filled this book with details, personal observations, and anecdotes that pull you into the IRRI adventure.

Why such a book?

The IRRI adventure tells the story of a truly remarkable international agricultural research center. The impact of IRRI through rice research and the benefits it has brought to rice farmers and mankind throughout the developing world is immeasurable. It goes beyond rice. It extends to a growing family of international research centers. Somewhere, even today, there are those who will ask, "What does it take to inspire creation of such a Center? What is required to put together an Institute like IRRI?"

The answers are provided by Chandler in these seven concise chapters.

Bob Chandler's name is on this book. It is basically his story. The input of Frosty Hill is also recognized. But the work of Sunny Chandler, the lady who was IRRI's first, although unofficial, secretary, and Bobs most ardent supporter throughout the adventure, must also be noted. She served as Bobs adviser-critic on the first drafts of the manuscript, did all typing of the final draft, and put her professional knowledge of the English language to work as an *in-house* editor throughout.

IRRI Editor Walt Rockwood spent 2 days with the Chandlers on their Massachusetts farm during the final stages of editing; the Chandlers later added final touches and checked galley proofs at IRRI. Gloria Argosino, IRRI

Preface

The International Rice Research Institute (IRRI), established in 1960 by the Ford and Rockefeller Foundations, was so successful that it stimulated the development of a worldwide network of international agricultural research centers based largely on the IRRI pattern. Mainly for this reason, it seemed important that the early history of IRRI, including the origin of the concept, be recorded.

Privileged to be party to most of the discussions that took place between the two foundations after their portentous decision to join forces in establishing the Institute, I later served for 12 years, from 1960 to 1972, as its first director. As such I participated in the planning of the physical plant, the selection of the initial professional staff, and the development of the research and training program. It was an intensely active and fruitful time, one that I now regard as the most exciting and challenging of my career. To those of us who worked together in planning and executing a research program that revealed new vistas for the yield potential of tropical rice, the experience was extraordinarily interesting and rewarding. Because much of IRRI's early research was of a pioneering kind, the resulting advances were often beyond expectation and thus doubly gratifying. That the project was truly *an adventure in applied science* I am confident the group of young scientists working at IRRI during the 1960s would agree.

In recognition of IRRI's widespread contributions to the improvement of rice and its culture, the Institute received in 1969 the Ramon Magsaysay Award for International Understanding and in 1970 shared with CIMMYT the UNESCO Science Award. In addition, numerous individual honors were bestowed upon its administrators and scientists for their achievements in furthering knowledge on the production of the essential grain.

Because the annual reports of the Institute, which give an excellent account of its work, do not name in the text the scientists engaged in the various projects, I have chosen in this book to identify the senior scientists who were responsible for specific findings. Regrettably, space does not permit naming the scores of capable Filipino junior scientists whose contributions were so essential to IRRI's success. I can do no more than salute their efforts sincerely and gratefully.

In the first chapter, drawing on the diary I was required to keep as an officer of the Rockefeller Foundation and on pertinent documents and actions of the Ford and Rockefeller Foundations made available to me, I have described in considerable detail the many conferences and processes surrounding the formation and establishment of IRRI. Such particulars may seem excessive to

some readers. Those, however, who were involved in IRRI's early activities and those who have served or now serve as trustees or staff members of the various international agricultural research centers, including IRRI, I hope will find the story informative and interesting.

In describing the early results of IRRI's research and training program (Chapter 4), I set the cutoff date as 1967 because by that time, IR8 and IR5 had been named and widely distributed and the Institute's research strategy had become well established.

Chapter 7, entitled *IRRI Today,* is not, of course, early history. Nevertheless, because the Institute has achieved so much during the past decade, it seemed appropriate that the book contain an account of selected major research advances and of the significant changes in personnel, physical plant, and financial support that took place after I retired and Dr. Nyle C. Brady became IRRI's leader.

I am indebted to Dr. Harrar for providing from the archives of the Rockefeller Foundation material pertaining to the development of the concept of IRRI and to the early negotiations with the Ford Foundation that resulted in the joint project of establishing the Institute.

Dr. Hill, in 1979, spent considerable time at IRRI assembling facts and documents pertaining to the Institute's establishment. He generously made that material available to me, as well as a careful account he had prepared of the evolution of the Ford Foundation decision to become involved in the formation of IRRI.

I am grateful to the late Dr. Sterling Wortman for giving me a detailed account of the series of Bellagio meetings that resulted in the formation of the Consultative Group on International Agricultural Research.

I am especially beholden to Dr. Brady, the director general of IRRI when this book was being prepared, for extending to me the privilege of writing this chronicle and for agreeing to issue it as an Institute publication.

Those at IRRI who have been most intimately involved in the preparation of the manuscript naturally are members of the Office of Information Services; namely, Dr. Thomas R. Hargrove, head of the department, Mr. William H. Smith, who sent me much background material from IRRI's files, and Mr. Walter G. Rockwood, who capably edited the entire manuscript and in the process made invaluable suggestions for its improvement.

Dr. Dennis J. Greenland, deputy director general of IRRI, obligingly read the last chapter of the manuscript — *IRRI Today* — and made helpful suggestions for its improvement.

I am deeply indebted to my wife, Muriel (Sunny) Boyd Chandler, for her helpful criticism and suggestions with respect to the contents of the book, for undertaking the preliminary editing, and for typing the first draft of the manuscript. Her encouragement and assistance were substantial assets in this undertaking.

Templeton, Massachusetts — Robert F. Chandler, Jr.

CHAPTER 1

An international institute for rice research in Asia

Rice is the principal food for half of mankind, and the people of Asia produce and eat 90% of all rice grown. In much of Southeast Asia, that grain provides people with 70-80% of their calories and 40-70% of their protein. To countless numbers of Asians, then, rice is life.

From the 1930s through the 1950s, rice yields in the less developed countries of Asia stagnated at pitifully low levels. For example, the average yield (as reported by FAO) for the 6 countries of Burma, India, Indonesia, Pakistan, the Philippines, and Thailand during the period 1934-38 was 1,360 kilograms per hectare, and 20 years later (1954-58) it was essentially unchanged (1,400 kg/ha).

Before the 1950s, the less developed countries of Asia depended upon increasing the land area planted to rice for producing enough food for their expanding populations. It was becoming evident, however, that the supply of new land suitable for growing rice was nearly exhausted and that the future enlargements in production would have to be brought about by improving yields on land already devoted to that crop. Furthermore, as the rice situation became more critical, population growth rates showed no signs of diminishing. In 1958, the world population was about 2.8 billion and United Nations demographers predicted that it would reach 6 billion by the year 2000. Already, with several hundred million malnourished people in the rice-growing countries, it was clear that widespread and drastic action had to be taken to avoid a serious food shortage in Asia. As Forrest F. Hill stated before the Ford Foundation trustees in 1959, "At best, the world food outlook for the decades ahead is grave; at worst, it is frightening." Such was the situation at the time this narrative begins.

ORIGIN OF THE CONCEPT OF AN INTERNATIONAL RICE RESEARCH INSTITUTE

The Rockefeller Foundation's intensive work in the agricultural sciences began in 1943 with the Mexican Agricultural Program. Later, similar country programs were established in Colombia (1950), Chile (1955), and India (1956). Those programs emphasized research on basic indigenous food crops and livestock and the training of promising young scientists. In each program, American scientists worked side by side with their local counterparts with the aim of developing strong national leadership and building enduring research and educational institutions.

The success of those operations was widely recognized. In particular, the Program in Mexico, under the brilliant leadership of J. George Harrar, had manifestly demonstrated that an intensive, problem-oriented research and training activity could transform a food-deficit country to a food-surplus one in about a decade.

Rice was not included in any of the country programs, but foundation officers were aware that it was the major food crop in most of Asia and increasingly felt that it merited specific attention. To become familiar with the state of rice research and with the major problems facing rice farmers, and to determine how the Rockefeller Foundation might contribute to rice research and education, Warren Weaver, director of the Foundation's Division of Natural Sciences and Agriculture, and Harrar, deputy director, went to Asia in 1952 and again in 1953.

Their travels in the rice-growing countries, visits to scientific and educational institutions, and talks with government officials confirmed that there was real need for an international rice research center in Asia.

In October 1954, Weaver and Harrar prepared a paper for the Board of Trustees of the foundation, in part setting forth the various reasons for establishing "An International Rice Research Institute in Asia." Because their report contains the first presentation of the need for such a center, its main arguments are quoted.

> "Before DNSA[1] officers went on the trip primarily devoted to rice, through Asia and Southeast Asia, there had been suggestions from several sources that perhaps the Rockefeller Foundation should aid in setting up and financing a single large international institute, somewhere in Asia, devoted to rice research. Having gathered information on this subject from many individuals from the rice-producing countries from (as far East as) Japan, around Southeast Asia, and as far West as India and Pakistan, we would now sum up this particular possibility as follows:
>
> Advantages of a single definitive center for rice research in Asia
>
> a) International, or at least multiple-country, cooperation in any field of science is, broadly speaking, a good thing. It furnishes a basis for international friendships and understanding, and contributes toward a pattern of global living which is undoubtedly a desirable and necessary part of the future.
>
> b) The basic problems concerning rice are universal problems, which can be properly attacked in one central laboratory which would then make the results available to all. Many of the really fundamental physiological, biochemical, and genetic problems are essentially independent of geography and are certainly independent of political boundaries; so that these problems could effectively and efficiently be attacked in one central institute.

[1] Division of Natural Sciences and Agriculture.

c) A central institute should, at least in theory, lead to financial savings and related gains in efficiency, since it should eliminate unnecessary duplications of facilities and effort.

d) At such a central institute, it should be possible to concentrate expensive types of instrumentation (phytotron, electron microscope, mass spectroscope, etc.). More important than this, it should also be possible to concentrate a high-powered and efficient international team of experts, supplementing each other and forming in total a more effective group than any one country could hope to produce. This should, moreover, result in the best utilization of this top group of experts, working on common problems under optimum conditions.

e) Such an international center should furnish otherwise unobtainable facilities for training of personnel for use in the cooperating countries.

f) Such a center could serve as a depository for research publications on rice, and should thus develop into the definitive library location for this field of research.

g) Such a center should work out some reasonable agreement, among the cooperating countries, with respect to the languages for rice research papers, thus making more readily useful the work done in various countries."

Significantly, the advantages of an international rice research institute, as spelled out by Weaver and Harrar, are as valid today as they were a quarter of a century ago.

The original hope was that the foundation would provide funds for building the institute and that the major rice-producing countries, jointly, would meet the operating expenses. However, when Harrar and Weaver broached this idea to government officials in rice-growing countries, all were in favor of the idea of a central rice research institute in Asia but each stated that his government could support such an organization only if it were located in his own country. That reaction eliminated any hope of creating a research center financed by multicountry contributions.

In view of the scope of funding needed to build and staff an international research center large enough to have a major impact on rice production in Asia, the officers and trustees decided that it would be unwise for the Rockefeller Foundation to attempt such a venture alone. Weaver and Harrar, however, did recommend to the trustees that the foundation get involved in strengthening rice research and training in Asia, not by establishing a rice research institute, because that did not seem feasible, but by helping to improve existing institutions that already had substantial rice research programs under way. They estimated that the foundation might spend $5 million on rice research and training in Asia during the ensuing 5-year period. To implement the Rockefeller program, they recommended a thorough examination of existing educational and research organizations in Asia to determine where funds could most wisely be invested.

The Rockefeller Foundation obtained the services of Richard Bradfield, an eminent agronomist from Cornell University, to undertake the suggested

survey during an 18-month period beginning in January 1955. For the first 8 months of the study, I (as newly appointed assistant director in the Agricultural Sciences of the Rockefeller Foundation) accompanied Bradfield. We visited the principal agricultural colleges and experiment stations in the Philippines, Japan, Taiwan, Thailand, Burma, Indonesia, India, and Pakistan. As a result, numerous grants were made for scientific equipment, for books and fellowships, and for specific research projects. This was the start of the Rockefeller Foundation's action program in agriculture in Asia.

At the dose of the survey, Bradfield submitted a report on agricul — research and education in Asia, including recommendations for activities that the Rockefeller Foundation might usefully support. He then returned to Cornell University, and I handled the foundation's agricultural interests in Asia. Contrary to persisting belief, we did not travel in Asia to seek a site for an international rice research institute. Indeed, before leaving New York in early 1955, we had been instructed by the foundation not to explore further the possible formation of such a center with Rockefeller Foundation support.

THE FORD FOUNDATION ENTERS THE SCENE

The Rockefeller Board decision in 1954 had shelved the concept of an international rice research institute in Asia, for lack of financial support. Fortunately, however, the Ford Foundation developed an interest in the establishment of the proposed institute. The result was a combined venture by the two foundations - one that was unprecedented. Its importance warrants an amount of what led to it.

For two weeks in October 1957, I journeyed in West Pakistan, talking with government officials and with representatives of foreign assistance agencies and visiting educational and research institutions in the region. George F. Gant, Ford Foundation representative in Pakistan, traveled with me to assess various Pakistani institutions and programs, some of which already had received assistance from either the Ford or the Rockefeller Foundation. We discussed the possibility of a joint effort by the two foundations to strengthen the College of Agriculture in Lyallpur. Gant and I agreed that at some future date when he was in New York, arrangements would be made for officers of the two foundations to meet to discuss such a cooperative project

The meeting took place about 10 months later. Harrar and I were invited to join a group of Ford Foundation officers for lunch at the Ford Foundation on 18 August 1958 to discuss the possibility of a joint venture to strengthen the Lyallpur institution. Present from the Ford Foundation were Forrest F. Hill, vice president for overseas development, George F. Gant, then program director for South and Southeast Asia, Alfred C. Wolf, program director for Latin America, and Walter Rudlin, program associate. After considerable discussion, it was agreed to confer again on the matter at a later date.

Toward the close of the meeting, a conversation that would have far-reaching implications took place. Turning to Harrar, Hill said, "You know, George, someone should undertake to work with rice the way you Rockefeller

Foundation people have with corn and wheat." Harrar replied that the Rockefeller Foundation had been concerned with the rice problem for sametime. Hill's final remark, referring to the respective foundations, was, "We have some money. You have experience in conducting agricultural research in the developing countries. We both are interested in doing what we can to help solve the world's food problem. Why don't we get together and see what we can do?"

That exchange between Harrar and Hill was the beginning of the idea of a cooperative project by the two foundations to establish the International Rice Research Institute (IRRI).

Anyone familiar with Ford Foundation policy at the time might well wonder at that organization's interest in supporting an agricultural program consisting largely of research in the applied sciences. Until then, Ford Foundation grants had been confined to education, economic planning, public administration, population control, and rural development. Nevertheless, the operation of such programs, particularly in the area of rural development, gradually prepared the way for the foundation's eventual interest in rice research.

The rural development work of the Ford Foundation had its largest expression in a community development program in India. Started in 1951, the foundation's program was undertaken chiefly for geopolitical and humanitarian reasons: geopolitical because it was feared that a rapidly increasing population in relation to food supplies in South and Southeast Asia would result in the developing countries falling into the Communist camp; humanitarian because of the prospect of greatly increased numbers of poverty-stricken and hungry people.

The program was of the self-help type, encouraging villagers to improve living conditions through their own efforts. It was operated on the assumption that improved technology, even agricultural production technology, was already available for application in all phases of community development and needed only an adult education program at village level to be used successfully. Unfortunately, in the area of agricultural extension particularly, not only were the village workers unequal to their task of helping farmers because of lack of education and experience but the so-called improved practices did not increase crop yields.

The plight of the Indian farmer, despite energetic, dedicated work in community development and agricultural extension, remained essentially unimproved.

In looking at Ford Foundation projects around the world, Hill visited the community development program in India and came to the conclusion that appropriate technology had not yet been developed to solve the difficulties the farmers faced in improving yields. A striking example of the problem was that when fertilizer was tried in farmers'. fields, both wheat and rice grew excessively tall and lodged badly; thus, grain yields were no higher on the fertilized plots than on the untreated ones. Hill saw that farmers faced the dilemma of getting traditionally low yields if they did not apply fertilizer and yet not

achieving an appreciable yield increase if they did. He concluded that the Ford Foundation, as well as several other agencies working on extension programs, had "got the cart before the horse," and that much more agricultural research was needed to support extension's work among farmers growing basic food crops.

He noted, in addition, that many of the community development workers in India did not have an agricultural background and had never grown a crop of rice or wheat themselves. He reasoned that not only was more agricultural research required but that extension people needed intensive training in the techniques of crop production.

As an agricultural economist, Hill looked also at the larger picture of the trends in food production and in population growth rates during the past several decades. He saw that the yield of cereal grains in the developing countries had been essentially static for many years, while population growth during the same period ranged between 2 and 3% annually.

In surveying the agricultural needs of the developing countries both Harrar and Hill deduced that the amount and quality of research on rice in Asia, outside of Japan and Taiwan, were inadequate. Although most of the rice-growing countries had a few well-trained research scientists working with the basic food crops, their number was too small and their research facilities and budgets were too meager to enable them to develop improved technology capable of substantially increasing yields.

These observations all pointed to the conclusion that a balanced, high quality, discipline-integrated rice research program was needed, along with financial support for a long enough period to explore fully the possibility of increasing yields.

Hill had completed his round of visits to the far-flung programs of the Ford Foundation at the time of the historic luncheon meeting on 18 August 1958. Harrar, who had successfully pioneered the Rockefeller Foundation's Mexican Agricultural Program and had demonstrated what agricultural research and training could do to increase food production in a developing country, had reached the firm conviction that a rice research institute was needed in Asia. The situation was ripe for the Ford and Rockefeller Foundations to join forces to develop a program for rice improvement.

After the 18 August meeting, Harrar went back to his files and dusted off the report he and Weaver had prepared for the Rockefeller Board of Trustees outlining the need for an international rice research center in Asia. During the next couple of months, several conversations took place among the officers of the two foundations regarding the actions that should be taken to prepare a plan for a cooperative program in Asia.

The first of those exchanges was on 29 August, when Hill and Gant were invited to a luncheon at the Rockefeller Foundation. Rockefeller Foundation officers present, besides Harrar, were President Dean Rusk and Albert H. Moseman, then deputy director for the agricultural sciences. Although that meeting was on a joint cooperative program at the College of Agriculture at Lyallpur (a plan eventually dropped in view of adequate U.S. assistance to that

institution), it had also been arranged to give more thought to a rice improvement program in Asia. The idea, it was agreed, would receive more detailed attention at a subsequent meeting.

Accordingly, on 3 October 1958, Hill, Gant, and Harrar met for lunch at the Rockefeller Foundation, and Harrar put forth in detail his ideas concerning the nature of an international rice research center and suggested that it be established in the Philippines. It was then agreed that, if the project was approved by the two foundations, Ford would put up the capital funds for land, buildings, and initial equipment and Rockefeller would handle the operating costs. Harrar promised to prepare a detailed memorandum on the plan, which he would first submit to Rusk for comment, then forward to Hill for presentation to the officers of the Ford Foundation.

Interest in the proposal had run high at the luncheon meeting, and later the same afternoon, Hill called Harrar to report that he had discussed the idea with Henry Heald, president of the Ford Foundation, and that it had been received with enthusiasm. He added that he would await a copy of Harrar's written proposal before proceeding further.

Later the same day, Harrar wrote a long letter to me — I was then traveling in Asia — stating that interest in the cooperative project was intensifying at both foundations. Harrar requested me to discuss the matter with appropriate Philippine Government officials and sound out the authorities at the College of Agriculture of the University of the Philippines at Los Baños on their reaction to having an international rice research institute near the campus.

I received Harrar's letter 16 October in Tokyo and prepared to give the subject top priority during my 18 November-6 December stay in the Philippines. Consequently, while there I talked with Juan de G. Rodriguez, secretary, Agriculture and Natural Resources; V.G. Sinco, president, University of the Philippines; L.B. Uichanco, dean, College of Agriculture, University of the Philippines; and D.L. Umali[2] who headed the College's rice and maize research program. The Philippine officials were enthusiastic about the establishment of an international rice research institute in their country. Uichanco stated that the College of Agriculture could spare as much as 40 ha of land and that more could be purchased.

Back in New York, meanwhile, Harrar had prepared his memorandum and sent it to Rusk on 8 October. Rusk, in a handwritten note, raised several questions but did not suggest that the statement be changed. The memorandum was forwarded to Hill about 10 October. Later discussions among Harrar, Hill, and me resulted in minor changes, but it was largely the material contained in Harrar's original memorandum that served as the guide to the development of both the research program and the physical plant of IRRI.[3]

[2] Umali became dean of the College of Agriculture in 1959 and was promoted to the position of vice president of the University of the Philippines at Los Baños in 1969. He resigned in 1971 to accept the position he still holds as assistant director general and regional representative for Asia and the Pacific of FAO. Umali's cooperation during the early years was a most significant factor in IRRI's successful establishment.

[3] The inclusion in the memorandum, reproduced in Appendix 1, of the principal reasons for favoring the Philippines as the location for IRRI will be of interest to some readers.

In January 1959, Bradfield, while in Asia for the Rockefeller Foundation, stopped in the Philippines and explored further the matter of the rice institute. He reported that interest in the project remained keen and that he and Uichanco felt the institute buildings should be built on a knoll called Higamot Hill, which adjoined the experimental rice fields of the College of Agriculture.

From March to June 1959, many conversations and conferences took place among Harrar, Hill, Gant, and me. Other officers of both foundations occasionally participated. Some of the more important developments during that period were:

- On 24 March, Angel Nakpil, a Philippine architect, called on me and expressed interest in being engaged as the architect for the proposed institute. Although his election did not materialize, Nakpil was helpful in giving the foundations an estimate of the cost of building construction in the Philippines. Indeed, based on his figures, the Ford Foundation was asked to be prepared to provide about $6 million for the capital costs, an amount substantially higher than Harrar's original estimate.
- On 17 April, at a lengthy conference at the Rockefeller Foundation, Harrar, Hill, and I discussed the proposals to be presented to the trustees of the foundations regarding the establishment of IRRI. Harrar's original statement had been revised, particularly with respect to estimated costs, and the changes were now shared with Hill, who continued to be extremely enthusiastic about the project. He expressed confidence that the Ford Foundation trustees would approve a grant in the neighborhood of the $6 million needed for the capital costs.
- Hill originally had planned to present a request for the $6 million. On 14 May, he and Gant informed me that they had decided, however, to request only $250,000 at the June meeting, with the understanding that approval of that grant would constitute a commitment to provide the remainder of the funds when a second request was made. Moreover, both felt that the foundations should spell out more explicitly the relationships among the Board of Trustees of IRRI, the Government of the Philippines, and the two foundations. The desired statement, Hill said, would be included in the docket item on IRRI to be presented at the June meeting of the Board.
- On 21 May, Hill and Gant gave me their draft of the docket item requesting $250,000 for the initial capital expenses of IRRI. When I showed the proposal to Rusk and Harrar, they suggested only one minor change in wording. The request (the text of which appears in Appendix 2) was approved by the Ford Foundation Board of Trustees on 19 June 1959.

As previously indicated, it was contrary to established Ford Foundation policy to support agricultural research programs, particularly those involving the natural rather than the social sciences. Yet the proposal to provide a sizable grant for the capital costs of an international rice research institute was approved by the Ford trustees without hesitation. In retrospect, their ready acceptance of the idea can be attributed to several factors. First, Hill, then the

only agriculturist in the New York office of the Ford Foundation, was a well-known agricultural economist whose judgment the Board respected. Secondly, Hill, being utterly convinced of the great need for research and training in rice technology in Asia, prepared his proposal to the trustees thoroughly and persuasively. Lastly, the Ford Foundation had so much money at its disposal that it welcomed proposals that appeared to be sound and showed real promise of having a significant impact on the world's food problem.

NEGOTIATIONS WITH THE PHILIPPINES

In April-May 1959, there was much correspondence between Harrar and Secretary Rodriguez in the Philippines, and arrangements were made for Harrar, Hill, and me to visit the country and confer with government and university officials on the conditions under which IRRI would be established.

We left New York 4 June and arrived in Manila some 40 hours later. Air travel in those prejet days made it a major undertaking to fly from New York to Manila but those who wanted to arrive at their destination in full working form could get berths (on the DC-7C, for instance) at additional cost. Hill, with more than his usual number of irons in the fire at the time, barely made the flight and not only had neglected to ask his office to engage a berth for him but had left his credit card behind. I produced my Rockefeller Foundation card and obtained a berth for Hill, who naturally had to endure some good-natured ribbing over the fact that the Ford Foundation, then with some five times the wealth of the Rockefeller Foundation, had to depend on the latter for such a minor item as berth space.

During our 5 days in the Philippines, we talked with the officials who would be involved in the establishment of IRRI in the Philippines. Visits among those in government were scheduled with President Carlos P. Garcia, Secretary of Agriculture and Natural Resources Rodriguez, and his Undersecretary, Dr. Amando M. Dalisay. At the University of the Philippines we had discussions with President Vicente G. Sinco and Vice Presidents E.T. Virata and Antonio Isidro. At the University's College of Agriculture in Los Baños we conferred at length with Dean Uichanco, Assistant Dean F.O. Santos, and Umali.

At the American Embassy we saw Charles E. Bohlen, ambassador to the Philippines, Quentin Bates, agricultural attaché, and Henry Brodie, economic advisor.

The discussions with university and college officials dealt largely with the availability of land for buildings and experimental fields. Although there was complete agreement that Higamot Hill would be ideal for the Institute offices and laboratories, Dean Uichanco reported that after conferring with his staff he had concluded that the college would not be able to spare the 40 ha for research fields that he had indicated would be available when he talked with me in November 1958. Instead, it would provide 7 ha around Higamot Hill for the Institute buildings, about 30 ha for research fields on both sides of the road east of Higamot Hill and an area of about 9 ha for staff residences. Besides this College land grantable to IRRI, there was a tract of about 40 ha that could be

purchased for about 3,500 pesos (then about US$800) per hectare. The Dean asked Umali to arrange for an option on that land (which was eventually bought by the University with Ford Foundation funds).

While in Los Baños, the foundation representatives were shown several possible sites for staff residences. The site selected appealed to the group because of the excellent view of the lake (Laguna de Bay) and because the housing would be far enough from the research center to separate the staff's personal lives from their official activities and yet near enough to be readily accessible. The original area of 9 ha for staff housing has since been expanded to accommodate additional residences.

The American ambassador and appropriate staff were visited mainly to acquaint them with the forthcoming project and to gain their views on any problems that IRRI might encounter in the process of becoming established in the Philippines.

One question raised was the possibility of the Philippine Government allowing IRRI to have what Harrar termed a "philanthropic exchange rate" for the conversion of U.S. dollars to Philippine pesos. At that time, most of the trade between the US. and the Philippines was conducted at an exchange rate of about 4 pesos to the dollar, whereas the official rate was pegged at the unrealistic level of 2 pesos to the dollar. Neither Ambassador Bohlen nor Economic Advisor Brodie believed there was any chance of obtaining a special exchange rate. However, they said that a bill had already been introduced in the Philippine Congress to devalue the peso and they were confident it would be passed within 2 years. They suggested that IRRI purchase most of the building materials abroad as a means of saving on construction costs.

The ambassador urged that the foundations definitely settle the provisions for tax exemption before, rather than after, IRRI was founded. He expressed genuine enthusiasm about IRRI's coming to the Philippines and thought that Los Baños was the ideal site.

The longest and most detailed conversations during the Philippine visit were with government officials. President Garcia, who had been thoroughly briefed beforehand by Secretary Rodriguez, extended a warm invitation to establish a rice research institute in the Philippines and told the foundation representatives that he had authorized Secretary Rodriguez to represent the Government in all negotiations pertaining to IRRI.

Further discussions were almost entirely with Secretary Rodriguez and Undersecretary Dalisay. After several meetings during the first 4 days, Dalisay presented the foundation representatives with a carefully prepared statement of the agreements reached during their visit. Secretary Rodriguez had already signed the document and space had been provided for Harrar and Hill to sign if they approved the contents. They explained that although they were in full accord with the terms of the agreement, they were not in a position to sign until they had had an opportunity to confer with their respective foundation presidents. (The agreement is not included here because its main points appear in the final Memorandum of Understanding, signed in New York in late 1959, which replaced it and which is reproduced as Appendix 3.)

One interesting point in the negotiations was that Dalisay believed that the tax exemptions sought for IRRI could be obtained more readily through the establishment in the Philippines of a research foundation which in turn would operate IRRI. Consequently, the agreement he prepared provided for the creation of a Rice Research Foundation. For some time, those working in Manila on the formation of IRRI did so under the impression that that was the way the Institute was to be operated. In fact, as a result, IRRI still uses RICEFOUND as its cable address. Not too long after moving to the Philippines, I talked with other government officials and with Philippine attorneys and learned that there was no advantage to creating a foundation and that IRRI could obtain tax exemption privileges directly. This obviously simplified the operation of the Institute.

Hill, Harrar, and I left the Philippines on 13 June with full assurance from government authorities that all foreign staff of the Institute would be exempted from Philippine income taxes and that they would be issued resident visas of an appropriate type. Furthermore, it was clear that there would be no problem about the Institute's exemption from import taxes on equipment and supplies outside the Philippines. Although Secretary Rodriguez believed that these exemptions could be obtained under Republic Act 2067, he said that just to be certain an executive order would be issued by the President and approved by the Cabinet.

During June-August, IRRI-related activities of the two foundations consisted principally of making funds available for the Institute's early operations in the Philippines. As mentioned, the Ford Foundation approved an appropriation of $250,000 for initial capital expenditures. A little later, the Rockefeller Foundation allocated $25,000 to cover operating costs for the remainder of 1959 and, with the approval of the Ford Foundation, assigned me to the Philippines to administer the program.

It was agreed that the original capital expenditure items needed in the Philippines would be purchased by the Rockefeller Foundation, with a portion of the Ford Foundation's $250,000 grant. In August, the sum of $90,000 was transferred to the Rockefeller Foundation for this purpose.

Later in the year, the Rockefeller Foundation appropriated an additional $160,000 for operating costs in 1960, bringing their total contribution for 1959-60 to $185,000. During this period, the Foundation treated its expenditures for IRRI as an operating program of the New York office, just as it did its programs in Mexico, Colombia, Chile, and India. Later, when IRRI became a legal entity, grants were made directly to the Institute. (The financing of IRRI through 1971 is presented in some detail in Chapter 5.)

On 7 September, my wife and I boarded the SS President Cleveland in San Francisco for our move to the Philippines (where we were to reside for nearly 13 years). On board was a 1959 Ford station wagon purchased in San Francisco.

The ship stopped in Honolulu, where I spent much of the day talking with Sterling Wortman, then head of the plant breeding program at the Pineapple Research Institute. He had worked in the Mexican Agricultural Program of the Rockefeller Foundation and was well known to Harrar and me. Hill had

previously agreed to determining Wortman's interest in joining IRRI. On hearing the plans for developing IRRI in the Philippines, Wortman stated that should he receive a formal offer, he would accept it. I got in touch with Harrar and strongly recommended that Wortman be appointed to the agricultural staff of the Rockefeller Foundation and be assigned to the Philippines as the assistant director of IRRI. The appointment was approved and arrangements were made for the Wortman family to move to the Philippines in early 1960.

Between Honolulu and Manila, I received a message from Secretary Rodriguez informing me that on 16 September (1959), President Garcia issued an executive order giving IRRI full tax exemption and other privileges requested.

My wife and I arrived in Manila Sunday, 27 September, and were met by Undersecretary Dalisay, who quickly cleared us through immigration and customs. The following day, the automobile cleared customs, and by Tuesday we had our Philippine driver's licenses and the car was registered. Indeed, IRRI received a genuine welcome in the Philippines and full cooperation was extended from the outset.

THE EARLY DAYS

We bought a typewriter and set up a temporary office in our room at the Manila Hotel while more permanent office space was being sought. My wife, Sunny, was familiar with clerical procedures and took care of letter writing and office management during the first weeks of IRRI's operation in the Philippines.

Space for offices was found in the newly constructed Trinity Building on San Luis (now Kalaw) Street in Manila. As the area rented was open floor space, architect Mel Calderon was hired to divide it into suitable offices and to engage a local contractor to do the work. On 2 November, the offices were occupied. By that time, Asuncion Nepomuceno, an experienced secretary, had been hired. She served as the Director's secretary until the following year when the approaching staff move to Los Baños induced her decision not to spend each work week away.from her family but to remain in Manila. Her replacement was hired before the staff transfer and Nepomuceno was able to give more attention to handling the office's daily stream of callers — the many scheduled visitors plus an almost equal number who were simply curious about the organization or hopeful of benefiting in some way from its establishment.

The setting up, especially in a developing country, of a venture of the uniqueness, complexity, and scope of IRRI involves so many actions, procedures, details, and moment-to-moment developments that the staff must become a close-knit interrelated group whose functions at every level exceed the routine, often to the point of sheer improvisation. Consequently, although the selection of the scientists and the development of the research program of IRRI are presented in a separate chapter, it is appropriate to describe here the Institute's earliest personnel — whether clerical, administrative, or technical — in the chronological order in which they joined the staff.

A capable bookkeeper, Carolina L. Ocampo, was hired on 1 December. Some months later, before the move to Los Baños, she left to accept a position abroad.

Jose D. Drilon, Jr. joined the Institute as administrative assistant on 1 December. Drilon had had extensive experience in the National Rice and Corn Corporation, serving as its assistant manager at the time he joined IRRI. Umali, then newly appointed dean of the College of Agriculture at Los Baños, recommended Drilon, citing his intelligence, honesty, and energy. "He gets things done," Umali told me.

Drilon, then 31 years old, stayed with IRRI for about 10 years, serving (after the Institute's formal organization) as executive officer.[4] In that key position he was responsible for all of IRRI's nonscientific operations, including buildings and grounds, cafeteria-dormitory services, security, secretarial and clerical appointments, employee relations, and more. His ability to deal with people diplomatically and to take quick, decisive action and his flair for good organization contributed greatly to the construction and staffing of the Institute and, subsequently, to its day-to-day operation. As is reported later, in the days of IRRI's founding Drilon played a most significant role in getting a law through the Philippine Congress granting IRRI tax exemption and visa privileges on a more secure basis than was possible under the President's executive order.

On 7 December, IRRI's first driver, Teotimo Alorro, started work. He had come with high recommendations from the U.S. International Cooperation Agency (ICA) and had been driving for 7 years without the slightest mishap. His record at IRRI was no less commendable. In 1981 he was still at IRRI, as a farm supply officer, and held the record for the longest period of service among IRRI employees.

On 1 February 1960, Rosa Maria del Campo was employed to serve as secretary to Wortman, who arrived 11 February with his wife and three children aboard the SS President Wilson.

After serving as assistant director for 2 years, Wortman was made associate director. He brought IRRI clear, creative thinking, a propensity for vigorous and quick action, and a warm personality. Moreover, he had the talent and experience to help guide the Institute in developing a sound and practical research and training program designed to increase rice yields on farmers' fields and to strengthen national rice research programs. Wortman's contribution to the progress of IRRI in those early years cannot be overestimated.[5]

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[4] IRRI lost a friend and supporter of long standing with the death of Jose D. Drilon, Jr. in mid-1981 at the time this book was in final draft. Drilon left IRRI in 1971 to serve his government in a series of important positions from general manager and chairman of the Board of the Rice and Corn Administration to undersecretary of Agriculture and director general of the Philippine Council for Agriculture and Resources Research (PCARR). Concurrently — from 1972 onward — he continued his distinguished international career as director of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).

[5] Wortman's premature death in May 1981 marked the passing of one who had forwarded significantly the application of scientific knowledge to the production of more food for the world's hungry millions.

Another 1960 appointee to the professional staff was Loyd Johnson, who joined IRRI 15 September as agricultural engineer. He and his family immediately took up residence at Los Baños in a house rented from the College of Agriculture. His assignment in 1960-61 was to establish the 80 ha of IRRI experimental fields, which entailed drilling deep water wells and building an underground irrigation system; land leveling and the construction of bunds around individual paddies; building roads, including several bridges; and installing an electrical system to supply power to the irrigation pumps. In addition, an open-ditch drainage system was constructed.

Johnson also supervised the establishment of a buildings and grounds department, including the selection of its superintendent and the ordering of the equipment and tools that would be needed. He played a major role also in selecting the equipment for the experimental farm.

Over the years, the Institute has continued to benefit from the excellence of Johnson's design and construction of the experimental fields.

As IRRI became involved in the hiring of architects and contractors, its financial burdens increased. The Rockefeller Foundation accordingly made available the services of its assistant treasurer, Robert Letort, as IRRI's chief financial officer. Although his duties at the Institute would be largely those of a comptroller, Letort was given the title of assistant treasurer as being more in keeping with his previous position in New York.

Letort and his family were not able to move to the Philippines until 24 October. In the meantime, the financial affairs of the Institute were administered by Drilon with the help of Ocampo and of Victor Arañez, who had started work on 16 July as Drilon's secretary.

By December, Letort had determined that he needed the assistance of a Philippine Certified Public Accountant (CPA). Letort was near retirement age and felt that when he left IRRI, a CPA would be able to handle the financial aspects of its operations.[6] Washington Sycip, of the well-known accounting firm of Sycip, Gorres and Velayo, was consulted. He recommended Faustino Salacup, who began work on 2 January 1961, with the title of assistant treasurer. Later, Salacup became treasurer, then comptroller, and in 1981 was named comptroller and secretary/treasurer of IRRI.

Among IRRI's professional staff, Salacup has had the longest term of service. Throughout, he has continued to handle the increasingly involved budgeting systems stipulated for the various international research centers after the formation of the Consultative Group on International Agricultural Research (CGIAR).[7]

In the early days of IRRI, however, Letort and Salacup worked out a system of accounting and bookkeeping for the Institute that was copied by several of the research organizations established in the mid-l960s, especially CIMMYT and CIAT.

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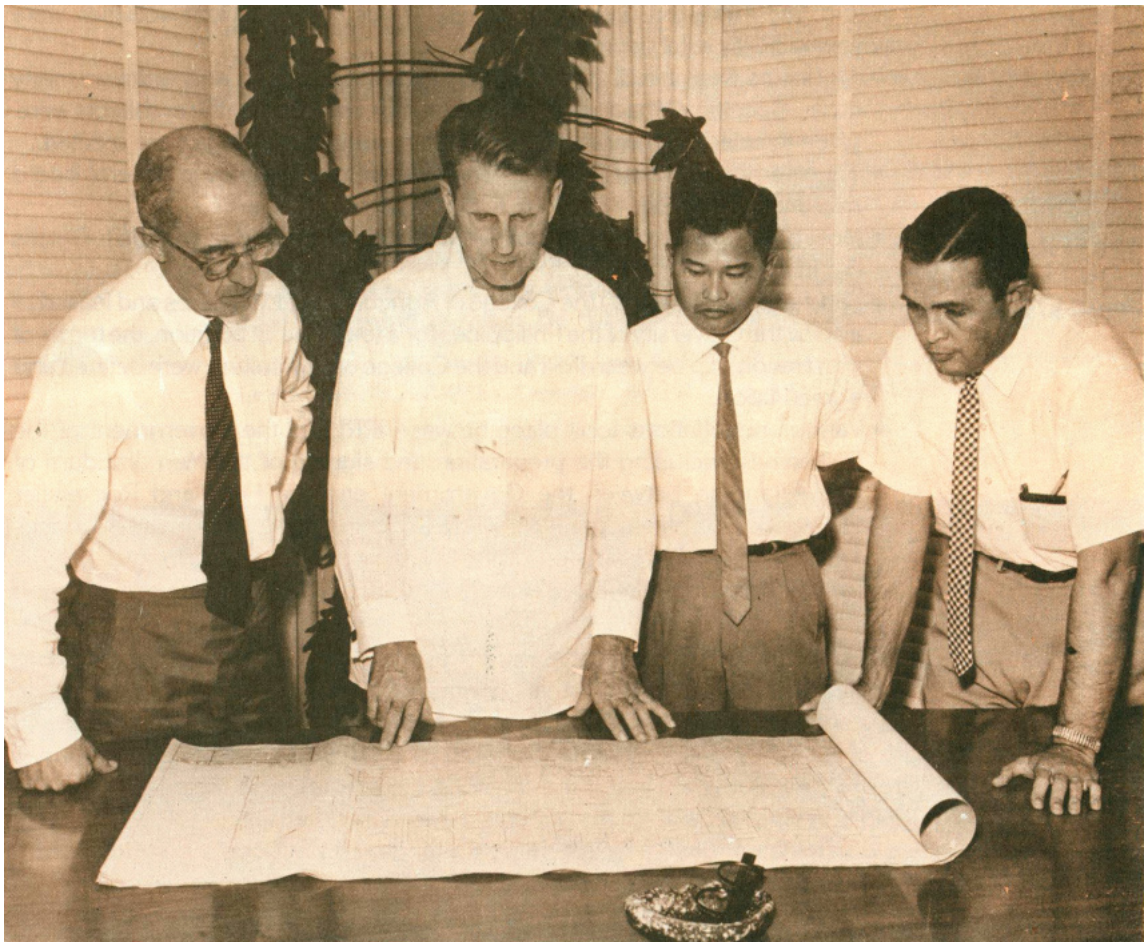
[6] Letort became seriously ill and had to leave IRRI after less than 2 years. He returned to France where he died in 1965.

[7] Chapter 6 details the formation of CGIAR.



The entire senior staff of IRRI (except for Johnson, stationed at Los Baños) on 9 November 1960: (left to right) Letort. Chandler, Drilon, and Wortman.

Thus, until the move to Los Baños, it was Chandler, Wortman, Drilon, Letort, and Salacup who constituted the professional staff that dealt with architects, carried on negotiations with the Government of the Philippines, and kept in touch with the Ford and Rockefeller Foundations and the University of the Philippines. Julita Tranca became my secretary on 1 January 1961, a position she held with flair and distinction for some 5 years, becoming so internationally minded in the process that she continued to serve in developmental organizations from Bangkok to Ottawa until her untimely death in October 1981.

On 31 July 1961, the Trinity Building offices were closed and Chandler, Wortman, and Drilon and their secretaries moved to Los Baños, to temporary offices in the service building, the first unit of the IRRI research complex to be completed. On the same day, an IRRI office was opened at the Manila Hotel, to which Letort, Salacup, and Nepomuceno transferred temporarily. A month

later, Nepomuceno resigned to devote more time to her family. Her efforts on IRRI's behalf had been constant and tireless. Henrietta Tinio was hired as secretary in the new office.

Although IRRI would be administered from Los Baños, a Manila headquarters was essential, then as now, to expedite communications, travel, purchasing, customs clearance, and the like, and to extend necessary services to Institute visitors from abroad. For those matters, Ifor Solidum had been hired 1 June as administrative assistant. He was later advanced to administrative associate.

From late 1959 through 1961, several types of concurrent activities were involved in IRRI's establishment:

- Architects were hired, and building plans were drawn and redrawn many times. Specifications and working drawings prepared by the architects were given to selected contractors for bidding, and the buildings were erected.
- The members of the Board of Trustees were selected and several board meetings were held.
- Most of the senior scientific staff were interviewed and hired in 1961. Details are in Chapter 2.
- Land was purchased by the College of Agriculture at Los Baños and leased to IRRI by the University of the Philippines for a token fee. In addition, the terms of the relationship between IRRI and the College of Agriculture were defined and agreed upon.
- Various negotiations took place between IRRI and the Government of the Philippines, including the preparation and signing of the Memorandum of Understanding between the Government and the Ford and Rockefeller Foundations, the incorporation of IRRI under the regulations of the Securities and Exchange Commission of the Philippines, and the placing of the bill before the Philippine Congress assuring IRRI of continuing tax exemption privileges.

On 6 October 1959, soon after my arrival in the Philippines, I went to Los Baños to discuss the land purchase situation with Dean, Uichanco and Umali, who was to replace Uichanco as dean of the College of Agriculture. I was informed that the 40 ha of land (which turned out to measure 37.6 ha) had been bought with funds from an $80,000 grant from the Ford Foundation (the money being used also for land surveying, legal fees, and tenants' relocation expenses).

Umali stated that 31 ha adjoining the acquired tract could be purchased. I agreed that an option should be obtained on that land and that I would get in touch with both foundations and request that the sum of $75,000 be transferred from the Ford Foundation to the University of the Philippines for the additional land and expenses connected with its acquisition. The additional tract was purchased by mid-1960.

The University agreed to lease to IRRI all the land for building sites and experimental farm for the token sum of one peso per year for a period of 25 years, with an option for renewal for a second 25-year period.

On 30 April 1960, University of the Philippines President Sinco signed a lease for all the University-owned land made available to IRRI for both buildings and experimental fields. On 4 October 1961, he signed a second lease covering all the land that had been purchased for IRRI by the University with Ford Foundation funds.

By the time the final land purchase was made, the College of Agriculture had decided that it could not spare the 30 ha that it had indicated earlier it could allocate to IRRI for part of its experimental farm. The College authorities pointed out, however, that the amount of land they could spare, plus that which had been purchased, would give the Institute 80 ha for field experimentation. This, then, was the size of IRRI's experimental fields for more than a decade.

Dean Umali and I had several discussions about the sort of affiliation that should be developed between the College of Agriculture and IRRI. On 18 March 1960, Umali, Wortman, and I agreed on the following terms of cooperation between the two institutions:

- Selected senior staff members of IRRI will be given academic titles as affiliate members of the graduate faculty of the University. With such appointments they may serve as members of the graduate school committees of students and may supervise thesis research projects of graduate students who are working with rice.
- IRRI and College personnel will have free access to both libraries.
- Any specialized equipment available at one institution and not at the other may be used by any qualified member of the other institution under appropriate supervision by, and with the permission of, the scientist in charge of the equipment.
- The College infirmary will be used as the health center for IRRI employees. IRRI will reimburse the College for medical treatment for its employees and, in addition, it will provide modest funds for expansion of the infirmary to accommodate the extra load.
- IRRI will provide funds for the expansion of the Maquiling School so that children of IRRI's scientific staff may be accommodated. Furthermore, IRRI will make a modest annual contribution toward the operation of the school.

All the terms in this agreement were carried out faithfully. Although there were occasional misunderstandings between IRRI and the College of Agriculture, they were of short duration and were always resolved amicably. Both parties made a real effort to cooperate; certainly IRRI profited greatly from having such a good neighbor.

As I mentioned earlier, the secretary of Agriculture had hoped that a memorandum of agreement between the Government of the Philippines and the two foundations could be signed in early June 1959, while Harrar, Hill, and I were still in the Philippines. Although this was not feasible from the standpoint of the foundations, they did fully agree that at a subsequent date an appropriate document would be executed. On 30 June 1959, Harrar wrote to Secretary Rodriguez reiterating the terms of the proposed agreement and

inviting him to New York at a mutually convenient time to sign a formal Memorandum of Understanding, together with President Rusk of the Rockefeller Foundation and President Henry Heald of the Ford Foundation. The outline of the Memorandum as prepared by Harrar and sent to Rodriguez was subsequently modified somewhat by correspondence between Harrar and me and in conversations in New York between Harrar and Hill. I, of course, discussed the changes with Rodriguez and Dalisay in the Philippines.

The Memorandum of Understanding (the full text of which appears in Appendix 3) between the Republic of the Philippines and the two foundations was signed in New York on 9 December 1959 by Rodriguez, Rusk, and Heald. Its preamble pointed out the importance of rice as a world food crop and the need for increasing its production in order to keep up with the burgeoning populations of Asia. It then described the proposed activities and objectives of IRRI, its organization, its powers, and the privileges being granted by the Government of the Philippines. It stated how IRRI would be financed and spelled out the arrangements made with the University of the Philippines for the acquisition of land. It indicated that the agreement should last for 50 years, but stated that if at any time it were mutually agreed that the Institute should be terminated, the land, buildings, equipment, funds, and other assets belonging to the Institute would become the exclusive property of the College of Agriculture of the University of the Philippines.

Soon after my arrival in the Philippines, Undersecretary Dalisay informed me that the tax exemption status of IRRI as contained in the Presidential Executive Order would be valid as long as the present administration remained in power. However, a new administration could remove that privilege if it so wished. Dalisay advised that IRRI take two steps to assure its continuing operation in the Philippines. First, it should be incorporated as a nonprofit, nonstock philanthropic organization under the regulations of the Philippine Securities and Exchange Commission (SEC). Secondly, it should make arrangements to have a bill introduced before the Philippine Congress which, if passed, would provide full tax exemption for IRRI and its foreign staff members. Such status could not be revoked unless a separate bill to do so were passed at a future congressional session, an action that Dalisay felt would be most unlikely.

To register with the SEC, it was necessary that IRRI submit its Articles of Incorporation, which had to be signed by five incorporators, the majority of whom had to be Filipinos.

The first draft of the Articles of Incorporation was drawn up by Attorney Cecilio Honorio of Research Associates, Inc., an organization of which Dalisay was a member. After modifying it somewhat, I sent the draft to New York, in November 1959, where Hill and Harrar made further revisions. It was decided that the incorporators would be Harrar and Hill of New York; and Rodriguez, Sinco, and Paulino Garcia (chairman of the National Science Development Board) of the Philippines.

The revised version of the Articles of Incorporation was checked by Attorney Jovito R. Salonga, well known for his experience in such matters, and on

22 January 1960 was sent to New York for the signatures of Harrar and Hill. After its return to the Philippines and signing by the three Philippine incorporators, the document was filed 29 February 1960 with the SEC.

The SEC likewise required a copy of a corporation's bylaws. At that time, of course, IRRI did not yet exist as a legal entity. At the first meeting of the Board of Trustees on 13-14 April 1960, however, the bylaws, prepared in the Philippines and examined by Hill and Harrar in New York, were approved, and a copy was filed with the SEC. It was next learned that the signed bylaws must also be submitted to the Insurance Commissioner in applying for the necessary Certificate of Registration of IRRI as a charitable trust. This was done on 18 April by Attorney Salonga. (The text of both the Articles of Incorporation and the original Bylaws appears in Appendix 4.)

The next step in negotiations with the Government of the Philippines was to draft a bill, to be introduced in Congress, providing tax exemptions for IRRI. Attorney Francisco Ortigas, chairman of the Board of the Ramon Magsaysay Award Foundation and fully familiar with the procedure for obtaining special tax status for philanthropic organizations, had volunteered his services in preparing the proposed bill. Salonga, during discussions over the Articles of Incorporation and the bylaws, also had offered to prepare a draft. Because the two versions turned out to be similar, passages from each were used in the final wording of the bill.

On 28 April, the bill was taken to Secretary of Finance Dominador Aytona, who promised to present it to President Garcia for certification as an Administration Bill, which meant that it should be passed during the current session of Congress.

Although fast action by Congress was expected once the Administration Bill was at hand, a fortnight went by without the bill being certified by the President, a prerequisite for its being considered before Congress adjourned. On 13 May, I tried to see Paulino Garcia, IRRI incorporator, at his office but found that he was attending a conference at Tagaytay, a town some 50 km from Manila. Because telephone connections in the Philippines were undependable, I drove to Tagaytay and explained the problem to Garcia. He sent telegrams to the executive secretary and to the legislative secretary, urging that the bill be placed on President Garcia's desk for his certification and signature. Three days later, Garcia called to tell me the President had certified the bill.

During 16-19 May, Drilon practically lived in the Halls of Congress making every effort to get action on the bill. Congress was to adjourn at midnight on 19 May. Many bills awaited action and lobbyists were exerting maximum pressure for their passage. At midnight, the clock was stopped so that the members of Congress could continue to pass legislation. During that time extension, House Bill Number 5005, granting tax exemption to IRRI, came up for consideration and was passed.

Although there was no real opposition to the bill, there was so much competition from other bills and so much agitation by their adherents that IRRI's bill would have been buried in the shuffle if it had not been for the skillful and persistent, yet diplomatic, efforts of Drilon as the Institute's

executive secretary. The passage of House Bill 5005, which then formally became Republic Act 2707 (reproduced in Appendix 5), has provided IRRI to this day with its special tax privileges.

SELECTION OF THE BOARD OF TRUSTEES

In correspondence among ourselves and from discussions with government officials in the Philippines during late 1959 and early 1960, Harrar, Hill, and I decided that the Board of Trustees of IRRI should consist of 10 members: one representative each from the Ford and Rockefeller Foundations; three representatives from the host country, namely, the secretary of Agriculture and Natural Resources, the president of the University of the Philippines, and the chairman of the National Science Development Board; the director of the Institute; and four members-at-large, chosen mostly from the major rice-growing countries. Philippine law prohibited the appointment of ex-officio members of the board of any corporate group. However, it was legal for an organization, through a resolution by its board, to designate individuals, by name, from specific organizations as board members. This the IRRI trustees did at their first meeting.

Logically, the Rockefeller Foundation selected Harrar as its representative and the Ford Foundation chose Hill. Rodriguez, as secretary of Agriculture and Natural Resources, became a charter member of the Board. Sinco, president of the University, and Garcia, chairman of the National Science Development Board, also became charter members.

In our extensive travels in Asia, Hill, Harrar, and I had become acquainted with prominent agricultural scientists and leaders of agricultural programs. Consequently, in early 1960 we had little difficulty in deciding on likely candidates for the board members-at-large. It was agreed that Harrar would send out letters of invitation. The list of prospective members was a distinguished one.

- Hitoshi Kihara was a well-known geneticist in Japan. Formerly at Kyushu University, he had been appointed in 1960 as director of the National Institute of Genetics of Mishima, an institution to which the Rockefeller Foundation had just made a grant for a study of the origin of cultivated rice. At Kyushu University, Kihara had gained an international reputation for his research on the origin of cultivated wheat. Because of his stature as a scientist, he received, and accepted, an invitation to become one of the first trustees of IRRI. Now almost 90 years old, Kihara is the oldest living charter member of the Board of Trustees of IRRI. He attended the Institute's 20th anniversary celebration, 21 April 1980, and appeared remarkably well and fit.
- Paul C. Ma was dean of the College of Agriculture of Taiwan National University in Taipei. Harrar and I knew him well and considered him to be one of the ablest men in higher education in agriculture in Asia. He accepted the invitation to join the Board.

- K.R. Damle was secretary of Agriculture of the Government of India. Hill, Harrar, and I had become well acquainted with him during our travels in that country. Damle was the key government official with whom the Rockefeller Foundation worked out its agreement to support an operating agricultural program in India. Although he had to obtain clearance from his government before he could accept Harrar's invitation, he was able to do so without difficulty. (It had been made clear to each prospective trustee-at-large that he was chosen not as a representative of his country but as a knowledgeable individual who could assist in guiding the policies and programs of IRRI.)
- M.C. (Prince) Chakrabandhu was director general of the Department of Agriculture within the Ministry of Agriculture of Thailand. Well known to the Ford and Rockefeller Foundations, he had recently received a travel grant from the latter to enable him to visit Asian and U.S. institutions engaged in agricultural research and education. Chakrabandhu had a B.S. degree from the University of the Philippines and an M.S. degree in plant breeding from Cornell University. He accepted the invitation to join the Board.

Although the first terms of the members-at-large were staggered in length to avoid all expiring at the same time, the standard term was 4 years. During the 20 years from 1960 to 1980, 37 trustees-at-large from 19 countries served on the Board.

In 1965, the Board of Trustees passed a resolution increasing the number of trustees from 10 to 14, thus making it possible to have as many as 8 trustees-at-large. (A complete list of all IRRI trustees from the outset through 1980-81 is presented in Appendix 6.) Beginning in about 1974, trustees were added from countries that were not important producers of rice. Among them were Ralph Riley of the United Kingdom, Francisco de Sola of El Salvador, Alban Gurnett-Smith of Australia, and H.W. Scharpenseel of the Federal Republic of Germany. A significant addition to the international membership of the Board was the appointment in 1978 of Lin Shih-Cheng from the People's Republic of China.

The first meeting of the Board of Trustees took place in Manila on 13-14 April 1960. All charter members attended. On 13 April, in accordance with corporate law, the group met first as Members of the Corporation, approving the bylaws and electing themselves as trustees of IRRI. Hill was elected temporary chairman of the corporation. After a half-hour, the meeting of the Members of the Corporation was adjourned and the first meeting of the Board of Trustees was convened. Harrar was unanimously elected chairman of the Board and Wortman was elected secretary and treasurer. After his election, Harrar adjourned the meeting so that the trustees could visit the proposed IRRI site at Los Baños.

Before the inspection of the building sites, the trustees attended the inaugural ceremonies of the International House of the College of Agriculture — built with funds from the Rockefeller Foundation — and were guests of the College

for lunch. After, with representatives of the College, the trustees visited the sites for IRRI's research center buildings and staff housing.

On 14 April, the trustees had an all-day session at the Trinity Building. At that meeting, I was appointed director of IRRI and Wortman assistant director; Letort was appointed treasurer effective on his arrival in the Philippines. Executive, Finance, and Program Committees were established and their responsibilities were defined.

Although many matters were discussed at the first meeting, the most significant action taken was the Board's approval of the architects' sketches of the buildings of the IRRI complex. To become acquainted with the abilities of the architects, the trustees had visited the Stanvac Refinery on Bataan Peninsula on 12 April. Alfredo J. Luz had designed the refinery laboratory and office building and Carlos D. Arguelles had been the architect for the residences. The trustees were favorably impressed with the buildings and felt that the staff houses were of about the quality desirable for the residences to be erected at IRRI. The architects appeared before the trustees to explain their ideas and the Board formally approved the selection of the architects, who until then had been hired on a provisional basis. (Interestingly, although Standard Oil had selected the same two architects, the coincidence did not become known to me until after I had made my initial recommendation to the foundations that Luz and Arguelles be retained as IRRI's architects.) (See the section on architects, pages 25-26.)

Before the 14 April meeting was adjourned, it was decided that a second meeting of the Board in 1960 would be required (the dates of 5-6 October were later agreed upon). Their business completed, the trustees were dinner guests at our house in San Lorenzo Village, a residential suburb of Manila where the Wortmans and Letorts also lived pending the construction of the houses in Los Baños.

At the October trustees meeting, Drilon was appointed secretary of the Board and, because Letort had not yet arrived, Wortman continued to serve as treasurer. Drilon served as secretary as long as he remained at IRRI.

The membership of the Board was by no means static. In February 1960, even before its first meeting, the replacement of Rodriguez as secretary of Agriculture and Natural Resources by Cesar M. Fortich had been announced. By the second meeting of the Board, Rodriguez had resigned and Fortich attended the meeting. Fortich, however, did not remain long on the Board, because the Philippine presidential election in 1961 resulted in a change of administration. The new President, Diosdado Macapagal, selected Benjamin Gozon as his secretary of Agriculture and Natural Resources. In the normal course of political appointments, there was a succession of secretaries of Agriculture and Natural Resources and consequently a corresponding succession of "ex-officio" Board members. By 1964, Jose Y. Feliciano had replaced Gozon. In 1967, Gozon was followed by Fernando Lopez, who served President Marcos as both Vice President and secretary of Agriculture and Natural Resources. Lopez was succeeded in 1971 by Arturo R. Tanco, who is still on the IRRI Board of Trustees, having held the post of secretary of Agriculture

The first meeting of the Board of Trustees of IRRI, 14 April 1960: From left end of table: Chairman J.G. Harrar, Paul C. Ma (hidden). Paulino J. Garcia, Vicente G. Sinco. Hitoshi Kihara, R.F. Chandler, M.C. Chakrabandhu, Juan de G. Rodriguez, and F.F. Hill. Not shown is K.R. Damle.

The Board of Trustees were always given an opportunity to visit IRRI's experimental fields. Here (8 January 1963) the members are being shown a rice blast nursery by S.H. Ou, plant pathologist. From left to right: Ou, Chakrabandhu (in background), Chandler, Kihara, Shen, Wortman. (associate director), Moseman (hidden by Hill), Hill, Romulo, K.W. Thompson (not a trustee but visiting at the time as vice president of the Rockefeller Foundation), and Garcia.

(Natural Resources became a separate department a few years ago) for a longer period than any previous incumbent.

Only three persons have been on the IRRI Board by virtue of the position of chairman of the National Science Development Board. Garcia served through 1963, when incoming President Macapagal replaced him with Juan Salcedo, Jr., who remained in office and on the Board until 1970. He was succeeded by Florencio Medina, who remained through 1977.

During the 21 years of the Institute's existence, there have been five presidents of the University of the Philippines and thus, concurrently, members of the IRRI Board of Trustees. Sinco served through 1962 and was replaced by Carlos P. Romulo, who remained until 1968. He was followed by Salvador P. Lopez, who was on the Board until 1974 and was succeeded by Onofre D. Corpuz, who served through 1978, when he was appointed Minister of Education. Corpuz was followed by Emanuel Soriano, who was succeeded by Edgardo Angara in 1981.

Another varying member on the IRRI Board has been the representative from the Rockefeller Foundation. Soon after President Rusk was named secretary of State by President John F. Kennedy in 1961, the foundation's Board appointed Harrar as Rusk's successor. Despite his heavy duties as president of the Rockefeller Foundation, Harrar served as chairman of the IRRI Board through the third meeting of the Board, which was held in Los Baños on 5 February 1962, just before the inaugural ceremonies of the Institute.

Before the fourth meeting of the Board, on 8 January 1963, Harrar had decided that there could be a conflict of interests in his serving concurrently on IRRI's Board of Trustees and as president of an organization that was a major donor. He consequently tendered his resignation as chairman and as member of the Board.

To fill the Harrar vacancy, the Rockefeller Foundation designated Albert H. Moseman, who was then director for agricultural sciences of the foundation. Moseman served until 1966 when he left the foundation at the urging of the United States Agency for International Development to accept a key assignment in Washington. The Rockefeller Foundation's next representative was Ralph W. Cummings, Sr., at the time director of its Indian Agricultural Program. In 1968, Cummings left the foundation to take a major administrative post at North Carolina State University and Wortman, then director for the agricultural sciences of the Rockefeller Foundation, was designated as its representative on IRRI's Board. Wortman served for 2 years until he was made vice president of the foundation, at which time Clarence C. Gray III, associate director for agricultural sciences, was named as the foundation's representative. Gray is now chairman of the IRRI Board of Trustees.

The Ford Foundation, on the other hand, has had only two representatives on IRRI's Board. Hill, who was a charter member in 1960, continued on the Board until 1978, the longest term of service of any member. When Harrar resigned in 1963, Hill was elected chairman and served in that capacity, with steadfast dedication and enthusiasm for 15 years. After Hill retired, of his own choosing in February 1978, Norman Collins, who was in charge of the Ford Foundation's agricultural program in India, was named as the foundation's representative on the Board.

The only other ex-officio member of IRRI's Board of Trustees is the Institute's director, of which to date there have been four. I served in that capacity from 1960 to mid-1972, when I reached the customary retirement age of 65. I was followed for a short period by Ralph W. Cummings, Sr., who left at the urgent behest of the Government of India and the trustees of the newly formed

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), to become the first director of that organization. In 1973, Nyle C. Brady resigned his position as associate dean of the New York State College of Agriculture, Cornell University, to accept the directorship of IRRI. He continued to serve in that post with infectious enthusiasm and a most distinguished record of performance until mid-1981. (IRRI's more outstanding advances under Brady's stewardship are presented in Chapter 7.) In 1976, the director's title was changed to director general, thus making possible the designation of director for those in charge of certain major divisions of IRRI's operations. In late 1981, the Board of Trustees chose Monkombu S. Swaminathan as director general. At the time of his appointment, he was a member (agriculture) of India's Planning Commission. Before that, he had served as secretary of India's Ministry of Agriculture and as director general of the Indian Council of Agricultural Research.

Other than the representatives of the Ford and Rockefeller Foundations, none of the members of the Board of Trustees of IRRI have been delegates of donor agencies, nor have they officially represented any government. Devoid of such vested interests, the Board members have always been able to look at IRRI's operations objectively. They have guided its program and policies and time and again have demonstrated their wholehearted enthusiasm for its achievements and goals.

At the first meeting of the Board, a program committee was chosen. The committee met on 15 April 1960 (the minutes are reproduced in Appendix 7). Members were Kihara (chairman), Rodriguez, Chakrabandhu, and Ma. Many, though not all, of the committee's recommendations were followed. When the committee met, IRRI had no buildings and only a small administrative staff and many of the details of its organization and program had not yet been thought through. However, from a perusal of the list of senior scientist positions, which the program committee recommended be established in the various fields of research, it is evident that only 3 of the 15 suggested were not filled in the first year or so of the Institute's operations. These were for a plant taxonomist or cytogeneticist, a soil physicist, and a farm management specialist. (The selection of the staff and the development of IRRI's research program are presented in Chapter 2.)

SELECTION OF ARCHITECTS AND DESIGN AND CONSTRUCTION OF PHYSICAL PLANT

Within a few days after arriving in the Philippines, my wife and I began looking at Manila buildings constructed recently or in the final stages of completion. The first to catch our eye was the new World Health Organization building, whose architect was Alfredo J. Luz. Another building that appeared to be both well constructed and attractive in design and use of materials was that of the Philippine-American Insurance Company. The Philippine architect was Carlos D. Arguelles.

Equally well known in Manila architectural circles was the firm of Juan F. Nakpil and Sons.

On 12 October 1959, I wrote to Alfredo J. Luz and Associates, to C.D. Arguelles and Associates, and to Juan F. Nakpil and Sons. I described the nature of the IRRI physical plant and asked whether they would be interested in being considered as the firm that would design the buildings and supervise the construction work.

Luz was in Europe and would return in early November but both Arguelles and Nakpil wished to be considered. I made immediate arrangements to spend a half day with each of them, inspecting the buildings they had designed. At about the same time, due to Filipino newspaper publicity surrounding the establishment of IRRI, several local architects got in touch with me and asked to be considered for the project. Each was carefully interviewed and given an opportunity to show some of the buildings he had designed. In most cases, their organizations were too small to undertake a project the size of IRRI's.

On 5 November, Architect Luz sent word that he had returned to Manila, had read my letter, and was much interested in being considered as the architect for the professional buildings. Accordingly, Luz and I spent the usual half day discussing the project and looking at buildings that he had designed. I was impressed with them and with his philosophy and artistic ability. An additional attraction was that the World Health Organization building had been constructed largely of imported materials and thus Luz was thoroughly experienced in purchasing materials and equipment from foreign suppliers.

Earlier, I had spent considerable time with Arguelles and Nakpil and decided that of the two, Arguelles was perhaps the more flexible. Among his attributes were an especially pleasing personality, one that would be easy to work with, and an unusually progressive and adaptable attitude with respect to design.

Early in my interviews with Arguelles and Luz, I had learned that the latter had no real interest in designing residences, whereas Arguelles enjoyed doing so. As a consequence, I recommended to the Ford and Rockefeller Foundations that Luz be selected as the architect for the professional buildings and that Arguelles be the architect for the residential area.

Toward the end of November, I received a letter from Harrar informing me that I could proceed with the two architects but only on a provisional basis. I was authorized to work out an agreement with them for the preparation of site plans, preliminary floor plans, perspective drawings, and cost estimates. Harrar made it clear that he and Hill felt that this preliminary work should be self-contained and should in no way involve a commitment to the architects to continue beyond that stage. Being on the scene and knowing the architects fairly well, I was confident that they would perform capably and be approved for the full project by the IRRI Board of Trustees when the Institute was formally established.

Design of the buildings

I took both architects to Los Baños, showed them the land chosen for the buildings, and made immediate arrangements to have topographic maps of the two sites drawn for them.

On 10 December 1959, Luz and Arguelles started working on building design and cost estimates. There naturally was much discussion with the architects regarding room sizes, arrangements of offices and laboratories, and other essential details, and several revised plans were drawn during the ensuing 6 weeks. In the same period, Drilon and I were developing a list of laboratory apparatus, farm equipment, vehicles, office and house furniture, etc., so that a total cost figure could be given to the Ford Foundation by 1 February 1960.

On 27 January, about 7 weeks after the architects started work on the plans, the site plans, preliminary floor plans, and total estimate of cost for the entire project were flown to New York. This information was followed a few days later by the perspective drawings, so that those concerned in New York could get a clear idea of the appearance of the buildings from the outside.

Included in the original plans were:

- an administration building containing a 200-seat auditorium, library, and administrative offices;
- a laboratory building designed to include all the scientific departments except agricultural engineering;
- a service building providing space for grain drying, seed storage, experimental farm headquarters, motor pool and car servicing, and for all building maintenance services (such as plumbing, painting, and air-conditioning and electrical systems), plus the agricultural engineering offices and workshops for designing farm equipment;
- a cafeteria-dormitory building with accommodations for 60 research scholars (the dining facilities had sufficient capacity to feed resident employees and scholars and a special staff dining room for entertaining official Institute visitors); and
- the staff housing area, which included a guesthouse with accommodations for 8, a director's house, 14 staff residences, 8 duplex apartment units, a swimming pool and bathhouse, and 2 tennis courts.

The cost estimate for these buildings, plus site preparation and such facilities as roads, guardhouses, storm drainage and sewer systems, electrical substations, water supply systems, and experimental fields was $6,900,000. The Ford Foundation accepted this figure, and at the meeting of its Board of Trustees on 17-18 March, Hill presented the proposal, which was approved without change. (As the Docket Item for the proposal contained not only the rationale for establishing IRRI but the details of the cost estimate, it is reproduced entirely in Appendix 8.) With the $250,000 already provided for preliminary costs, the appropriation of $6,900,000 brought the total Ford Foundation contribution to $7,150,000.

Two items not included in the original plans were built in 1961 within the $7,150,000 budget. One, which we called the plant growth center, consisted of four greenhouses and their headhouses, which contained darkrooms and plant growth chambers. The other was the paving in concrete of Pili Drive between the College's then agronomy building and the IRRI service building, thereby eliminating the difficulty of maintaining a gravel road during the

rainy season. These facilities came within the budget because of its 15% contingency item and because more than $500,000 was exchanged at a rate appreciably higher than the official figure by purchasing stock of Philippine corporations in the U.S. and selling it in the Philippines, a perfectly legal operation approved by the Central Bank.

The Ford Foundation felt that it would be well to have a prominent U.S. architect involved in the IRRI building project and offered to provide the services, as a consultant, of Ralph "Squabbie" Walker, considered by many as the "Dean of American architects." Walker visited the Philippines in February and October 1960. He made no major changes in the design of the buildings. In fact, the few suggestions for change were made only during his first visit when he expressed the opinion that the plans called for too much paving in front of the cafeteria-dormitory building and for too few of the graceful and decorative coconut palms near the buildings. In addition, in the original plans the administration building was where the laboratory building is now; and Walker suggested that the position of the two buildings be reversed to make it easier for the scientists to go back and forth between the service and laboratory buildings. The Philippine architects respected Walker's judgment and were pleased to follow his advice. He in turn was impressed with the ability of both Luz and Arguelles, remarking to me, "These boys are good. I wish I had them in my shop in New York!"

The final design of the physical plant of IRRI was completed by the end of May 1960. Luz and I spent much of the period of 5-13 June in New York discussing the building plans with Harrar, Hill, and Walker. Although Arguelles did not go to New York, I carried his final house designs there where they were considered by the same group. No important changes were made and the architects were given authority to prepare specifications and working drawings to be put in the hands of reliable contractors for competitive bidding.

Between Walker's February visit and the meeting in New York, Wortman and I made many changes in the design of the service and laboratory buildings. Sterling Hendricks, a prominent scientist in the U.S. Department of Agriculture, was consulted on the internal design of the laboratory building and the plant growth center in April 1960 and made many useful suggestions. In retrospect Wortman, Hendricks, and I were overly conservative in our estimates, but at the time, it was not anticipated that IRRI's growth would be so great nor that funding would be available for more than the rather providently planned facilities. Moreover, it could not be foretold with any certainty that the Institute would continue as such beyond the first 25 years. Looking back on IRRI's many years of achievements, it takes an effort to recall the more tentative approach required at the start when the Institute was a totally new venture in a developing country.

Wortman and I had no problem working with the architectural firms. Both were cooperative and productive and met all necessary deadlines. Naturally, as the work progressed (and even before it began), questions arose and had to be settled with a minimum of delay and a maximum of accord. There was

much interchange between Wortman and me on the one hand and the architects on the other and many plans were redrawn as a result.

Occasionally, the architects had to correct the mistaken notions of laymen and always managed to do so tactfully. For instance, when my wife and I first talked with Arguelles about the design of the staff houses, we suggested a two-story design be used throughout. Conditioned to the traditional houses of the eastern U.S., with sleeping quarters upstairs and general living area below, we had been thinking entirely subjectively. After the Wortmans arrived, however, Mrs. Wortman expressed understandable dismay at having to go upstairs and downstairs all day "chasing after" her three young children.

A group of Cornell University professors and their families were living on the Los Baños campus at the time, and an informal survey was made among them as to preference for two-story or one-story houses. About three-quarters of the families voted for having all the rooms on one floor. Consequently, the architect was asked to design two types of IRRI houses.

We asked that the bedrooms in the director's house be upstairs (along with a family room and a study). To provide for guests and for future directors who might have growing families, there were four bedrooms. Over the years, the director's three guest rooms have been increasingly useful in augmenting the Institute's regular accommodations during the periods when international conferences have been held at IRRI.

When living in Manila, the Wortmans, Letorts, and Chandlers had all joined the Manila Polo Club, primarily to have access to its dining facilities and its attractive swimming pool. The latter they considered to be just the right size and design for the pool at the IRRI housing area, as Architect Arguelles was duly informed. The color of the pool was particularly admired. With no past experience in pool construction, my wife and I thought that the blue of the Polo Club pool was due to the blue color of the tiles used. Consequently, when the IRRI pool was at the tiling stage, we were surprised and disturbed to find that the tiles being installed were white. I rushed to Arguelles' office with the idea of stopping the work until blue tiles could be purchased. Arguelles, who had designed many swimming pools, patiently assured me that the tiles would look brilliantly blue as soon as the pool was filled with water. My wife and I sighed over our ignorance and the white tiles were installed.

At times, however, the architects had to accede to contrary opinion. Just before Ralph Walker made his second visit to the Philippines, Architect Luz had a new idea about the exterior design of the laboratory and administration buildings. The early plan was to have aluminum mullions at the edge of the walkway around the buildings (as they appear today). Luz' new scheme was to have a series of preformed concrete arches around the exterior of the buildings. This treatment would in no way affect the interior design or arrangement of the rooms. On 18 August 1960, Luz presented the idea to me, along with drawings illustrating the proposed exteriors. I conceded that the new design was artistic but felt that the arches it featured might give the buildings a more cloistered look than was strictly in keeping with a scientific

institution. I agreed, however, to submit the idea, without prejudicial comment, one way or the other, to Harrar and Hill in New York, to Damle in India, and to Garcia in the Philippines, to obtain several reactions.

By the time all the opinions were in, Ralph Walker returned to the Philippines. He agreed with Luz that the new design was an improvement. Garcia and Damle, although not feeling strongly for or against the change, had no objection to it. The vote in New York, however, was to retain the original design, one that had already been approved by all concerned—and after more thorough consideration at that.

The various side issues, however, in no way interfered with daily progress in setting the stage for the construction of the IRRI complex.

Because the service building had a simple design, plans for it were completed earlier than those for the other buildings. IRRI was interested in getting the service structure completed as early as possible so it could be used for offices until the other buildings were ready and for storage of farm machinery and owner-bought building materials. The bids for the service building were received in September 1960 and the contract was awarded to the Atlantic, Gulf and Pacific Co., Inc. (A.G. and P.). Because the structural steel had to be fabricated, work did not begin until 26 October.

The working drawings and full specifications for the rest of the buildings were completed by the architects in early November and were distributed to selected building contractors at that time. The preparations, of course, required the services of engineers as well as architects. Arguelles subcontracted his engineering work with DCCD Engineering Corporation, and Luz used his staff engineers.

Because IRRI was nongovernmental, it was not necessary to have open competitive bidding. The architects invited several contractors to submit bids on the buildings, having selected only those firms with a reputation for dependability and good workmanship and large enough to handle the IRRI project without a shortage of equipment or workers.

Bids for the staff housing area were opened on 23 December. The low bidder was the Avecilla Building Corporation. Work on the director's house and the first 8 staff houses started 4 January 1961; work on the rest of the housing units started 20 March.

Bids for the professional buildings at the research center site were opened on 12 January 1961. The low bidder on the laboratory and administration buildings was Francisco Cacho & Co.; D.M. Consunji, Inc. won the contract for the cafeteria-dormitory building. I signed the contracts with both companies on 17 January, the terms being that work would begin within 10 days and that the administration and cafeteria-dormitory buildings would be completed in 300 days and the laboratory building in 365 days.

Many individual contracts had to be signed for such operations as site preparation and roads, storm drainage and sewer systems, and electrical work, operations that were supervised by the architects (whose engineers had drawn up the specifications).

My report at the annual meeting of the IRRI Board of Trustees on 5 February 1962 included the following description of the quality of the specifications for the buildings:

> "The new materials used have been chosen for durability and low maintenance costs. The exterior surfaces of the research center buildings, for instance, require no painting. Floors are covered with vitrified, unglazed tiles noted for their wearing quality. All wood is termite-proofed (Wolmanized). The aluminum frames and mullions are anodized to prevent surface oxidation. The extra cost of such features as these should prove an economy in the long run.
>
> The staff houses were designed for efficient and convenient living and, above all, for permanence. Though the houses will require painting, the quality of the construction is as high as that of the Institute's science buildings."

Although at the time that statement was made the buildings were new, in general the materials selected proved to have the lasting qualities desired.

After some time, however, there was evidence that further reductions in maintenance costs might have been made. For example, rustproof pipes (that is, if indeed they were known at the time) for the water system, particularly in the humid tropics, would have saved money and labor, for within 5 years some of the underground pipes in the housing area had to be replaced. Similarly, the repainting of house exteriors was a major continuing expense that could have been avoided. Profiting from that experience, I suggested, when I helped design the Asian Vegetable Research and Development Center in Taiwan in 1972, that all exterior walls be constructed of reinforced concrete and brick (which was then covered with glazed tile), requiring no maintenance whatsoever.

On the other hand, the design of the IRRI structures proved lastingly suitable and advantageous. In the research center, the administration and laboratory buildings provided useful flexibility in the arrangement, and later rearrangement of the rooms (whose uses and sizes changed considerably even during the early years). Being independent of the roof, which rested on a series of reinforced concrete columns, the interior walls were non-supporting and could be changed in position as needed. The service building offered similar flexibility within its structural steel framework. (As a matter of record of the original use, as at early 1962, of the interior space of the buildings most modified in that respect, the floor plans of the administration, laboratory, and service buildings are shown in Appendix 9.)

Construction of the physical plant

The staff housing and the research center construction projects were handled not only by different architects but by different contractors and subcontractors. Therefore, they are discussed separately here.

The staff housing area. Obviously, the first operation after making the topographic survey and map was to develop the site and build the roads.

Architect Arguelles and the DCCD Engineering Corporation prepared a land grading plan that would place each house on a terrace with the screened porch facing Laguna de Bay, thus providing a good view of the lake for all but two or three houses at the lower end of the sloping street. (Today, because of the luxuriant growth of the trees in the intervening years the lake cannot be seen from most of the original houses.)

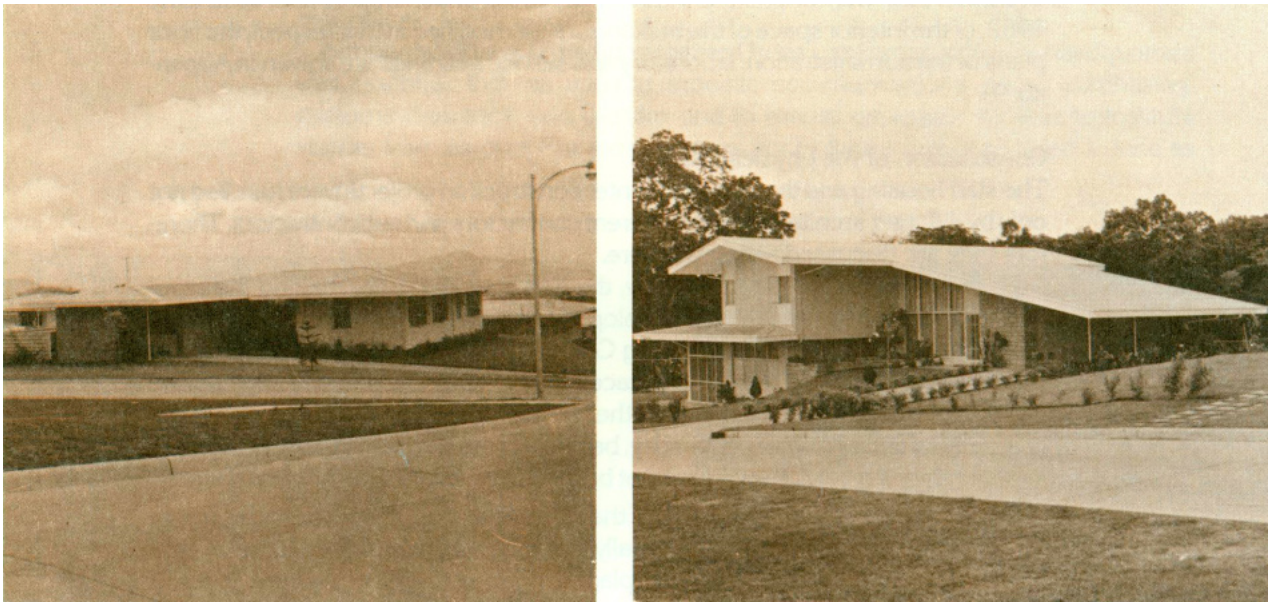
Concurrently with the preparing of the site, a water supply for the housing area had to be found. It was thought originally that a well could be driven at the present pump station and sewage disposal plant. Engaged to drill a test hole 5 cm in diameter, the Shamrock Well Drilling Company (somehow lacking the luck of the Irish) went down 255 m in solid andesite rock without encountering an aquifer. Therefore, it was necessary to get permission, readily given by Dean Umali of the College of Agriculture, to drill a well at the lower end of the College campus and to pipe the water up the hill. The well was drilled in November 1960 and yielded about 1,100 liters/minute. A booster pump, which raised the water to a 113,500 liter tank behind the director's house, was installed near the entrance to the housing area.

The lots for the two-story (really split-level) houses were graded to provide a large, lower ground level for general living quarters and a top floor for the bedrooms with a smaller ground level between for main entrance and carport. The exteriors of both the one-story and the split-level houses are shown in the accompanying photographs.

At the time that the residential site was selected, the so-called national road to the 1959 Boy Scout Jamboree area traversed the grounds. Part of the site development contract called for moving the road to the west side of the tract. In addition, to avoid serious erosion the creek alongside the road was straightened. (Sections of the national road have been moved twice since its first relocation, to accommodate additional IRRI housing.)

The contract for the site preparation and road grading work was awarded to R.F. Sugay & Co., Inc., which began work on 3 August 1960 — and finished by January 1961, when house construction started. Between August 1960 and May 1961, contracts or subcontracts for the remaining preconstruction work were let. They included the underground electrical system to the Delta Engineering Corporation; the storm drainage and sewer system to J.C. Bongco; and the pump house and sewage treatment plant to R.F. Sugay & Co., Inc., which also laid the pipeline from the IRRI well at the lower end of the adjacent campus to the housing area. In addition, numerous agreements were signed with local suppliers for such specialized services and materials as plumbing; aluminum roofing, windows, and sliding doors; exterior and interior painting; interior electrical work; wooden sash and cabinets; and terrazzo floors.

The principal landscaping at both housing area and research center was handled by Gertrude Stewart. To assure variation in the furnishings and general decor of the houses, four Manila interior decorators were hired, having been carefully selected from among many firms. Mel Gana did the guesthouse; the residences were divided more or less equally among Berenguer-Topacio, Phyllis Harvey, and Cancio Associates, Inc. The decorators submitted to IRRI



A one-story (left) and a split-level house as they appeared in late 1962.

sketches of furniture and color schemes, and samples of drapery and upholstery materials. Staff members and their wives who had already arrived in the Philippines naturally had a voice in the selection of such items for their prospective houses. All furniture was made in the Philippines according to IRRI approved style and specifications.

There have been no significant changes in the interior plan of the original staff houses, each having three bedrooms, two and a half baths, a living-dining area, a study, a kitchen and utility area, maids' quarters, screened porch, and carport. The total floor space in all houses was the same, and the lot sizes were almost identical throughout. There were three different floor plans for the more numerous one-story houses, to give needed variation in layout and to ensure that no matter on which side of the road a house was located, its porch would be on the downhill side (this detail being no problem in the split-level houses, which were all on one side of the road).

The 8 units (later enlarged to 10 units) of apartments contained one- and two-bedroom duplexes for unmarried staff, for a few younger scientists at the associate level, and for visiting scientists.

The Avecilla Building Corporation started constructing the houses on 10 January 1961. Except for moving the position of the director's house up the hill about 18 m to increase its distance from the swimming pool area, no significant changes were made in the plan that Architect Arguelles had submitted on 30 May 1960. The estimated cost of the entire project was $1,209,334, the final figure being somewhat, though not appreciably, higher.

The contract with Avecilla called for the completion by 1 July 1961 of eight housing units (director's house, guesthouse, and six staff houses), the swim-

ming pool, and tennis courts. A second contract with Avecilla was signed on 20 March 1961 specifying that four more staff houses would be completed by 1 September 1961 and that the eight apartment units and the remaining four houses would be finished by 31 December 1961.

Avecilla, a former professor of civil engineering at the University of the Philippines, was always calm and considerate. He was overly optimistic, however, about completing the project on time. In late April, concerned that the construction work was running behind, Wortman and I asked the architect to arrange a conference with Avecilla. The latter promised to add extra men and insisted that the work would be completed on schedule. When, in late May, the same complaint was made, Avecilla said, "Don't worry, we'll make it on time." In June it was unmistakably evident that the first eight units would not be finished on time, and a new arrangement allowed Avecilla until 1 August to complete the first phase. At that, he didn't quite meet the second deadline.

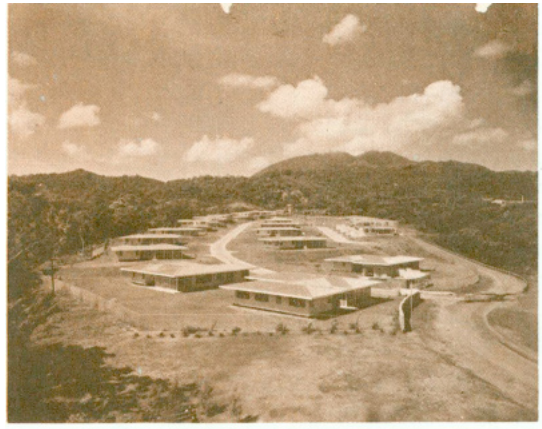
The Wortmans, Drilons, Johnsons, and Chandlers moved into their assigned houses between 11 and 14 August. Even that timing would not have been possible had not Wortman spent the last week supervising the final operations. This was largely a matter of scheduling the work of the various subcontractors so that one job would not impede another. Without such overseeing, delays were inevitable. For example, as the painters finished a room, the electricians would enter to install wall plates for the outlets and in the process leave dirty finger marks over the newly painted walls, which would then have to be repainted. Wortman saw to it that each room was finished in the proper work sequence and that the door was then locked.

The entire housing area project was completed, and most of the houses were occupied, by January 1962.

The Research Center. The first operation undertaken at the research site was the drilling of a deep well to supply water needed in the actual construction process and for later supply of water for the research center. The well, completed in June 1960, was 160 m deep and yielded more than 800 liters/minute. It still provides the water supply for IRRI's research center buildings at the original site.

In August 1960, bids were opened for the site preparation and road construction work and the contract was awarded to Dimson (Manila), Inc. Site preparation began on 26 August. The initial work was to level Higamot Hill to make a plateau for the administration, laboratory, and cafeteria-dormitory buildings. A gentle grade was then made from the low plateau to the site of the service building. All this ground then had to be compacted to provide a firm foundation for the buildings and driveways.

When the grading of Higamot Hill was nearing completion, it was discovered that a portion of the laboratory building site had a deep deposit of volcanic cinders, too loose a base for the foundations, of course. The decision after consultation with the architect was to grout the area — forcing a concrete "soup" into the cinders thus forming a sort of floating base for the building. In



The IRRI staff housing area in February 1962 (top) and as it appeared in February 1982.

effect, the cinders became the aggregate for the mixture of cement and water that was injected. For both the laboratory and administration buildings, Luz designed foundations strong enough to support a second story if in the future such expansion became desirable.

The basic site preparation and driveway construction were finished in late January 1961 and in no way held up the building schedule.

The erection of the service building, a relatively short operation, was completed on 10 March 1961. Not much more site preparation was needed for the structure than to remove a grove of coconut trees and to smooth the ground, the original level of which was not changed appreciably.

The IRRI research center site in early 1960. In the foreground — where the Service Building now stands — is the foundation of an old UP College of Agriculture building. In the background is Higamot Hill, which was leveled to form the plateau on which the original main buildings were constructed.

Construction of the laboratory, administration, and cafeteria-dormitory buildings started the last week of January and was completed within a year. A clause was inserted in each contract calling for a 1,000 peso/day penalty for any delays in finishing the construction work. Although both contractors had asked for an extension, it was not granted except to compensate for a few days' delay in the provision of certain owner-furnished materials. In the main, however, the work went well and the three buildings became a source of pride and interest not only to the Los Baños community but to the nation in general.

Two major difficulties inherent in the construction work and equipment of the buildings were encountered some time later. The first problem was that the flat roofs developed leaks after a few years of use. Luz had assured me that the roofs would easily last 20 years (although no such guarantees were written into the contracts). Nevertheless, cracks developed in the reinforced concrete covering the roof, and several thousand dollars had to be spent to strengthen it. Apparently, the original concrete layer had not been thick enough to withstand the mild earthquakes that occurred twice during IRRI's first decade. The other difficulty that developed was with the airconditioning system in the laboratory and administration buildings. At the time of construction, the recommended system for central air-conditioning was a water-cooled one. However, in spite of the water softeners in use at the research center from the outset, deposits of both calcium carbonate and silicates formed on the copper tubing of the cooling system and after 3 years or so of operation noticeably

The start of construction work on IRRI's physical plant, 26 September 1960. as workers dig holes for the footings for the Service Building. In the background Higamot Hill has essentially disappeared.

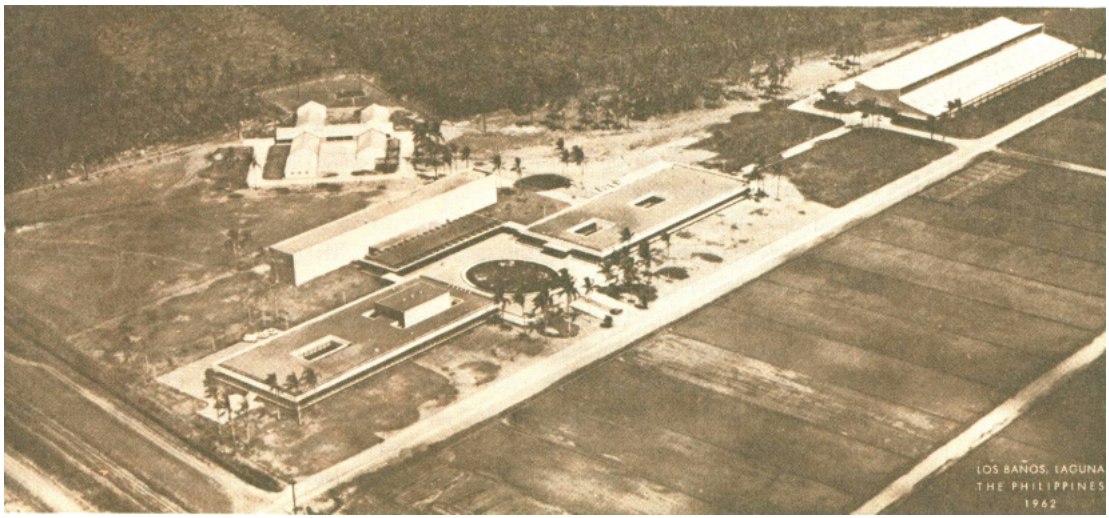
reduced its efficiency. Later, the equipment was changed to an air-cooled system (developed after the time of the Institute's construction), and little trouble was experienced thereafter.

The plant growth center (comprising the four original greenhouses, headhouse, light-controlled darkrooms, and space for five Percival growth chambers) was the last building project to be started. The contract was awarded to A.G. and P. Work began on 8 June and was completed on 15 January 1962. The buildings (including roofs) were solidly constructed of reinforced concrete. The greenhouse materials were bought from Lord and Burnham in the U.S. The only modification was that instead of the side walls being of the usual glass, they were of aluminum screening. Four greenhouses soon proved to be insufficient and other units were added between March and September 1963, using local structural materials. However, because the plastic film with which they were at first covered did not prove durable enough, these additional greenhouses were later covered with glass.

In the early stages of the building construction, a pump house and water tank had been erected at the research center. The design of the tank (built by A.G. and P.) was the result of a contest that Architect Luz conducted among young architectural students in the Manila area.

The accompanying photograph is an aerial view of the original buildings as they appeared in late December 1961. The coconut palms visible in the area were dug up in the process of preparing the experimental fields and transplanted as full-grown trees. A total of 85 of them were planted around the research center and in the housing area, and survival was 100%. Intensive hand labor was required, but the ornamental effect of the tall palms and the shade they provided were immediate and lasting.

Most of the landscaping was done by Gertrude Stewart, from a plan that I worked out. Maximo Francisco handled the plantings around the service building and Ronnie Laing designed those in the exterior (central plaza) and interior (administration and laboratory buildings) ornamental pools.



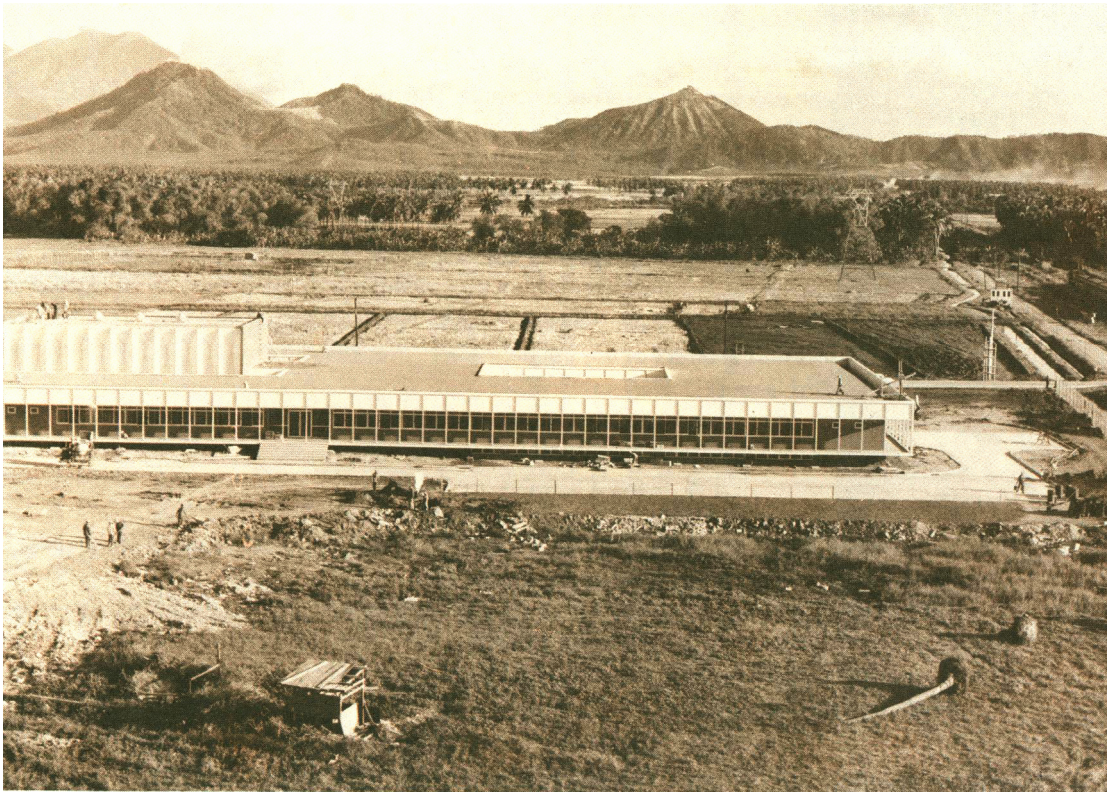
The IRRI research center as it appeared from the air in late December 1962.

The last building to be constructed at the research center was a small guardhouse at the entrance driveway. It was built in January 1962.

As the construction proceeded, so, concurrently, did the ordering, manufacture, and installation of the Institute's furniture, including laboratory benches. The latter contained the usual series of pipes to be connected to the laboratory supplies of water, compressed air, gas, etc. One day in January 1962, while walking through the laboratory building, Wortman and I came upon the plumbing crew completely stalled in the strange new task of connecting the benches to their supply sources. Both farm raised, we had had to turn our hands to plumbing chores in the past and of course were also well acquainted with the details of a science laboratory. So, with the plumbers looking on, two senior administrators (with a degree of satisfaction, it must be admitted) connected up the first bench in the plant pathology lab — after which the observant crew was able to finish the work on the rest of the benches throughout the building.

Except for a few minor inside jobs, all construction work was finished — and the buildings completely furnished and decorated (by Berenguer-Topacio, Phyllis Harvey, Aguinaldo's, and Oesco) — before 7 February 1962, the date of IRRI's inauguration (described in a later section). Impressive in that era of a still developing Philippines, particularly in a rural area, the IRRI complex drew an increasing number of visitors of all ages and backgrounds. Indeed, it became something of a national attraction. More significantly, IRRI's presence, quite apart from its program, set a standard of institutional excellence in the quality and design of its physical plant and staff housing.

Developing the experimental fields. Agricultural engineer Loyd Johnson's original assignment was to design and develop IRRI's 80-ha experimental field. He later continued as a member of the research staff.



The administration building (now Chandler Hall) nearing completion in December 1961.

Wortman and I had ordered a D-4 Caterpillar crawler-type tractor with a bulldozer blade, an Eversman land leveler, a heavy disc plow, and several international Harvester wheel-type tractors with diesel engines. Delivery of this equipment started just before Johnson's arrival and was completed a month or so later. Federico Ramos (whose professional background is described in the next chapter) had been hired as assistant field superintendent and reported for work on 1 October 1960.

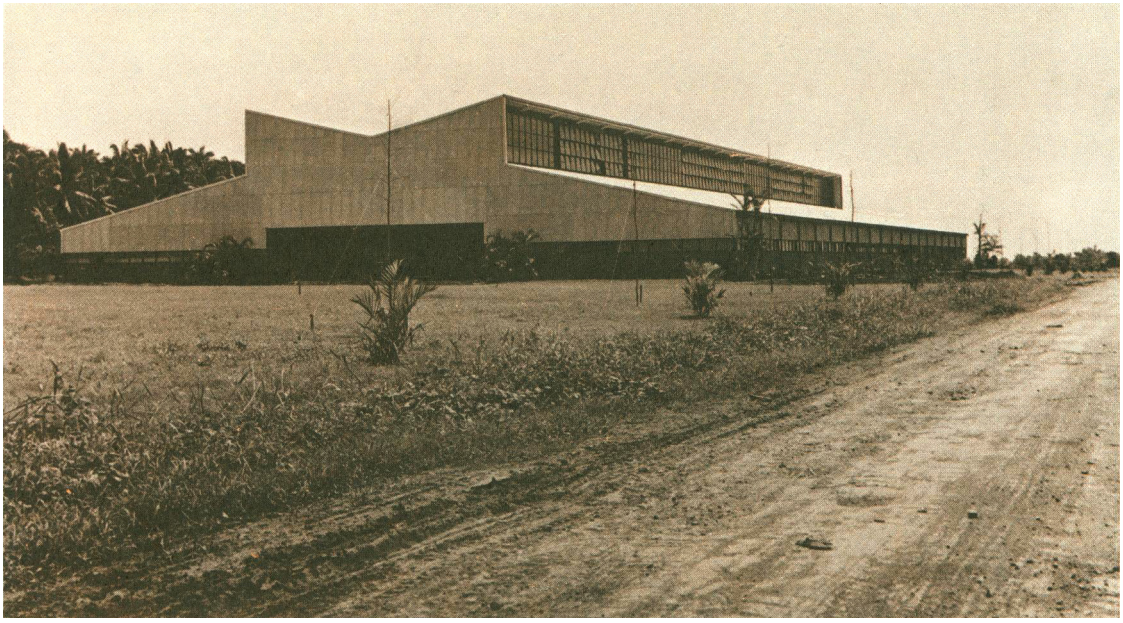
Johnson's design for the experimental field included roads and an underground irrigation system along with the necessary drainage ditches. Under Ramos' supervision, the area was divided into many paddies separated by permanent dikes or bunds. Any part of the field could be irrigated or drained at any time. Although a National Irrigation Service canal passed through the area, IRRI decided to have its own water sources to avoid the accusation of depriving farmers of water during the dry season. Two of the four deep wells that were drilled — Los Baños is a thermal spring region — yielded hot water, and a storage area was built where the water could be cooled before being released onto the research plots.

Although the total area of the experimental field was 80 ha, a considerable part of it was taken up with roads, ditches, bunds, and natural creeks. Thus, the

actual area available for growing rice was about 55 ha. In the early days of IRRI, that proved to be sufficient.

Parts of the tract had to be cleared of coconut trees, some of which were used for landscaping. The trunks of others were used in building temporary bridges over the creeks so that tractors could be moved about freely for land clearing, leveling, and final preparation for planting.

Under Johnson and Ramos, the work progressed rapidly. By mid-November 1960, IRRI had 30 people on the payroll at Los Baños. Except for the project engineers who served as inspectors of the construction work on the buildings, all were farm laborers employed in the development of the experimental field. Johnson was especially conscientious about the quality of the work. For



The service building on 8 June 1961 (top), and the same building on 20 July 1961, after full-sized coconut trees had been planted.

example, each piece of concrete pipe for the underground irrigation system was pressure tested for leaks.

The total cost of developing the experimental field was about $250,000.

By mid-1961, IRRI had a large area planted to rice, much of it devoted to growing pure seed for the Bureau of Plant Industry. Besides giving certain IRRI staff members (not excluding the director and assistant director!) an opportunity to observe the growing of rice at first hand, those early plantings helped in determining the variability in the newly leveled experimental plots.

Although much of the work was completed by mid-1961, minor refinements in the land development and the solving of early production problems in the paddies took most of Johnson's and Ramos' time for all of 1961 and 1962. It was 1963 before Johnson could start his research on machinery design, studies of land preparation, and other experiments.

Additional buildings. The buildings described so far include all that were in the original plan and that were completed by January 1962. However, several

Clearing coconut trees from land that was purchased to provide extra area for the experimental field (late 1960).

more structures were erected in late 1962 and in 1969 with funds left from the original Ford Foundation grant of $7,150,000 plus those from a supplementary Ford grant of $360,000. The additional buildings included a staff residence, 2 more apartments (bringing the total to 10), a women's dormitory with 16 rooms, the 4 greenhouses already mentioned, and a screenhouse for the varietal improvement program. IRRI also constructed a cistern for storing rainwater from the roof of the service building, for use in the water deionizer in the laboratory building and the greenhouses.

The house and apartments were needed because IRRI had already found that it had underestimated its staff requirements. The women's dormitory was built after it became clear, in 1962, that there would be women trainees staying at the Institute and, furthermore, that the parents of a number of the unmarried females on the secretarial staff and among the research assistants would worry constantly unless their daughters lived in a separate dormitory with a house mother in charge.

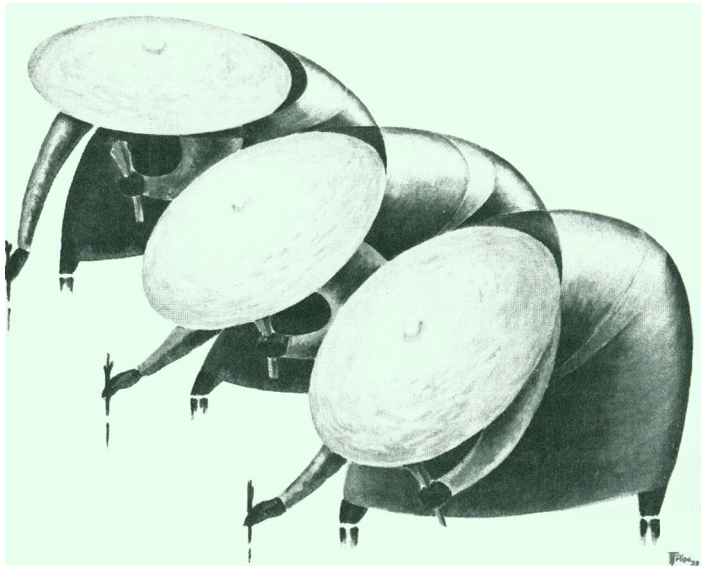
Rainwater was collected because the Los Baños well water, although softened at IRRI, still contained enough soluble salts so that the deionizer had to be flushed out every few days. Collection of rainwater alleviated the problem considerably, although the supply would run out toward the end of the dry season. Later, both sides of the service building roof were tapped to increase the amount of rainwater collected.

THE INSTITUTE IS DEDICATED

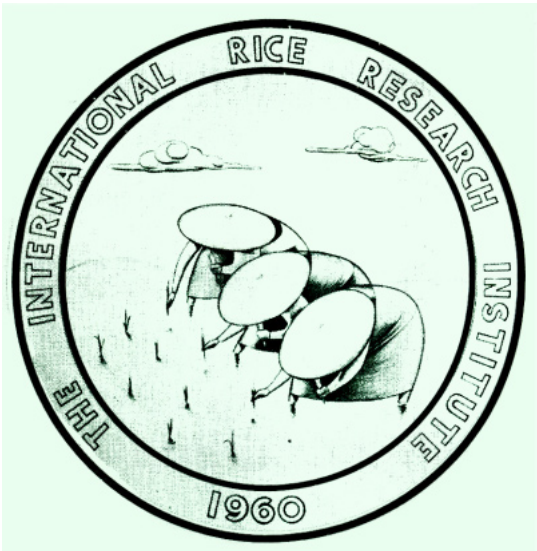
In January 1961, I told the architects that I hoped all construction work would be completed on schedule and the grounds would be fully landscaped by April 1962, when the dedication ceremonies of the Institute would be held. I was assured by them that the buildings would be finished in 12 months, which would mean that all construction would be complete by the end of January 1962. This would give a comfortable margin of time in which to get the laboratories in full running condition and to complete the landscaping, some of which could not be done until the contractors left. It so happened, however, that the "comfortable margin" was removed. IRRI was asked to hold its dedication ceremonies about 2 months earlier than originally planned.

In September 1961, word was received from New York that John D. Rockefeller 3rd was scheduled to be in India and other parts of Asia in late January and early February 1962 and that he would like IRRI to hold its dedication ceremonies within that time so that he would not have to make a second trip to the Philippines for the occasion — at which, from the beginning, IRRI had wanted him to speak. After talking with the architects, Wortman and I agreed that an earlier dedication date would be possible, and when I was in New York on 11 October 1961, the decision was reached that the Institute would be dedicated on Wednesday, 7 February 1962, and that a meeting of the Board of Trustees would be held 2 days before.

One problem was that the order for the Institute's dishes, which were even then assumed to be on the high seas, had been lost in the mail and never



The evolution of IRRI's logo. The Chandlers bought a painting (right) by Felipe in 1960. In 1961, Drilon showed it to a local artist who came up with a design (bottom. left). After discussion between Drilon and the artist, it was decided to embellish the scene with a view of Mt. Mayon (right).



reached the Rockefeller Foundation's purchasing department. I learned this when I was in New York in October, along with the even more disturbing part that by the time the order could be filled and shipped, the dedication ceremonies would be an event of the past. Some 250 people would be fed by IRRI at noon on 7 February; it was essential to have the china. Consequently, I made arrangements to have it shipped by airfreight — the cost of which ($2,600) exceeded the price of the dishes by $400!

The real difficulty in preparing for the dedication ceremonies was inducing President Macapagal to be on the program, which Wortman and I had

tentatively worked out and presented to Harrar and Hill in New York in October. After I returned to the Philippines in early December, I set about making arrangements to invite President Macapagal to participate in the program.

As Trustee Garcia was chairman of the National Science Development Board and thus had cabinet status, I approached him first, asking for his assistance in getting the President's acceptance. Garcia said he would be glad to do this and asked that I prepare a letter of invitation which Garcia would personally deliver to the President. He suggested also that Cardinal Santos be asked to give the invocation. I prepared both letters of invitation and delivered them to Garcia on 29 December 1961.

On 4 January 1962, I checked with Garcia and found that Cardinal Santos had to attend an event in Baguio on 7 February but that Father Francisco Araneta, rector of Ateneo University, could give the invocation. Garcia said he had sent the invitation to President Macapagal through his executive secretary, Amelito Mutuc. Moreover, he had talked to Vice President Emmanuel Pelaez, who would be willing to speak if the President could not. The same day, I talked with the assistant executive secretary, Rodrigo Perez, who told me he had spoken to the President on the subject and that the latter had responded that he didn't want to make any commitments for early February because of the many important matters coming up in Congress at that time. I asked Perez whether he had given the President a full description of the IRRI event and its importance to the Philippines. As his reply was somewhat indefinite, I decided to keep trying.

On 8 January, I saw Garcia again, learned that no word had been received from President Macapagal, and agreed to wait until 12 January before taking other steps. On that date, Garcia, not having heard from the President, urged me to discontinue my efforts and instead to accept Vice President Pelaez as the dedication speaker.

A few weeks earlier, it had been announced that President Macapagal had appointed Benjamin Gozon as secretary of Agriculture and Natural Resources. I decided to seek his help in reaching the President. This I did on 12 January, and Secretary Gozon said he would call me with the results of his intercession not later than 15 January. On that day, although no word had come from Secretary Gozon, I happened to mention to Architect Luz that plans were coming along fine for the dedication ceremonies except for my inability to get President Macapagal's acceptance to appear on the program. Luz smiled at my ignorance of Philippine politics and explained that Garcia at the time was out of favor with the President and would soon be replaced. According to Luz, the person closest to the President was Senator Estanislao Fernandez, who he said could walk in to see President Macapagal "even when he was shaving." Furthermore, Fernandez was from Laguna Province, where IRRI was located.

Luz added that he and Fernandez were good friends and that he would arrange a conference between the senator and me. So saying, he picked up the telephone, got in touch with the senator, and made an appointment for 3 p.m. the same day in Luz' office. At that meeting, Senator Fernandez said he would

Leaving the IRRI dedication ceremonies on 7 February 1962 are (left to right) Philippine President Diosdado Macapagal; John D. Rockefeller, 3rd; another guest; and president of the Philippine Senate Ferdinand E. Marcos. now President of the Philippines.

arrange for me, accompanied by Secretary Gozon, to see President Macapagal the next day.

By previous arrangement, Gozon and I were at Fernandez' residence in Manila at 9:30 a.m. When I arrived, it seemed that there must have been 50 people in the house waiting to see the senator and seek some favor. Fernandez was not in but Gozon, who knew his way about, found that he was on the golf course and would be returning shortly. The senator came, asked to be excused while he showered, and 15 minutes later came down the stairs, waved a greeting to the many supplicants, and went off with Gozon and me to Malacañang Palace to see the President.

Everything went well and by 10:30 a.m., President Macapagal (doubtlessly already briefed on the subject) had accepted the invitation. He said that there would have to be a few changes in the program to conform with protocol and that I should see Protocol Minister Zamora and Press Secretary Hechanova about the details.

In the tentative program sent to the President, it was planned to have Trustee Sinco of the University of the Philippines extend greetings and Trustee Damle of India give a major address. President Sinco had to be eliminated from the program because no Philippine official could precede the President of the country. Furthermore, no other major address could be included, and Damle's speech was therefore canceled. However, it was agreed that after Father Araneta's invocation, greetings could be extended by Rockefeller as chairman of the Board of Trustees of the Rockefeller Foundation, by Hill as vice president

of the Ford Foundation, and by Damle as a representative of the Board of Trustees of IRRI. The greetings would then be followed by the address by President Macapagal. It was also approved that Harrar and I would divide the presiding duties.

From then on, everything seemed to be moving along successfully. A dinner for the Board of Trustees was scheduled at the Manila Hotel on the evening of 6 February the night before the dedication ceremonies were to take place. The list of honored guests naturally included Mr. and Mrs. Rockefeller. During the day, however, word was received from Rockefeller that his flight was grounded in Singapore because of engine trouble and that he and Mrs. Rockefeller were flying to Hongkong in the hope of getting a good connection to Manila. Later in the day, further word came that there was no good connection to be made and that they therefore would rent a Cathay Pacific DC-4 for the flight to Manila.. They arrived at 9:00 p.m. on 6 February. Harrar met them at the airport, expressing the general relief of all that they had got there safely and in time. "We knew we had to be here for tomorrow's occasion," said Mrs. Rockefeller, "but it really disturbed John to have to rent a private plane; he hates to do that kind of thing."

The ceremonies on 7 February went off smoothly. That this was so (amidst the influx into the quiet Los Baños community of the President and his considerable entourage, visitors of state, members of the diplomatic corps and other guests of all ranks, a host of security and military personnel, and the news media in force) was a tribute to the organizational ability of Wortman and Drilon. As chairman of the special committee for the event, Wortman and his able group managed to swim in the sea of protocol, keeping track of who had been invited, who had or had not responded, where and when transportation was needed, and in what order the guests should be seated in the auditorium and at the luncheon — in short, weaving a great mass of detail into a successful operation.

The bronze plaque at the entrance to the plaza was unveiled by Mrs. Macapagal and Mrs. Rockefeller, revealing along with the names of the charter members of the Board of Trustees the legend:

THE INTERNATIONAL RICE RESEARCH INSTITUTE

AN EDUCATIONAL AND RESEARCH CENTER

devoted principally to the study and improvement of rice,
the world's major food crop.
Established by
the Ford Foundation and the Rockefeller Foundation
in cooperation with
the Government of the Republic of the Philippines.
Organized April 14, 1960
Dedicated February 7, 1962

Mrs. John D. Rockefeller, 3rd, and Mrs. Macapagal, the First Lady of the Philippines, unveil the bronze plaque at IRRI 7 February 1962.

With driver Alorro, President Macapagal, Rockefeller, and Chandler leave the IRRI research center to inspect the housing area (7 February 1962). The 1959 Ford station wagon was IRRI's first vehicle and was on the ship with the Chandlers when they arrived in Manila September 1959.

The assemblage then moved to the auditorium for the invocation, the various speeches of greeting, musical selections by the University of the Philippines Conservatory Trio, and climaxing the program, the address of President Macapagal.

Luncheon, a dignified affair, mainly with arranged seating at individually served tables, was attended by some 250 people, including (besides the many visitors) IRRI professional staff and, of course, representatives of the neighboring College of Agriculture. It took place in the dining rooms and lounge of the cafeteria-dormitory building and gave many of the guests an opportunity for a leisurely view of the two murals commissioned for the Institute from the well-known Philippine artist, Vicente Manansala.

In the afternoon, a program of dances, arranged especially for the occasion of IRRI's dedication, was presented in the auditorium by the world-renowned dance troupe of the Bayanihan Folk Arts Center in Manila.

There followed the second of two guided tours (the first having taken place just before lunch) of the Institute buildings, the residential area, and the experimental fields.

With the dedication over, 11 of the scientific staff already in residence, and 3 more appointments approved for the near future, IRRI was ready for its great adventure in applied science.

CHAPTER 2

Developing and staffing the research and training program

The scope of the rice research program to be developed by IRRI was first outlined by Harrar in his memorandum of October 1958 (see Appendix 1). He had clearly visualized a broad spectrum of research on rice. His listing of research areas needing attention covered essentially all the activities later undertaken by IRRI. The earlier mentioned Memorandum of Understanding, signed on 9 December 1959 by representatives of the Ford and Rockefeller Foundations and the Government of the Philippines, presented the general program of the Institute, emphasizing not only basic and applied research but a training program and a library and documentation service. It included, also, the need for distributing improved genetic lines and varieties to other research centers. Thus, IRRI's mandate had been thought out in general terms before formal organization started.

In developing the details of the research and training program, Wortman and I used those earlier documents as our guide. In addition, we had many discussions with Harrar, Hill, Gant, Moseman, and Hendricks. Furthermore, the Program Committee of the Institute's Board of Trustees had given serious attention to IRRI's research imperatives when it met in April 1960.

With this background, Wortman and I felt reasonably confident about the research programs that should be undertaken and the kinds of scientists that would be required. Because I had traveled widely in Asia during the 5 years before IRRI's formation and Wortman made several trips in 1960 and 1961 through the rice-growing countries of Asia, we were well acquainted with agricultural scientists there. The Rockefeller Foundation, particularly, with its programs in Mexico, Colombia, Chile, and India, had contacts with many agriculturists. The Ford Foundation, too, was acquainted with agricultural specialists through its rural development programs. It was from such experience and contacts as these that most candidates for the various positions were found.

From the outset, it was agreed that staff would be recruited from any of the free countries of the world, but that because of Asia's primacy in rice production, a special effort would be made to identify Asian scientists experienced in, or at least familiar with, rice research. A further principle that Wortman and I set was, in general, to employ promising young scientists still seeking to make a name for themselves, rather than more mature and renowned persons who might tend to rest on their laurels. The idea was that in the course of establishing reputations through their research at IRRI, the younger scientists would establish the reputation of the Institute as well. With few exceptions,

that employment principle was carried out. All, except three, scientists of the original group at IRRI in 1962-63 were in their thirties or late twenties.

Each candidate was first interviewed in his own country, or where he was posted at the time, and then, if mutual interest continued, was invited to IRRI to become acquainted with the working and living environment. If the decision was to hire the candidate, an offer was made during his visit. He could either give an immediate answer or reply in writing later.

Initially, all Americans on the staff were employed by the Rockefeller Foundation and then assigned to the Institute. Although the salaries and perquisites of these employees were set by the foundation, their work programs were determined only by IRRI; professionally they were treated in exactly the same way as the non-Americans. At the start, about half of the senior professional staff were Americans, but gradually the number of foundation-employed scientists decreased. As they accepted positions elsewhere, they were replaced either by Asians, or by Americans hired directly by the Institute. Today, no permanent scientists at IRRI are employees of the Rockefeller Foundation.

When the organizational framework for the Institute was developed in 1961-62, the IRRI administrators decided to create only eight departments: Varietal Improvement, Agronomy and Soils, Plant Protection, Plant Physiology, Chemistry, Agricultural Engineering, Statistics, and Agricultural Economics. In addition, there would be the nonresearch professional units consisting of Library and Documentation Center, Experimental Farm, Food and Dormitory Services, Buildings and Grounds, and the administrative group comprising the director, the associate director, the executive officer, and the treasurer. Although after a few years it was deemed advisable to create separate departments for disciplines that originally had been combined within a department, the description that follows outlines the program objectives for each of the original units — and of the disciplines within them.

Because the early successes of IRRI are directly attributable to the performance of its initial staff, the accounts given of the search for and hiring of the senior staff to head the various operations are quite detailed for original appointees and for any replacements or additions during the first 5 years of IRRI's research program.

But because this is mainly a chronicle of IRRI's beginning years — and because, too, of the necessary restrictions of space — scientists who joined IRRI from 1967 onward are mentioned with what might otherwise seem undue brevity.

Furthermore, space unfortunately does not permit a description of the original junior scientific staff (the research assistants), nor of the many other IRRI employees, the support staff, all of whom played an indispensable role in getting the research and training program off to a running start. The policy set at the beginning was to hire one to three senior professionals with a Ph D degree, or its equivalent in experience, for each department and to employ Philippine college graduates with either BS or MS degrees to work with them as a team. This policy continues at IRRI today. Many of the research assistants

who were with IRRI in the early years have gone abroad for advanced degrees and returned to positions in Philippine government agencies, universities, or colleges; others have gone directly from their IRRI posts to various agencies in the Philippines, including private commercial organizations and to other international centers. Thus, IRRI has served as a training ground for many young Filipinos now pursuing successful careers elsewhere.

VARIETAL IMPROVEMENT

Many years before IRRI was established, scientists in Japan and Taiwan had made considerable progress in developing superior varieties of rice. The Japanese breeding program began as early as 1910, but most of the progress in breeding modern rice varieties occurred after 1927. The Japanese developed a series of rice varieties that were stiff-strawed, upright-leaved, and fertilizer responsive with a high yield potential. The varieties were of the japonica type with short wide grains, which, when cooked, were stickier and glossier than were the grains of the indica varieties grown in the tropics.

During the 1930s and 1940s, Japanese and Chinese plant breeders in Taiwan developed japonica varieties adapted to the high temperatures and shorter day lengths of the tropics. Called *ponlai* varieties by the Chinese, they were widely grown in Taiwan and formed the bulk of its rice exports to Japan.

After World War 11, when Taiwan ceased to be under Japanese rule, the government mounted a sizable rice breeding program to improve the local indica varieties. Out of this effort emerged a variety called Taichung Native 1, which was a cross between Dee-geo-woo-gen, a short heavy-tillering variety, and Tsai-yuan-chung, a tall, disease- and drought-resistant cultivar. Taichung Native 1 was first released in 1956. By 1960 it was widely grown by Taiwanese farmers, often yielding 6 to 8 t/ha when well managed.

Another important rice breeding activity in the 1950s was the indica-japonica hybridization project of the Rice Breeding Working Party of the International Rice Commission of FAO. The original crosses in the project were made at the Central Rice Research Institute (CRRI) in Cuttack, India. The Asian countries participating in the project sent seeds of their more promising varieties to CRRI where the varieties were crossed with a group of japonica varieties that had been assembled there. Later, progeny from these crosses was distributed to the cooperating countries for trial and selection. From this program came such superior varieties as ADT-27 in Tamil Nadu State in India, and Malinga and Mashuri in Malaysia.

Several national programs, independent of the FAO project, were active in the 1950s in breeding improved indica varieties, typical of which were BPI-76 in the Philippines and H-4 and H-5 in Sri Lanka (at that time, Ceylon).

This chronology of progress is reported here to point out that IRRI's program was not the beginning of modern rice breeding. Good genetic stock was available to start a massive breeding program to develop improved varieties for the tropics and subtropics.

As we traveled in Asia, Wortman and I became aware of the progress that had been made, especially in the development of varieties with superior plant

type and resistance to disease attack. Emphatically, it was knowledge of the advances made in Japan and Taiwan that helped IRRI set its specific rice-breeding objectives at the start of its program in 1961-62.

Although, as stated, active rice breeding programs were going on in several countries in South and Southeast Asia, by 1960 they had had little impact on average rice yields. An urgent need existed for an intensive program of rice breeding to develop for the tropics and subtropics varieties that were short, stiff-strawed, nonlodging, and fertilizer responsive, and that had resistance to, or at least tolerance for, the major disease and insect pests. Consequently, from the outset it was agreed that rice breeding and genetics would be a major effort at IRRI.

Wortman suggested that the department to conduct this work be called varietal improvement, rather than plant breeding. In other words, it would be named for the objective rather than for the process. The next step was to find a plant breeder to head the department.

As early as mid-1959, Harrar, Moseman, and I had talked with Peter R. Jennings, then a rice breeder in the Rockefeller Foundation's Colombian Agricultural Program, about the plans for establishing IRRI in the Philippines. It was not specifically suggested at that time that Jennings join IRRI's staff, but it was proposed that when possible, he make a trip to Asia to become familiar with rice research and production in that part of the world. He made that trip in September-October 1960.

During the latter part of his tour, Jennings was accompanied by Wortman, who introduced him to various Asian rice scientists. The two ended their trip in the Philippines on 2 October 1960, a time when both Harrar and Hill were there for the second meeting of the IRRI Board of Trustees. Jennings had developed a keen interest in the rice problems of the Asian tropics; and after conversations involving the five of us — Jennings, Harrar, Hill, Wortman, and me — it was unanimously agreed that Jennings would be transferred by the Rockefeller Foundation from Colombia to the Philippines, as rice breeder and department head. His arrival at IRRI was set for October 1961, when a staff residence would be available for him and his family.

Jennings had obtained his Ph D degree in plant pathology, with a minor in plant breeding and genetics, at Purdue University. At that time, E.C. Young, dean of the Graduate School at Purdue, was also a member of the Board of Consultants to the agricultural program of the Rockefeller Foundation. Familiar with the country programs of the foundation, he knew of its interest in hiring bright young people who showed promise of becoming leaders in their fields of specialty.

In the spring of 1956, Young informed Harrar that a brilliant graduate student by the name of Jennings would be completing his Ph D requirements in June and was highly qualified to work abroad for the foundation. Harrar said that the only position open at the time was for a rice specialist in Colombia. After conversations between Young and Jennings at Purdue and correspondence with New York, Jennings and his wife went to New York on 7 August 1956 and were interviewed by Harrar, Moseman, and me.

Jennings was hired, spent a training period with Henry "Hank" M. Beachell, the rice breeder at the rice research station in Beaumont, Texas, and later went to Mexico for some experience in the Rockefeller Foundation program there. He then went on to Colombia, where he developed an excellent rice research and training program. His move to IRRI, an organization concentrating on rice research, was logically the next step in his specialization in that field.

Because much remained to be learned about the genetics of tropical rice varieties, it had been decided early on that IRRI would include a geneticist in its first group of scientists.

Although several possible candidates from India and Japan were considered, it so happened that Te-Tzu Chang visited the Philippines in September 1960. He had an MS degree from Cornell University and a Ph D degree from the University of Minnesota and at that time held the position of senior agronomist in the Plant Industry Division of the Joint Commission for Rural Reconstruction (JCRR) in Taiwan. Both Wortman and I were highly impressed with Chang's background in and knowledge of rice. Wortman made arrangements to visit Chang in Taiwan. After that visit, Wortman recommended that IRRI invite Chang to come for a formal interview. This took place on 28 March 1961. When offered the position, Chang accepted and agreed to report for duty by October 1961, at which time a house would be available for his family.

Both Jennings and Chang proved to be excellent choices. As reported in more detail later, they quickly assembled a large collection of rice varieties, including the short-statured cultivars from Taiwan. From this early assemblage of germplasm, Jennings made the crosses that resulted in such early successes as IR8 and IR5.

When Jennings was in the Philippines in October 1960, he stated that in his opinion Beachell was the best rice breeder in the world. One thing was certain, Beachell was among the top in the field and had an outstanding reputation in America. Jennings recommended that Beachell be brought to IRRI as a consultant for one month. During that time, Beachell worked with Jennings and Chang in setting up some of the long-term objectives of the rice breeding program and in working out the methodology to be followed. Beachell soon caught the excitement of IRRI's program and indicated that he would be available in a little more than a year to join the Institute on a full-time basis. The arrangement was urged by Jennings and Wortman, and I approved it. Beachell and his wife arrived in the Philippines, for the second time, in October 1963. A sound, skillful, and practical breeder with inspiring enthusiasm for and dedication to rice improvement, Beachell turned out to be a great asset to IRRI. He, Jennings, and Chang made a fine team. When I was asked some years later who, among the three senior scientists in the Varietal Improvement Department, should receive the coveted John Scott award for the creation of IR8, I replied that the prize should be split among the three: Jennings for selecting the parents and making the cross, Beachell for identifying IR8-288-3 from among the multitude of segregating lines, and Chang for having brought to the immediate attention of IRRI breeders at the start the value of the short-statured varieties from Taiwan such as Dee-geo-woo-gen, I-geo-tse, and Taichung

Native 1. It was not chance that of the 38 crosses made in 1962, 11 involved a dwarf variety from Taiwan as one of the parents.

Jennings continued to head IRRI's Varietal Improvement Department until 1967 when he left the Institute to assume the leadership of the rice program at the Centro Internacional de Agricultura Tropical (CIAT), the newly formed international agricultural research center in Cali, Colombia. He established a first-class research program at CIAT and soon either introduced or bred varieties that revolutionized Colombia's irrigated rice industry. Later, after spending a short time as a New York officer of the Rockefeller Foundation, Jennings went to Costa Rica to head the CIAT-administered rice improvement program in Central America. In 1980 he returned to CIAT where he is now concentrating on the improvement of dryland rice, still as an employee of the Rockefeller Foundation but with a full-time assignment to CIAT. He has received several honorary degrees and various prizes in recognition of his substantial contributions to the understanding of the rice plant and to its increased productivity.

One of Jennings' most recent achievements is the book entitled *Rice Improvement.* After preparing the first draft of the manuscript, he enlisted W. Ronnie Coffman and Harold E. Kauffman, both of IRRI, as coauthors, to add some of the more recent techniques emanating from the Institute's breeding and international rice testing programs. The book was published by IRRI in 1979. It is a practical manual on rice breeding and without doubt is the best guide that exists today for young rice breeders in the less developed countries, especially in the tropics. *Rice Improvement* has been translated and printed in several languages for use in national programs.

Chang has continued at IRRI and has established a global reputation not only for his contributions to the knowledge of the genetics of rice but as an expert in the collection, description, and preservation of the world's rice germplasm.

Beachell replaced Jennings as head of the Varietal Improvement Department in 1967 and continued in this post until he reached retirement age (65) in 1972. He then accepted a position in IRRI's outreach program in Indonesia. When he took his second retirement in 1981, he had made an outstanding contribution not only to the extension of IRRI's genetic materials in Indonesia but to the guidance, encouragement, and training of younger Indonesian scientists. Indonesia's rice yields increased remarkably in 1979, 1980, and 1981, and Beachell's untiring efforts have been an important part of this advance. Over the years, Beachell has continued to make annual trips to Korea, where he is highly respected (and has received important honors) for his assistance in making possible the dramatic increases in rice yield in that country.

When Jennings went to CIAT in 1967, IRRI appointed as plant breeder Gurdev S. Khush, an Indian national who was then an assistant research geneticist at the University of California at Davis. When Beachell retired in 1972, Khush was made head of the Varietal Improvement Department, and the previously mentioned W. Ronnie Coffman was recruited as plant breeder to fill the vacancy resulting from Beachell's departure. The important contribu-

tions of Khush and Coffman, and of the earlier members of the department as well, are reported in later chapters.

AGRONOMY AND SOILS

From work done elsewhere, especially in Asia, it was evident from the start that IRRI would need to do research in agronomy and soils. Wortman and I decided to combine all agronomic and soil science research in one department composed of three principal scientists — an agronomist, a soil chemist, and a soil microbiologist. The agronomist would work on soil fertility, on water and weed control, and on such problems as land preparation techniques, plant spacing, and comparisons of direct-seeded and transplanted rice. The soil chemist would study the influence of flooding on chemical properties of the soil and the impact of and cure for such adverse soil conditions as iron toxicity, salinity, and zinc and phosphorus deficiency. The soil microbiologist would investigate the microorganisms in rice soils, the biological fixation of elemental nitrogen, and the degradation of pesticides and herbicides in flooded soils.

The first candidate interviewed for the position of soil chemist was C.T. Abichandani, the soil chemist at CRRI in Cuttack, India. Bradfield and I were well impressed with his work when we were in India in 1955. I had visited with him several times between 1955 and 1960. In December 1960, Abichandani was invited to IRRI for an interview, and it was decided to make him a tentative offer. At that early stage in the Institute's development, all new appointments and the salary to be offered were referred for approval to Harrar as chairman of the Board of Trustees. It developed that the salary offered to Abichandani was too low to attract him and he decided not to accept the position.

At the meeting of the Board of Trustees on 5-6 October 1960, the matter of a salary scale for IRRI professional staff was discussed and a committee composed of Sinco, Fortich, and Garcia was formed to make a study of the salary levels being used by other international organizations such as the Food and Agriculture Organization (FAO) and the World Health Organization. This report was not ready in December when Abichandani was interviewed. It was completed by late January 1961 and I carried it to New York in February and discussed it with Harrar and Hill. In the course of the conversations, it was agreed that IRRI senior scientists would be offered salaries no less than the minimum of the corresponding grades in other organizations hiring international staff. From then on, IRRI had little trouble attracting capable people.

The next soil chemist to be interviewed was Felix N. Ponnamperuma, of Sri Lanka. He had obtained his Ph D at Cornell University and was well known to Bradfield. Wortman and I had become acquainted with him during visits to Sri Lanka. In 1961 he was soil scientist in the Department of Agriculture in his own country. Ponnamperuma visited Los Baños for an interview in May 1961. Because he had studied abroad on a government scholarship, he was required to spend a certain number of years working for his government before he accepted other employment. IRRI made him an offer and agreed that if necessary, it would reimburse the Sri Lankan Government for the remaining

time he still owed it. Ponnamperuma accepted IRRI's offer and arrangements were made for him to spend about three months at the University of California, Berkeley, to catch up on the newest techniques in instrumental analysis. After completing that training, he arrived at IRRI in December 1961.

Ponnamperuma turned out to be a prime choice. Through the exhaustive studies he conducted at IRRI, he became a world-renowned authority on the chemistry of submerged soils. He is still on IRRI's staff and in recent years has concentrated on identifying rice varieties and genetic lines that are tolerant of adverse soil conditions.

When IRRI turned to finding a qualified agronomist, Wortman suggested that James C. Moomaw of the University of Hawaii be considered. He was invited to IRRI for an interview in July 1961. Offered the position, he accepted it and arrived with his family in November 1961.

Moomaw had never grown a crop of rice but he was a well-trained agronomist, having received his MS degree in soil science from the University of Idaho and his Ph D in plant ecology from Washington State College. In Hawaii he was working on forage crop management, particularly in the area of soil fertility.

Moomaw soon learned about rice management by working with the crop and by visiting other soil scientists and agronomists in Asia. He developed a first-class research program investigating continuous cropping, fertilizer response, water management, and weed control. As IRRI's early annual reports will verify, he was the first scientist at the Institute to work with multiple cropping.

Moomaw was asked by IRRI to be its resident scientist in Sri Lanka from 1967 to 1969. After a successful experience there, he spent a one-year study leave at the University of California, Davis. While he was there, the International Institute of Tropical Agriculture (IITA) in Nigeria, which was just getting started, became interested in obtaining him as its agronomist to initiate a rice research program. The Rockefeller Foundation agreed to his transfer and Moomaw joined IITA in 1970. After launching its rice research program, he was made leader of the farming systems program and in 1973 became director of outreach activities. Moomaw left IITA in 1975 to become the second director of the Asian Vegetable Research and Development Center in Taiwan. He held that post until 1979, when he returned to the U.S. to become program officer for Southeast Asia for the International Agricultural Development Service (IADS) in New York. In February 1982, he became executive director of the Near East Foundation, with headquarters in New York City.

By 1963, Moomaw had asked IRRI to hire an associate agronomist to conduct the soil fertility work of the department. He suggested that the Institute consider Surajit K. De Datta, an Indian scientist who had obtained his Ph D at the University of Hawaii under Moomaw and who was then on a postdoctoral appointment at Ohio State University.

The new position was approved; De Datta was interviewed, hired, and arrived on the job in January 1964. Although his thesis had involved some rather basic problems of soil phosphorus, he soon became enthusiastic about

IRRI's main goal of increasing the yield of rice in the less developed countries. By 1966, De Datta took just pride in getting high yields on both experimental and farmers' fields through the use of modem varieties and good management.

When Moomaw left IRRI, De Datta was promoted from associate agronomist to agronomist. He has served as the head of the department since then. He has conducted a dynamic program in soil and water management and in chemical weed control. In 1979, while on study leave at the University of California, Davis, he wrote a book entitled *Principles and Practices of Rice Production,* which was published by John Wiley and Sons in 1981. The work is already recognized as a major contribution to the rice science literature.

The search for a soil microbiologist was more difficult, chiefly because there were fewer people trained in that area than in soil fertility, for example. At the time that IRRI was seeking candidates for the post, the customary activity for soil microbiologists was to work on the degradation of residues of pesticides and herbicides in soil. Although the Institute was interested in that subject, it wished to stress particularly the nitrogen transformations in flooded soils and the amounts of nitrogen fixed by microorganisms.

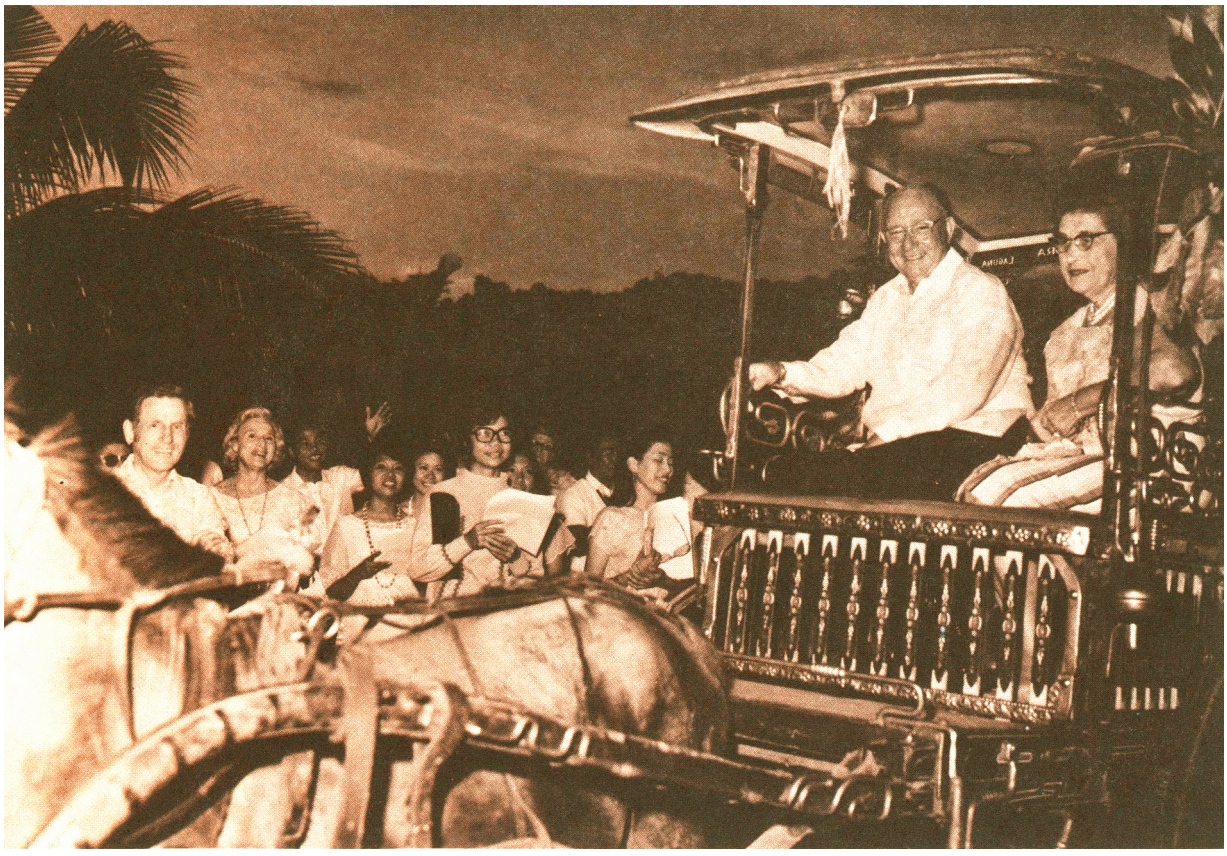
The first candidate interviewed for the post was M.I.H. Aleem, a Pakistani recommended by Martin Alexander of Cornell University under whom Aleem had worked for his doctorate. He came to IRRI for an interview in early August 1962, made a favorable impression, and was offered the position of soil microbiologist. Later, he declined the offer for unspecified personal reasons.

In October 1962, when I was visiting Cornell University, Alexander told me that he had a bright graduate student by the name of Ian C. MacRae who would be a good candidate for IRRI's post when he completed his Ph D degree requirements in June 1963. I interviewed MacRae on that same visit and was well impressed with his attitude and qualifications. When offered the post later, he accepted it and reported for duty in July 1963.

MacRae performed most creditably at IRRI. As an Australian, however, he was attracted back to his own country when, in 1967, he was offered a permanent position on the teaching and research staff at the University of Brisbane.

In seeking a replacement for MacRae, IRRI once again turned to Alexander at Cornell. He recommended Tomio Yoshida, a recent graduate student of his, who was then on a temporary postdoctoral appointment at Colorado State University. I interviewed Yoshida in Colorado in June 1967 and arranged for him to join the staff in the Philippines in October of that year. Yoshida (with his family) stayed at IRRI until 1974, when he returned to his native Japan. He was replaced in January 1975 by Iwao Watanabe, also Japanese, who still leads IRRI's soil microbiology program.

In 1962-63, IRRI had two visiting scientists attached to the Department of Agronomy and Soils. Ellis F. Wallihan, who was on sabbatical leave from the University of California, Riverside, arrived 30 July 1962 and spent one year helping IRRI select and install laboratory apparatuses. In addition, he studied the nitrogen nutrition of the rice plant, attempting in particular to work out



Bradfield retired from IRRI at age 75. He and Mrs. Bradfield rode from their house to the research center in a calesa to attend the despedida that IRRI gave them.

methods of tissue analysis for detecting the nutritional status of rice. The other visiting scientist was Edward H. Tyner, on sabbatical leave from the University of Illinois. He arrived in September 1962 and spent a year studying the forms and availability of phosphorus in flooded rice soils.

Another activity included in the Department of Agronomy and Soils in IRRI's early years was multiple cropping. Richard Bradfield, who had traveled extensively in Asia in the mid-l950s, became intensely interested in developing cropping systems associated with rice. When he retired from Cornell University, the Rockefeller Foundation hired him as a special consultant and assigned him to IRRI in late 1964 to work on multiple cropping in tropical rice-growing countries. Although then 68 years old, Bradfield had unusual energy and was deeply absorbed in his work. He laid a good foundation for cropping systems associated with rice, preparing the way for more extensive work to be undertaken by IRRI later. Bradfield's work is not included in IRRI's annual reports, but he published a number of articles in scientific journals. A good summary of his findings can be found in *Rice, Science and Man,* the publication that stemmed from IRRI's tenth anniversary celebration in 1972. Bradfield continued at IRRI until 1 July 1971, when he retired for the second time. His

impact at IRRI has been an important and lasting one.[1]

Although the original plan was to have all four of the activities just discussed included in one Department of Agronomy and Soils, it soon turned out that the individual senior scientists were coming to the director and associate director with their problems of program and budget. Therefore it seemed simpler to create departments for each of the major programs. In 1964, the Department of Soil Chemistry was formed, with Ponnamperuma as its head; and the remainder of the activities were included in the Agronomy Department, with Moomaw as head. By 1965, Soil Microbiology became a separate department, with MacRae as its head. Bradfield remained in the Agronomy Department until 1968, when the Department of Multiple Cropping was established.

These moves away from a combined department to individual ones should not be construed as an indication of poor cooperation among the staff but rather as a practical way to handle budgets and projects.

PLANT PROTECTION

It was clear from the outset that IRRI's original staff should include a plant pathologist and an entomologist. Disease and insect attack caused severe yield losses on farmers' fields, and the kinds of pathogens and insect pests varied greatly among areas and environments.

As with agronomy and soils, Wortman and I decided to combine pathology and entomology in one department, Plant Protection. That designation lasted only through 1963. From 1964 onward, IRRI has had two separate departments, one of Plant Pathology and the other of Entomology.

Rice blast disease was, and still is, the most serious disease of rice in the humid tropics, especially in nonirrigated fields. Consequently, IRRI sought a plant pathologist experienced in the nature and control of that disease.

When Wortman visited Thailand in early 1961, he met Shu-Huang Ou, a Chinese scientist from Taiwan, who was a pathologist in the FAO regional office in Bangkok. Ou had received his Ph D degree from the University of Wisconsin in 1954 and had worked in Taiwan until 1957 when he took a special assignment in Iraq. When I was in Iraq in 1957, in fact, I heard of Ou's successes there. He had developed a method of testing rice varieties for resistance to the physiologic races of the rice blast disease and had established a series of test nurseries at many sites in Asia. Wortman felt that Ou knew as much about rice diseases as anyone he had met on his Asian visits, and he was particularly impressed with the thorough work that Ou had done with rice blast.

Ou was invited to the Philippines in early April 1961 and, while there, was offered the post of plant pathologist and head of the Plant Protection Department. After returning to Thailand, he decided to accept the offer and arrived at IRRI, with his family, in late 1961.

While on his first study leave from the Institute, Ou wrote an excellent book entitled *Rice Diseuses.* It was the first treatise devoted exclusively to the diseases

[1] Bradfield died in May 1981, just after his 85th birthday.

of the rice plant since G.W. Padwick's *Manual of Rice Disease* appeared in 1950. (Both books were published by the Commonwealth Mycological Institute of Kew, England.)

Ou gave distinguished leadership to IRRI's plant pathology program until he reached retirement age. In 1978, Jerry Pat Crill replaced him.

When IRRI was planning its research program in 1960-61, the statement made at a Rice Working Party meeting of the International Rice Commission of FAO was that viral diseases of rice were of minor importance and posed no threat to the industry. However, as early as 1962, IRRI's experimental plots were seriously affected by two viral diseases. The problem became so acute in 1963 that the Institute decided it should add a staff member who would devote full time to the study of rice viral diseases and their control.

The first step in this direction was to arrange for Dr. Tosi Take Iida, a prominent rice virologist from Japan, to spend a year as a visiting scientist at IRRI not only to conduct research on the rice viral diseases of tropical Asia but to help IRRI develop a sound virus research program. Iida arrived in January 1964 and stayed for one year. By the time he left, IRRI had hired Dr. Keh Chi Ling as permanent virologist. Ling had received his Ph D at the University of Wisconsin and at the time was plant pathologist at the Taiwan Sugar Research Institute.[2]

Rice is not only severely attacked by fungal and viral diseases but by bacterial diseases as well. Although Ou and his staff were working on the most important of the bacterial diseases, bacterial blight, it was decided in 1972 to add a staff member to devote full time to those diseases. It so happened that IRRI was ending its program with the All-India Coordinated Rice Improvement Project, and Harold E. Kauffman, who had served as a pathologist there, was transferfed to IRRI's headquarters in the Philippines. He worked on bacterial diseases until 1975 when he was asked to assume leadership of IRRI's International Rice Testing Program. To replace him as a specialist in bacterial diseases of rice, Twng-Wah Mew, then a plant pathologist at the Asian Vegetable Research and Development Center in Taiwan, was appointed to the position as associate pathologist.

Thus, IRRI eventually had three senior pathologists, one to work on fungal diseases, another on viral diseases, and a third on bacterial diseases.

The search for an entomologist began in 1961. IRRI wanted a true economic entomologist, one who could pursue studies of insect control not only through the use of insecticides but by developing varietal resistance in cooperation with the Varietal Improvement Department. At that time, practical entomologists were as scarce as soil microbiologists.

When Wortman visited India in 1961, Guy B. Baird of the Rockefeller Foundation office in New Delhi told him of an impressive young entomologist at the Indian Agricultural Research Institute by the name of Mano D. Pathak. Baird suggested that Wortman interview Pathak away from his laboratory where (in the academic tradition of the Old World) the senior members of the

[2] Ling died at IRRI on 12 February 1982 at the age of 57.

department would dominate the conversation so thoroughly that Wortman would have no real opportunity to get to know the candidate. This Wortman did and felt that Pathak could head IRRI's entomology program most satisfactorily, although he was only 28 years old at the time. Pathak had obtained his Ph D degree at Kansas State University under the direction of Reginald H. Painter, a world authority on controlling insects by developing resistant plant varieties. In India, Pathak was working with sorghum stemborers, which gave him a good background for work with the rice stem borers, a group of devastating insects in the rice fields of the tropics and subtropics.

Pathak was attracted by IRRI's program and arrangements were made to bring him to the Philippines for an interview in December 1961. He was offered the post of entomologist in the Plant Protection Department, and he and his family arrived in the Philippines in April 1962. Pathak developed a first-class research program. He headed the Entomology Department from its creation in 1964 and in 1974 was promoted to the position of assistant director of Research. Later, his title was changed to director, Research Coordination. His successor as head of the Entomology Department was Elvis A. Heinrichs, who is still at IRRI.

By 1968, IRRI's entomological program had become a busy and productive one. Pathak asked that an associate entomologist be added to study population dynamics and insect ecology. It so happened that IRRI at the time was approaching the Canadian Government for funding, so the Institute included in its proposal an additional entomologist. IRRI was encouraged by the Canadian director in the Asian Development Bank (who was handling arrangements on the Philippine end) to proceed with hiring the required people and purchase of equipment. In January 1969, I made a tour of Canada seeking qualified scientists. Among those interviewed was a young graduate student at MacDonald College of McGill University by the name of V. Arnold Dyck. As ill luck would have it, the Canadian grant did not materialize (for reasons explained in Chapter 5) and IRRI had to be helped out financially by the Ford and Rockefeller Foundations. IRRI hired Dyck after he had finished his graduate study and been awarded his Ph D degree. He joined the IRRI staff in June 1970 and is still there.

The only other addition to the senior staff in entomology has been James A. Litsinger who joined the Department of Entomology in 1974 to work exclusively on the insect control problems of the Cropping Systems Program.

PLANT PHYSIOLOGY

The Japanese had made great progress in investigations of the physiology of the rice plant, including studies of photosynthesis, the effect of plant type on growth and yield, and detailed examinations of the mineral nutrition of rice. Such research, however, had been almost exclusively in the temperate zone and little was known about the physiological processes of indica rice varieties in the tropics or subtropics. Accordingly, IRRI placed a plant physiologist on its early list of scientists to be added to the staff.

The first physiologist to be interviewed was Terrence Senewiratne, of Sri Lanka, whom Wortman and I had met at the University of Sri Lanka in Peradeniya where he was a member of the faculty. Senewiratne was invited to visit the Philippines in May 1961 and was offered the position of head of the Department of Plant Physiology. Like Ponnamperuma, he had to work for the government for as many years as he had been absent getting his Ph D in the U.S., and he still had 2 years to go before his debt would be paid off. However, he agreed to approach his government to see whether it would waive the requirement and let him join an international center that would have an impact on Sri Lanka's rice production. Several weeks later, we received a letter from Senewiratne stating that he would be unable to join IRRI's staff.

Some years afterward, when Senewiratne was an officer of the Asian Development Bank in Manila, he told me that the real reason he had to turn down IRRI's offer was that because he was an only son, his father had ruled that he must remain in Sri Lanka for as long as the parent lived. Thus did Asian filial ties influence the composition of IRRI's staff.

IRRI administrators had become well acquainted with Yoshiaki Ishizuka, a prominent professor of soil science at the University of Hokkaido in Sapporo, Japan. He recommended that IRRI consider (for the post of plant physiologist) a faculty colleague who had been one of his graduate students, Akira Tanaka. On further inquiry, Tanaka was strongly recommended also by Kihara of the IRRI Board of Trustees and by Bradfield, then still at Cornell.

Tanaka was invited to the Philippines in December 1961 and made a most positive impression on the staff. Offered the post of heading the physiology program, he accepted, arranging to arrive with his family by April 1962. Tanaka developed a first-class physiology program and brought to IRRI a wealth of Japanese knowledge and expertise, which were great advantages to the new institution.

Unfortunately, in those years, the Japanese Government placed a limitation on the length of time a scientist could stay abroad. Tanaka had to return to Japan in 1966 unless he was prepared to sever all connections with official institutions there. It was a great deal to ask of any Japanese scientist to relinquish his hard-won standing in an academic environment like Japan's where coveted positions were not readily relinquished to younger aspirants through the retirement of senior incumbents.

Tanaka was replaced by Shouichi Yoshida, another former student of Ishizuka's. In 1965, Yoshida was a scientist at the National Institute of Agricultural Sciences in Tokyo where he was working almost exclusively on silicon in rice. I interviewed him in Tokyo in September 1965 and found that he welcomed the idea of conducting research in a broader field than was possible at his post in Japan. He was invited to visit IRRI in January 1966. He was hired and, with his family, arrived at IRRI in April 1966 just as Tanaka was about to leave. Not long after Yoshida joined IRRI, the government of Japan relaxed its regulation and allowed such scientists to remain abroad indefinitely without penalty.

Yoshida maintained the high standards of research that Tanaka had set and went on to make many valuable contributions to the knowledge of the physiology of tropical rice. He is still at IRRI and in addition to being head of the department is in charge of IRRI's large phytotron. While on study leave at the University of California, Davis, in 1978-79, Yoshida wrote a book—*Fundamentals of Rice Crop Science* — that IRRI published in 1981. It is the most complete and up-to-date account of the scientific knowledge of rice to be found in the literature.

Actually, the first senior staff member to be hired for the Plant Physiology Department was Benito S. Vergara. In 1960, he had just returned from the University of Chicago where he obtained his Ph D degree in plant physiology, and was then a young staff member in the Department of Botany at the University of the Philippines at Quezon City. Wortman and I first talked to Vergara in January 1961. In March, I took him to Los Baños to see the laboratory and housing facilities that were then under construction. Mutual interest deepened and it was decided that he would join the staff as associate plant physiologist on 1 July 1961. He was still in his twenties and understood that IRRI would seek a more mature and experienced person to head the Plant Physiology Department.

Vergara has been a strong member of IRRI's research team. He has worked on numerous projects, among which are testing of genetic lines and varieties for tolerance to cold temperature and to flooding and many detailed studies of photoperiodism in rice. In 1976, he wrote *A Farmer's Primer on Growing Rice,* a step-by-step guide to the management of modern rice varieties, which has turned out to be a popular publication.

The Institute's decision to make plant physiology an important part of its research program set a precedent that was followed by the other international agricultural centers (a network described in Chapter 6) created in the 1960s and early 1970s.

CHEMISTRY

Two purposes were behind IRRI's decision to establish a Chemistry Department. The first was to examine the rice grain itself, studying the kinds of starch it contained, its protein levels, its amino acid quantities. The other was to study chemical changes occurring in the plant from the seedling stage to maturity. Regarding the first objective, much work had been conducted on the cereal chemistry of wheat but little on rice. As to the second objective, almost all of the basic work on the chemistry of the developing rice plant had been done in Japan on rice grown in cool climates. There was a need to understand better the metabolism of rice plants under tropical conditions.

At about the same time that IRRI was interviewing Vergara, it became acquainted with Bienvenido O. Juliano. He, too, was still in his twenties and had recently received his Ph D from Ohio State University. He had returned to his home country, the Philippines, and was employed as a chemist by the Philippine Refining Company. Wortman and I first interviewed him in No-

vember 1960. He was offered the post in March 1961 and started work on 1 July. His first assignment, at that early stage in IRRI's development, was to draw up a list of basic equipment and supplies that IRRI would need in its laboratories. Next he was to make a thorough search of the literature on the chemistry of the rice plant, with particular reference to the chemistry of the grain.

As in the case of Vergara, Juliano was appointed to an associate position — that of associate chemist — with the understanding that a more senior person would be selected as head of the department. By 1968, Juliano had been promoted to the position of chemist and head of the Department of Chemistry. His research work has concentrated on the chemistry of the rice grain and he soon became internationally known for his contributions to the knowledge of the changes occurring during rice ripening, especially with respect to protein content and quality and to variations in the composition of the starch in different varieties.

In the earlier years, however, a senior chemist still had to be found. Because of the advanced nature of rice chemistry in Japan, IRRI naturally started its search in that country. Kihara said that some of his colleagues in Japan recommended highly a young, Japanese chemist, Takashi Akazawa. Akazawa's biographical data were sent to IRRI, and he was invited to the Philippines in late June 1961 for an interview. When Akazawa was offered the position of chemist and head of the department, he replied that he was interested provided that IRRI would hire other Japanese scientists. He was assured that this was a distinct possibility and that he would be kept posted on developments. After Tanaka was hired, Akazawa accepted the offer, and his appointment was confirmed to begin 1 July 1962.

Akazawa did some excellent basic research on starch biosynthesis in ripening grains and on the nitrogen metabolism in rice leaves. In late 1964, however, he found it necessary to return to Japan, where, at Nagoya University, he has continued a distinguished career.

In 1964, Yasuo Natori was a scientist on the staff of the School of Medicine of the University of California in San Francisco. Word travels fast among Asian scientists and, having heard that Akazawa would leave IRRI, Natori applied for the vacancy. Highly recommended by his colleagues in California, he was invited to IRRI for an interview and was hired. Natori was highly effective but his real interest was to return to his native Japan to work as a biochemist in a university. He found such a position in mid-1966 and left IRRI to join the faculty of a Japanese medical college. By that time, Juliano, as mentioned, had become well established in his field of the chemistry of the rice grain and subsequently was made head of the Department of Chemistry.

AGRICULTURAL ENGINEERING

After Johnson completed the construction of the experimental fields in 1961-62, he started his research program. He realized that machinery, designed especially for the small rice farmer of Asia, was sorely needed. In his travels, he had been impressed with the equipment that Prince Debriddhi Devakul of Thailand's Rice Department had designed. Arrangements were made to have

the Prince spend 9 months at IRRI as a visiting scientist to assist in starting the equipment development program. During his stay, Debriddhi spent much of his time improving the design of a cone thresher. Johnson, although also working on that project, concentrated on testing available equipment for wetland preparation and studying losses of irrigation water by evapotranspiration and percolation. He also investigated the relationships between spacing and yield components.

In 1967, Johnson went to Louisiana State University on study leave, and then in 1968 joined CIAT in Colombia to assist that recently established center in developing and equipping its experimental farm. Johnson is a thorough, conscientious engineer with sound ideas. His contributions to the early development of IRRI's program were truly substantial.

Johnson's work with methods of land preparation and with simple harvesting equipment attracted the interest of visitors from USAID, and in 1965 that agency made IRRI a grant of $360,000 over a 3-year period for a research project entitled *Farm and Equipment Requirements for the Production of Rice and Associated Food Crops in the Far East and in South Asia.* The project was started in 1966 with the arrival of Stanley S. Johnson, a USDA agricultural economist stationed at the University of California, Davis, who got a 3-year leave of absence to undertake surveys of rice farm operations in the Philippines.

In 1967, Amir U. Khan, originally from India, who had recently obtained his Ph D degree at Michigan State University, joined IRRI, succeeding Johnson as head of the Agricultural Engineering Department. Khan had an unusually inventive mind and during the next decade created many original machinery designs, some of which are being manufactured in considerable quantity in South and Southeast Asia. A. Colin McClung, then associate director of IRRI, deserves the credit for discovering Khan. In 1966, McClung visited the University of California to talk with William Chancellor about his interest in going to IRRI. Chancellor, feeling that he could not leave his post in California permanently, recommended Khan for the job and suggested that McClung visit Khan while he was in the U.S. McClung was much impressed with Khan's background, notably with his imagination and innovativeness. It took a bit of persuasion to get Khan, a naturalized American citizen, to leave the U.S. and go to IRRI. He felt that it was important that he be hired by an organization with headquarters in the United States. The Ford Foundation came to the rescue by giving him a 5-year contract, which was later renewed. Khan arrived in 1967 and is still on IRRI's staff, although since 1976 he has been stationed in Pakistan where IRRI operates an agricultural machinery project in cooperation with the Government of Pakistan. Without question, two of the most creative agricultural engineers working on equipment design in Asia during the past two decades are Debriddhi Devakul of Thailand and Amir Khan of IRRI.

Since 1974-75, IRRI has had a succession of visiting scientists as well as several more permanent staff additions in the Agricultural Engineering Department. Although the many people coming and going in that program are not listed here, some of the achievements of IRRI's current program in agricultural engineering are presented briefly in Chapter 7.

STATISTICS

As soon as IRRI's research program started, it became obvious that a statistician would be required to assist in plot design and in the interpretation of research results.

When the need was discussed with Dean Umali of the College of Agriculture, he recommended that IRRI consider Burton T. Oñate. As Oñate had received his Ph D degree from Iowa State University in 1959 on a Rockefeller Foundation fellowship, I was somewhat acquainted with him. In 1962, he was head of the Statistical Coordination Office of the National Economic Council of the Philippines. He was interviewed by IRRI administrators and by several of the scientific staff in July 1962 and started working for IRRI that year. Oñate performed well, contributing particularly in the area of survey sampling techniques. In 1967, however, he joined the Asian Development Bank.

Fortunately for IRRI, a young Thai scientist with a Ph D degree in biometry and statistics from North Carolina State University had arrived in Los Baños in 1967. She was Kwanchai A. Gomez and, in accordance with Thai custom, was called Kwanchai. At North Carolina State University, she had met and married Arturo Gomez, a fellow graduate student who was pursuing his Ph D degree in plant breeding under a Rockefeller Foundation grant. When Gomez returned to the Philippines, and to the faculty of the College of Agriculture, he naturally was accompanied by his bride. She was anxious to work in her chosen field and, after a preliminary interview, IRRI was quick to hire her as Oiiate's replacement. Kwanchai proved to be a most able statistician. She is still at IRRI and has made many contributions to its research program especially in planning and conducting surveys under farm conditions and in interpreting the data. In 1975, jointly with her husband she wrote a book entitled, *Statistical Procedures for Agricultural Research with Emphasis on Rice.* Published by IRRI, it is an unusually concise, clear guide for agricultural scientists making statistical analyses of their research results. The Gomez book, an IRRI best seller, is now being revised for its second printing.

AGRICULTURAL ECONOMICS

Despite some opinions to the contrary, IRRI's original plans as prepared by Harrar in 1958 did include work in agricultural economics. That IRRI was somewhat late in hiring its first economist was due to the difficulty it had in finding a qualified scientist who was interested in studying problems of production economics rather than working in the grander area of macroeconomics. It was felt that as IRRI developed new methods of rice production, a knowledge of their economic effect was essential.

The first candidate for a staff position in agricultural economics was S. Pathak, an Indian who had just completed his Ph D degree in agricultural economics at Cornell University under the direction of Stanley Warren. He was highly recommended both by Warren and by Andron B. Lewis, then on the staff of the Council on Economic and Cultural Affairs (now the Agricultural Development Council). At Warren's suggestion, Pathak stopped off at

IRRI in July 1961 after completing his graduate studies. I was impressed with his attitude and his background and training. He was concerned with the problems of the farmer and was interested in working in the area of production economics. Wortman and I suggested to Pathak that he accept an appointment for a 3-year period, with the idea that if mutual satisfaction resulted, the appointment could be made a permanent one. After his return to India, however, Pathak informed IRRI that for family reasons he would have to decline the offer.

In April 1962, Arthur Mosher, then president of the Council on Economic and Cultural Affairs, visited IRRI. I told him that I had just received a letter from Gordon Sitton, who at the time was on the Council's staff in Bangkok, stating his interest in becoming a candidate for the position of agricultural economist at IRRI. Mosher recommended him highly, and Sitton and his wife were invited to visit IRRI in May 1962. I found him to be an able agricultural economist with 2.5 years of experience in Southeast Asia. I offered him the position of head of the Department of Agricultural Economics. After thinking the matter over, Sitton informed IRRI that he would be interested in joining the staff if he could have "the title of Assistant Director," but that otherwise he would have to decline the offer. As IRRI had no position open with that title, Sitton did not come.

In October 1962, I went to New York to discuss my operating budget proposal for 1963 with the Rockefeller Foundation and to interview several candidates for positions at IRRI. Through previous correspondence, Moseman had informed me that a promising candidate for the position of agricultural economist on IRRI's staff was Vernon W. Ruttan, then on leave from Purdue University and serving on the Council of Economic Advisors to the President of the United States.

Ruttan and his wife were invited to New York for an interview. My colleagues at the Rockefeller Foundation and I were definitely impressed with the couple and Ruttan was offered the position of head of the department. Ruttan accepted IRRI's offer and arrived on the job in May 1963 with his family — and the family Basset hound, Jake, who must be recorded for all who knew that interesting character. Ruttan soon developed an excellent knowledge of the economics of rice production in Asia. Unfortunately, after a time, the Ruttans had a health problem with one of their children and felt they should return to the U.S. where specialized medical attention would be available. In mid-1965, Ruttan resigned to accept the position of chairman of the Department of Agricultural Economics at the University of Minnesota. Ruttan developed an international reputation and is widely respected as an agricultural economist. IRRI was fortunate to have had his talent on its staff even for a short period.

At the time Ruttan left, Randolph Barker was working in the Philippines on the Cornell University team, which under a Ford Foundation grant assisted the College of Agriculture in developing its graduate study and research program. A number of IRRI staff members and I were thus well acquainted with Barker. His background and experience were ideal to fill the requirements of a

replacement for Ruttan. I approached Barker and then talked with George Trimberger, project leader of the Cornell group. Although Barker still had about 1.5 years before his assignment as visiting professor at the College would end, arrangements were made for him to supervise the graduate students who had thesis problems in agricultural economics at IRRI and to guide IRRI's young research assistants who were in the department when Ruttan left.

Barker joined IRRI on a full-time basis in July 1967 and continued to head the agricultural economics program until 1978 when he left to return to Cornell University as international professor of Agricultural Economics. He had an extremely successful career at IRRI and during his 11-year stay came to be recognized around the world as the leading rice production economist. He was replaced as department head by Robert W. Herdt who had joined IRRI in 1974. Barker and Herdt (the latter while on study leave from IRRI at Cornell University) have collaborated on a book on the rice economy of Asia, which should be published in 1982.

From 1972 onward, the Department of Agricultural Economics at IRRI expanded considerably. Thomas Wickham joined the department in 1972 as associate agricultural economist to work on the economics of water management. Herdt was at IRRI as a visiting scientist in 1973 but mutual interest was such that he joined the staff on a permanent basis the following year. Yujiro Hayami of Japan joined the staff in 1974 for a 2-year period, and the next year Edwin C. Price was added to the department as associate agricultural economist in the cropping systems program. When Barker left in 1978, John C. Flinn, an Australian agricultural economist then at IITA, joined IRRI, and Herdt became head of the department.

LIBRARY AND DOCUMENTATION CENTER

In the earliest documents describing the projected activities of IRRI, it was recognized that an essential element would be a good library that would contain the world collection of important rice literature and such other reference materials as would be needed by a group of natural and social scientists engaged in an active research and training program. Furthermore, the facility should be able to make available to scientists in developing countries any articles that they were unable to get in the libraries of the institutions where they were working.

The search for an IRRI librarian began in May 1960 when I talked with the head of the Library Science Department at the University of the Philippines, asking whether she could identify a recent graduate who would be qualified to undertake advanced study in the U.S. on a Rockefeller Foundation fellowship and eventually become IRRI's librarian. She replied affirmatively and I told her that I would be in New York the next month and would take up the matter with Dorothy Parker, the Foundation's library specialist in the New York office.

Parker agreed that the proposed plan was a logical one and called Ralph Shaw, who headed the School of Library Science at Rutgers University in New

IRRI's capable librarian, Lina Manalo Vergara, ponders a problem at her desk.

Jersey, to see if he would be willing to accept a graduate student from the Philippines on a Rockefeller Foundation fellowship. He answered that he would be glad to do so but that he already had a graduate student from the Philippines, Lina D. Manalo, who would be receiving her master's degree in September of 1960. He added that she was the brightest student he had ever had from all of South and Southeast Asia and that he was certain she would become an excellent librarian.

Parker and I invited Manalo to New York for an interview on 13 June. The interview went so well that she was invited back a week later to have lunch with Harrar, Parker, and me and to discuss the details of her appointment. It was agreed that Manalo would receive a Rockefeller Foundation training grant when she finished her degree requirements in September. Under the grant, she would devote the first 4 to 6 months as an in-service trainee at the National Agricultural Library in Washington, D.C. She would then spend the remainder of the period working in the New York office of the Rockefeller Foundation under the guidance of Parker, ordering the basic materials needed to start IRRI's library. After that, she would go to the Philippines and start her appointment as IRRI's librarian.

Manalo turned out to be a first-class librarian, well trained, conscientious, hardworking, and innovative. She has an engaging personality, and her lively interest in the arts has encouraged and often initiated IRRI-sponsored cultural activities. In my opinion, and that of more disinterested judges as well, Manalo has built the best library among the network of international agricultural research centers. She married Benito Vergara, IRRI's plant physiologist, in September 1968 and continues to head IRRI's Library and Documentation Center.

The Manalo-Vergara wedding gave us a first among the senior staff. The wedding was on the portico of the IRRI guesthouse with guests standing on the lawn below. (Our dog, Chrissy, considered herself invited and was an alert and dignified spectator of the discreetly amplified ceremony until stirred by the strains of the organ to respond soulfully — and on key.) The Vergaras also provide the rare situation of a husband and wife on the senior staff of an international center.

Parker was of inestimable value in getting IRRI's library off to a good start. Besides helping to identify and train Manalo, she obtained the services of Keyes Metcalf, librarian emeritus of Harvard University, to assist in designing and equipping IRRI's library. More importantly, she administered the preparation of a 10-year bibliography of rice literature for the period 1951-60. The basic work was done by Margaret Bryant in the National Agricultural Library in Washington during 1961 and 1962. Since then, annual bibliographies have been prepared and issued by the IRRI library staff.

IRRI soon established a small office in Tokyo to assemble the bibliography of Japanese rice literature. In addition, it arranged for translations into English of the more important Japanese journal articles. Jukyu Cho was in charge of the Tokyo office until he retired in 1973. On request, IRRI arranges for translations from languages other than Japanese.

With its microfilm and services, IRRI's library serves well not only its own scientists and research scholars but many rice specialists in developing countries where library services are inadequate. Furthermore, IRRI's library facilities are used extensively by both faculty and students of the University of the Philippines at Los Baños.

EXPERIMENTAL FARM

From the first, it was obvious that IRRI would need a farm superintendent and because all farm laborers would be Filipino, it was felt that the superintendent should be Filipino. In the search for a qualified candidate, Dean Umali again came to the rescue. He recommended Ramos, who had graduated from the College of Agriculture in Los Baños and had obtained his MS degree at Ohio State University. In 1959, Ramos was a supervisor in the National Rehabilitation Resettlement Administration on a project in Mindanao.

Wortman and I interviewed Ramos first in March 1960 and again in May. In July, he was offered the position of assistant field superintendent. He accepted the offer and began work on 1 October, about 2 weeks after Johnson arrived, to design and construct the experimental fields. Ramos was soon promoted

from assistant to field superintendent. In 1966, his title was changed to that of associate agronomist and farm superintendent.

Ramos turned out to be an excellent selection. He handled the farm workers well, gave full cooperation to the scientists in their field experimentation, and was innovative. He designed and built IRRI's first electric fence for rat control.

By 1962, the work load had become so heavy that Ramos asked for an assistant. In response, IRRI hired Orlando D. Santos as assistant field superintendent. In 1967, Santos was promoted to associate farm superintendent.

Ramos and Santos have continued to operate IRRI's experimental fields well, and now administer the work on about 230 ha of land devoted to rice and rice-based cropping systems research.

FOOD AND DORMITORY SERVICES

The original organizational scheme for IRRI included a training program for agricultural scientists and extension personnel working with rice. Obviously, housing and feeding facilities for the research scholars would be needed. IRRI

In the early days, before IRRI's power tillers were designed and built, the experimental plots were prepared with carabaos. Ramos hired local rice farmers whenever needed. In this instance, 22 men with their animals are preparing the fields for IRRI's world collection of rice in 1963.

would also have to employ secretarial staff and research assistants, many of whom would be unmarried and would require living accommodations in Los Baños, a community already overcrowded with students and faculty. Consequently, included among IRRI's original structures was the cafeteria-dormitory building.

The decision was to hire a manager of Food and Dormitory Services and to give that person responsibility, also, for operating the guesthouse and for providing assistance to the residents of the staff housing area with their day-to-day problems of obtaining household help, maintaining furnishings, and the like.

To find a suitable candidate, the assistance of Presentacion Perez, then head of the Department of Home Economics on the Quezon City campus of the University of the Philippines, was sought. She strongly recommended Rebecca C. Pascual, one of her former students who had majored in food and nutrition and who had gone on to obtain her MS in institutional management at Purdue University. In 1961, Pascual was administrative dietician at the Johns Hopkins University Hospital in Baltimore.

Pascual was interviewed by Parker of the Rockefeller Foundation, who reported that she was well qualified for the post and had an interest in returning to the Philippines. Offered the position of manager in June 1961, she replied that she would accept if IRRI could wait until November for her arrival. When IRRI replied that someone was needed sooner than that to get the guesthouse in operation and to order the equipment and supplies for the cafeteria, Pascual suggested the hiring of Nenita Esguerra as an assistant manager. Esguerra had worked in the Food Services Department at the Johns Hopkins Hospital along with Pascual but had returned to the Philippines. Esguerra was interviewed, was offered the post, and began work in August 1961.

Pascual and Esguerra did an outstanding job of organizing and operating the Food and Dormitory Services and the guesthouse. I recall that even when I would ask for an official luncheon, banquet, or other dining service, on very short notice, it would be provided well and cheerfully.

Because of budgetary restrictions and the rather modest income of those who used the facilities daily, the fare in the cafeteria had to be rather simple. Yet it also had to be varied in order to meet the requirements of the many ethnic groups represented in the training program. Their dietary restrictions were always a source of concern (no pork for the Muslims, no meat for the vegetarian Hindus, no beef for even nonvegetarian Hindus). When the diners of the various persuasions as well as those merely accustomed to their own national fare voiced their needs, Pascual and her staff did their best to meet the requirements and to provide a satisfactory menu for the international group. This was not always accomplished without incident. For example, when A. Colin McClung, then the associate director and in charge of training and the outreach international activities, was at his desk shortly after noon one day, a recently arrived Muslim research scholar from Malaysia appeared at his office door, walked in, plunked his loaded cafeteria tray on McClung's desk and

demanded, "Would you like to eat this stuff?" Summoning his considerable powers of diplomacy, McClung calmed the ruffled diner, who later became a strong supporter of IRRI — and no doubt less critical of its cuisine.

The staff dining room was provided with excellent food and service. Occasionally, however, communications could break down there as they do everywhere. For instance, when N. Parthasarathy, then rice specialist in the Regional Office of FAO, Bangkok, was visiting the Philippines, he was invited to IRRI for lunch. I called the cafeteria office in the morning and announced that an Indian guest would be there for lunch and that any menu would be satisfactory as long as it contained no beef. I emphasized my request by repeating, "anything but beef." However, with my Maine accent and a habit of talking rapidly, all that got through to the person who received the call was the word beef. When the group sat down to lunch, neither chicken nor fish was served, but tenderloin steak. Much embarrassed, I assured my guest that he could easily order something else from the kitchen. But Parthasarathy replied, "Don't worry a bit. This is not an Indian cow, and I have no compunction about eating a Philippine cow."

Pascual is still manager of the Food and Dormitory Services at IRRI and has responded with customary flexibility and skill to the increased demands on those facilities brought about by IRRI's greatly expanded size in recent years.

Esguerra left in 1969 and was replaced by Ester Novero Nocon, who had been on Pascual's staff for several years as head food supervisor.

OFFICE OF COMMUNICATION

An Office of Communication for IRRI was not established immediately but, rather, after a period of evolution. In the early stages, Wortman and I knew for certain only that IRRI would need two nonresearch specialists, a photographer and an editor, whom we thought to attach to the Library and Documentation Center. The photographer would maintain a visual record of IRRI's research achievements, its important visitors, etc., and the editor would handle its publications from manuscript form to final printing.

With respect to the former, a young Filipino, Urbito Ongleo, had appeared at Chandler's office in the Trinity Building in Manila in June 1961, showing as an example of his ability a photograph he had taken of IRRI's service building. He had been graduated recently from the College of Agriculture at Los Baños and was then working with his photographer brother in that community. In the course of his duties, he had developed an abiding interest in photography and wished to make it his life work. I told him that IRRI did not yet need a staff photographer, although it had made arrangements for a commercial photographer in Manila, V.G. Miller, to go to Los Baños occasionally to take pictures of the construction work then in progress. Suggesting that Ongleo keep in touch, I said I would be glad to give him consideration later in the year.

From our separate assignments at the Mexican Agricultural Program of the Rockefeller Foundation, Wortman and I knew the photographer Neil Maclelland. We asked the Foundation if it would send Maclelland to IRRI for a brief

period to help plan the darkroom and to specify the equipment and supplies that would be needed. The Foundation agreed and Maclelland arrived in September 1961 and stayed for 3 weeks. After interviewing several applicants for the position of photographer, he concluded that Ongleo was the best qualified in the group. Based on that recommendation, IRRI hired Ongleo and attached him to the Library and Documentation Center.

Ongleo is still at IRRI with the title of photography supervisor in the Office of Information Services.

When IRRI's administrators first considered the position of editor, they thought to hire a Filipino. However, as they got acquainted with possible candidates, they realized that only unusually gifted individuals were skilled enough in English as a second language to be capable editors and that such persons already had careers as prominent writers or university professors. It was decided, therefore, to seek an editorial assistant who could handle some of the work and to search for a fully qualified editor from a country where English was the mother tongue. An advertisement placed in several Manila newspapers describing the opening for an editorial assistant at IRRI brought about 30 letters of application, of which, surprisingly, only one was free of grammatical error. That exception was written by Cora V. Mendoza, who had recently been graduated from Santo Tomas University as an honor student in English (and who was married to a staff member of the Forest Products Research Institute at Los Baños). I interviewed her in September 1961 and hired her for the Library and Documentation Center. Mendoza is still at IRRI as assistant editor in the Office of Information Services.

When I was in New York in October 1962, to present to the Rockefeller Foundation the 1963 operating budget estimate (only $515,000 in those days) and to interview candidates for IRRI staff openings, Moseman again proved helpful. He reported having received an inquiry from a Francis C. Byrnes, who was about to receive his Ph D degree from Michigan State University in the field of communication, as to whether the Foundation might have an opening for him. Moseman felt that his background, experience, and training would qualify him to take charge of IRRI's editorial and publishing program.

Arrangements were made for Byrnes and his wife to come to New York on 15 October for an interview. When I described the duties of the post, Byrnes frankly declared that he had been a qualified and experienced editor before he started his graduate studies at Michigan State and that now he was seeking a position where he could exercise the training he had recently received in the rather newly developed (and increasingly important, as it turned out) science of communication. He indicated that although he was investigating two other opportunities, he would be interested in going to IRRI if the Institute would broaden the responsibilities of the position so that he could play a role in training, and in establishing better communication among scientists, extension technicians, and farmers — and provided IRRI would hire others to take responsibility for the major load of strictly editorial work. I was impressed with Byrnes' arguments for a communication program and agreed to implement it if he accepted the offer to join the Rockefeller Foundation with

assignment to IRRI. Following an exchange of correspondence, this was arranged and Byrnes and his family arrived in the Philippines in March 1963, after he had received his doctorate from Michigan State University.

On Byrnes' arrival, IRRI created the Office of Communication and gave Byrnes the title of communication specialist. Ongleo and Mendoza were then transferred to the new department.

In 1964, Byrnes added Rogelio D. Feliciano to the staff as an assistant editor. He was later promoted to associate editor and finally to editor. He resigned in 1969 to accept another position.

In 1965, it was decided that an experienced science editor whose first language was English was needed. Edward A. Jackson, an Australian, was found and hired. His writing was concise and clear and presented even the most technical information in a highly readable way. Unfortunately, because of family problems he returned to Australia in August 1967.

Jackson's replacement was Merry Lee Corwin San Luis, an American working in the information office of USAID in Manila. She had an engaging personality and was much interested in IRRI, to which she had brought many official visitors. She had majored in English in college and appeared to be as qualified for the position of editor as she was enthusiastic about the job. She was hired in February 1968 as Corwin but by the time she reported for duty in July of that year, she had married Governor Felicisimo San Luis of Laguna Province. Although Mrs. San Luis had considerable ability, editing did not turn out to be her forte and she resigned from IRRI after less than a year.

Some months after Jackson's departure in 1967, Byrnes left IRRI to head the communication and training programs at the newly created CIAT in Colombia. In his 5 years at IRRI, he had built an outstanding information and (with Golden, see page 77) training program that set a pattern for the growing network of agricultural research centers to follow. At CIAT, where he remained until 1975, his contribution likewise was notable. From Colombia, Byrnes went to New York to take up his present position as program officer, communications and training, at IADS.

In 1968, IRRI's Office of Communication was divided into the Office of Information Services and the Department of Rice Production Training and Research. In 1969, with the position of editor vacant, it was learned that Steven A. Breth, then editor of Crops and Soils for the American Society of Agronomy, was seeking another position. I interviewed him in Wisconsin and was exceedingly impressed with his personality, experience, and ability. He and his family joined IRRI in November 1969. Breth turned out to be a superior editor and kept the quality of IRRI's publications gratifyingly high. His wife Nancy, an accomplished pianist, added a dash of culture and vivacity to the IRRI scene.

Breth stayed with the Institute until 1974 when he resigned to accept a position at the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) in Mexico. Since that time, IRRI's Office of Information Services (whose current program is described in Chapter 7) has expanded greatly.

Early training program

It is necessary to backtrack here, for concurrently with the development of the information services, a training program that became a major IRRI activity was started. When Byrnes arrived in 1963, he was not only willing but eager to include the training program within his department. Accordingly, from 1963 until late 1967 when Byrnes left to join the staff of CIAT, the training and information programs were combined in the Office of Communication. In 1968, as previously stated, the work was divided into two departments and a Department of Rice Production Training and Research assumed responsibility for practical training and applied research.

During the first 2 years or so of IRRI's existence, the training program was confined to providing young scientists from rice-producing countries experience in research in association with IRRI's senior scientists. Wortman was largely responsible for the early advances in this program. During 1960-62, he traveled extensively in Asia getting acquainted with scientists and institutions working with rice, while I (who had been over the same territory many times in the previous 5 years) generally stayed in the Philippines to handle the building and staffing activities. Abroad, Wortman talked about IRRI's training opportunities and interviewed prospective candidates for research scholarships at IRRI, which were supported by a grant from the Ford Foundation.

The first research scholars arrived at the Institute in June 1962. By November of that year, there were 27 in residence, most of them for periods of 1-2 years. Each, depending upon his field of specialty, was assigned to a particular senior scientist. Already arrangements had been made for those qualified and desirous of doing so to register for the MS degree at the College of Agriculture. Scholars who enrolled in such a program remained for about 2 years. All course work was done at the College and the thesis problems were directed by senior scientists at IRRI, who also served as chairmen of the research scholars' graduate committees. Those who did not enroll for graduate study usually stayed for a year, and several came for only a few weeks or months simply to learn some specialized technique.

During the first 6 months of operation, the research scholars were from Thailand and the Philippines. By 1963, however, more than 40 scholars had been accepted not only from Thailand and the Philippines but from Indonesia, Vietnam, Cambodia, and Taiwan. Some countries were slow to respond to the training opportunities offered by IRRI.

India, for example, understandably looked askance at this new institute administered and supported by Westerners, questioning whether it had much to offer a country that had been growing rice for many centuries and that supported the only research institute (CRRI) in South Asia devoted exclusively to that grain. Similar reactions were obtained from Pakistan, Sri Lanka, and Nepal. However, as IRRI administrators and scientists traveled in those countries and as the latter's delegates attended conferences and symposia at IRRI, interest quickened and even as early as 1966, the research scholars and fellows from India, Pakistan, Sri Lanka, and Nepal numbered 18. From that

year onward, the demand for training at IRRI was so great that some applicants from most countries had to be placed on a waiting list.

As mentioned, IRRI's training program during 1962 and 1963 was confined to research scholars assigned to senior scientists. It was administered by Wortman, and the day-to-day problems were handled by the scientists to whom the scholars were assigned. The operation of that segment of the program has continued in similar manner to the present day. However, beginning in 1964-65, IRRI's training program was expanded.

The most important factor in that expansion undoubtedly was the arrival of William G. Golden, Jr., in February 1964. He had written to IRRI earlier, stating that he was a rice specialist in the agricultural extension service at the University of California and had a sabbatical leave due in 1964. He was anxious to get acquainted with rice growing in the tropics and asked whether IRRI would be able to accommodate him for a one-year period. Wortman was able to meet him and his wife in California in late 1963 and was favorably impressed with his energy, enthusiasm, and knowledge of rice production in California. In our discussions later, Wortman and I decided that Golden would be useful in putting together — in terms that would be understandable to extension workers and literate farmers in such English-comprehending countries as the Philippines, India, Pakistan, and Sri Lanka — IRRI articles and bulletins on some of the developing techniques. However, after Golden arrived and had a little time to get settled into the department headed by Byrnes, it became clear that his real interest was in training people in the area of rice production techniques and in testing IRRI's findings on farmers' fields. He immediately found a kindred spirit in Byrnes, who was highly interested in improving communication among scientists, extension personnel, farmers, and the general public as well.

After Golden had had time to become familiar with IRRI's research program and to travel throughout the Philippines observing agricultural research and extension work pertaining to rice, he saw the need for better-trained extension people and for the testing of IRRI's findings in farmers' fields.

At that time, the agricultural extension program of the Philippines was conducted by an agency called the Agricultural Productivity Commission, which was directly responsible to the President rather than to the Secretary of Agriculture and Natural Resources. In mid-1964, the agency's Commissioner asked Golden if he could run a one-year training course in rice production for five technicians from the rice-producing districts of the Philippines. After discussion among Golden, Byrnes, Wortman, and me, the decision was for IRRI to undertake the operation even though at the time, it was expected that Golden would return to California in February 1965.

Golden and Byrnes set up a program for IRRI's first rice production training course. The first half was devoted largely to having the trainees grow a crop of rice on IRRI's experimental fields, doing every operation from preparing the land with a carabao to harvesting and threshing the crop. Much of the practical work was done in the morning, with afternoons devoted to classroom studies.

Here, Byrnes taught them communication methods, particularly how to make the extension worker more effective in getting the farmer to move from the traditional to the modern way of growing rice. Other IRRI scientists also gave lectures in their respective disciplines so that the trainees gained a thorough background of the many factors influencing rice yields.

In the second part of the course, Golden arranged for the trainees to conduct applied research experiments in their home provinces and to help train a second group of Agricultural Productivity Commission employees who came to IRRI in 1965 for a 6-month course in rice production.

This early work by Golden and Byrnes in the Office of Communication was the basis for IRRI's Rice Production Training and Research Program (described in some detail in Chapter 4), which became international in scope and is still going on. As it happened, Golden became so absorbed in the program that he decided his services would be more valuable in training people to help the underprivileged farmers of South and Southeast Asia than they would be back in California's rather affluent society. IRRI administrators and staff, impressed with Golden's performance, were equally anxious to have him remain. The only problem was that the University of California's regulations stipulated that a person who did not return after his sabbatical leave had to repay the University for the half-salary he had received during his leave of absence. The matter was easily settled when IRRI sent the University a check in the required amount. Golden was given the title of rice production specialist on IRRI's permanent staff.

In 1969, Golden accepted the Institute's offer to send him to Sri Lanka, following Moomaw, who had left for the University of California and on to IITA. Golden did an outstanding job in setting up a training program in Sri Lanka and in promoting the idea of on-farm trials. In 1974, he joined IRRI's outreach program in Bangladesh, a country then in considerable political turmoil, with agricultural progress not always the main concern of government officials. In 1975, Golden resigned to accept a position with Hawaiian Agronomics, a consulting firm with strong interest in Third World development. In early 1978, he met a tragic end, killed in an airplane accident in Egypt while on a mission to advise the Egyptian Government on the potentials of a rice irrigation scheme involving water from the Aswan dam. Golden was an energetic, hardworking, and dedicated man of thought and action who had a lasting impact on rice production in Asia.

When Golden was assigned to Sri Lanka in 1969, he was replaced at IRRI by Vernon Eugene Ross, who handled the training program until 1976 when he was transferred to the Institute's outreach program in Pakistan. Several years before Ross left, IRRI brought in L. Dale Haws as a second rice production specialist. Haws, upon Ross' departure for Pakistan, took over as leader of the Rice Production Training and Research Program.

BUILDINGS AND GROUNDS

IRRI's multimillion-dollar physical plant obviously would require maintenance. Buildings and grounds had to be kept up, complicated machinery had

to be kept in repair, and an emergency generating plant had to be operated whenever commercial electric power failed. An engineer was sought to serve as superintendent of property and to head the Buildings and Grounds Department.

Loyd Johnson, the only trained engineer on the staff, was asked to conduct the search for a qualified Philippine engineer. He placed ads in Manila papers describing the position and the qualifications sought and stating that the person hired would be paid 50 pesos a month more than his present salary. After screening the many applications received and conducting several interviews, Johnson decided that the top candidate was Hermenegildo G. Navarro, who had a degree in mechanical engineering. Wortman and I interviewed and hired him in 1961. Navarro was a man of unusual talents and much ingenuity and could identify with ease almost any mechanical equipment problem. He continued to head Buildings and Grounds until retirement in 1976.

ADMINISTRATION

At this point, information on the backgroundsand contributions of the original group of administrators I named in Chapter 1 seems appropriate.

I had received my BS and Ph D degrees, respectively, from the University of Maine and the University of Maryland, majoring in horticulture (with a minor in soil science). In 1947, after 12 years as professor of Forest Soils at Cornel1 University I became dean of the College of Agriculture and director of the Agricultural Experiment Station at the University of New Hampshire. Three years later I was elected president of that institution.

During the latter part of my stay at Cornell, I was granted a one-year leave of absence to serve as soil scientist in the Rockefeller Foundation's Mexican, Agricultural Program. In 1954, I rejoined the foundation. After an initial period of travel in Asia, I was given responsibility for the foundation's agricultural interests on that continent. My extensive travel to the rice-growing regions of Asia from 1955 to 1959 acquainted me with scientists and institutions working with rice. When it was decided that the Rockefeller Foundation would provide the first director of IRRI, I was asked whether I would be interested in assuming the post and I accepted with enthusiasm. The opportunity was clearly one of rare challenge and interest.

Wortman was equally enthusiastic about joining IRRI's administrative staff. His interest and optimism, like my own, were sustained at high level by the excellent financial and moral support that IRRI received from the Rockefeller and Ford Foundations. Not once did the two foundations fail to provide the needed funds or encouragement to get IRRI off to a healthy start.

Wortman was graduated from Oklahoma State University (in 3 years and at the top of his class), served in the U.S. Army in the Philippines during World War 11, and in 1950 received his Ph D degree in plant breeding and genetics from the University of Minnesota. He then joined the Mexican Agricultural Program of the Rockefeller Foundation as a geneticist in charge of the maize improvement program. In 1955, he left Mexico to head the Plant Breeding Department of the Pineapple Research Institute in Hawaii. As related earlier,

he joined IRRI as assistant director in February 1960 and 2 years later was promoted to associate director.

To repeat, Wortman made a lasting contribution in helping shape IRRI's research program, in getting the training well under way, and in laying the foundation for the outreach programs that the Institute was to develop later.

Wortman left IRRI in April 1964, to the general dismay of his associates, to accept the position of director of the Pineapple Research Institute (in Hawaii). In 1966 when Moseman left the Rockefeller Foundation, Harrar invited Wortman to become director of agricultural sciences. In 1970, Wortman was promoted to the position of vice president of the foundation. Wortman retained his concerned interest in food and population problems, however, and with Ralph W. Cummings, Jr., wrote a book entitled *To Feed This World,* published by the Johns Hopkins Press in 1978. The work received excellent reviews and is a major addition to the literature on food production and the world's burgeoning population.

After Wortman's departure from IRRI, Harrar and Moseman suggested that A. Colin McClung, the soil scientist in the Rockefeller Foundation's Colombian Agricultural Program, be considered as a candidate to replace him. They indicated their confidence in McClung and said that if he were interested in the opportunity, they would be willing to transfer him to IRRI. I went to Colombia in April 1964, interviewed McClung and his wife, and was much impressed. Mutual interest developed and McClung went to IRRI later the same month. He liked what he saw, and he and his family arrived to stay in August of that year.

With degrees in soil science from the University of West Virginia (BS) and Cornell University (MS and Ph D), McClung had had extensive experience with tropical soils. After serving North Carolina State University as a research professor of agronomy, he joined the IBEC Research Institute in Brazil in 1956 and remained until 1960, when he joined the Rockefeller Foundation's program in Colombia.

McClung's contributions to IRRI's success were substantial. He ran the Saturday seminars and administered the training program through 1967. His capabilities in developing a sizable and effective outreach program were especially outstanding. For example, during the year it took to get the Indian program into operation, McClung traveled in India with a USAID representative working out the details with government authorities in that country. He also cooperated closely with the Ford Foundation in their rice programs in Asia. Moreover, he interviewed and recommended most of the people who ultimately filled the posts in IRRI's outreach programs.

Articulate, warm, and quietly humorous, McClung met people well and impressed them not only with his pleasing personality and unmistakable trustworthiness but with his logical thinking. It is not surprising that he left IRRI in 1971 to accept the position of deputy director-general of CIAT in Colombia and then joined the New York office of the Rockefeller Foundation in 1973. When IADS was formed in 1975-76, McClung was invited to become its executive officer, and in 1979 he was made president of that organization,

which has a worldwide program with an annual budget of more than $5.5 million.

In 1966, IRRI's Board of Trustees approved a third position in top administration, with the title of assistant director. On the recommendation of Ralph Cummings, Sr., I interviewed Dilbagh S. Athwal, a plant breeder from India. He had received his doctorate at the University of Sydney in Australia and later, back in India, had developed an excellent reputation for pioneering work in the development of hybrid pearl millet.

In January 1967 when I was in New York, I interviewed Athwal, who was completing a one-year term as visiting professor at Ohio State University. A month later, he and his family stopped off at IRRI on their return to India. During the visit, Athwal was able to meet almost all the senior scientists. Strong mutual interest developed and the Athwals joined IRRI in 1967.

To free McClung for the outreach program development, Athwal took over the duties of administering the training program, found time to supervise the research studies of several postdoctoral fellows, and shared the general administrative duties of IRRI with McClung and me. In 1971, he was promoted to associate director, and after McClung left, he administered the Institute's international program. Athwal had sound judgment, was an indefatigable worker, and was highly regarded by the IRRI staff. In 1977, he left IRRI to become program officer for Asia at IADS in New York.

In December 1971, after McClung left, Marcos R. Vega, then director of research at the College of Agriculture at Los Baños, was appointed to the position of assistant director at IRRI.

In 1969, Zosimo Q. Pizarro, who had been an administrative associate under Drilon for some years, was promoted to the senior staff with the title of associate executive officer. In 1974, his title was changed to that of senior administrative associate.

Drilon, whose background and career I described in Chapter 1, left IRRI in 1971. Taking over his duties, Salacup served as both treasurer and executive officer. After Brady became IRRI's director general, and the budget grew in size and complexity as the Institute expanded, he asked Salacup to confine his responsibilities to the financial aspects of IRRI's administration. Hugh T. Murphy was subsequently appointed director for administration and assumed the duties of the previous position of executive officer.

WORKING TOGETHER

Although the general guidelines for IRRI's research and training program had been set up before the Institute was established, the details were worked out after the staff arrived. Thus, the various specialists had a role in developing the program in their respective disciplines. This was accomplished not in ivory tower seclusion but in the interested and critical atmosphere of mutual endeavor.

Every 6 months in 1962 and 1963, IRRI had a 5-day session in which the entire senior staff met to discuss the research projects actually in progress, to be certain that everyone was proceeding in the direction planned. From 1964

onward, these internal review meetings were held annually. This session continues today and in the opinion of many is the most important regularly occurring event at IRRI. Here the scientist can report what he has achieved during the past year and what he plans to do next. The meetings are fully attended and there is always lively and frank discussion among the participants.

This chapter tends to suggest that IRRI had a group of impeccable experts working in absolute harmony and without error, but such of course was not the case. In every department (administration being no exception), there was room for improvement — and, fortunately, the means of bringing it about.

The research program required careful watching. At times, the Institute would decide that a project was not paying off and should be abandoned for another that would be more productive. The quality of every project was continually monitored, especially the field experiments. Rat fences had to be maintained properly, birds had to be kept out of the plots, and yield levels had to be high. Because IRRI scientists had all necessary facilities at hand, there could be no excuse for low yields (other than on the control plots in fertilizer, insect, and disease experiments), except when typhoons occurred near harvest time.

An IRRI staff meeting in 1964. From left to right: De Datta, Ramos, MacRae, Ling, Iida, Ou, Tanaka, McClung, Pathak, Salacup, Johnson, Chandler, Beachell, Ponnamperuma, Byrnes, Moomaw, Ruttan, Oñate, Bradfield, Golden, Vergara, Juliano, Manalo.

At IRRI, as everywhere else, scientists and administrators were sometimes in error, but for the most part they were a carefully selected, intelligent, diligent, and dedicated group with genuine enthusiasm for their work. Many were widely renowned and each stood high among his colleagues around the world who were conducting scientific studies of rice.

IRRI staff families, too, were not immune from the parental, filial, and marital problems that afflict the species, but on the whole there was a general feeling of friendliness and cooperation among them, and a considerable amount of conviviality and downright fun prevailed at the many social activities they shared. Considering that the nationalities represented were as many as eight, with all the variation in customs and outlook that would imply, the IRRI home community was an exceedingly neighborly one. Indeed, because of the very diversity of its residents there were cross-cultural benefits not to be found in the average environment.

CHAPTER 3

Establishing administrative policies

The productivity of a scientist working abroad is greatly influenced by the degree of contentment of his family. Both Wortman and I had experienced the benefits of an excellent system of services to staff and their families in the Mexican Agricultural Program of the Rockefeller Foundation. Consequently, every effort was made to provide first-class living conditions for the IRRI senior professional staff. As Harrar had developed the system used in Mexico and Hill had seen the Ford Foundation provide comfortable conditions for its foreign-based staff, there was complete agreement with such policies from the chairman and the vice chairman of the Board of Trustees.

The original administrative policies and attitudes I describe here we developed to provide staff member and their families with needed amenities, to foster a good *esprit de corps,* and thus to maintain a high level of achievement in pursuing the goals of the Institute.

SALARIES AND WAGES

At the time that staff hiring began, a salary scale was set up and a decision reached to offer even the younger senior scientists no less than the lower rates for corresponding job classifications in the schedule followed by the United Nations and other international agencies. The scale for the Philippine research assistants and other indigenous employees was determined by the salaries and wages offered by the College of Agriculture. Attempting to attract and keep high-quality Philippine personnel, IRRI tended to adhere to salary and wage levels near the top of each category. As the College raised its rates, IRRI followed suit.

HOUSING

Because an early survey of the Los Baños area had shown that adequate housing was not available, it was decided to build houses for the staff and, for reasons of economy and convenience, locate them in a compound with common water and electrical facilities. As discussed in Chapter 1, all permanent senior staff were able to live in houses attractively furnished and decorated by the best firms in Manila. Associate-level personnel, certain unmarried staff members, and visiting scientists lived in the so-called row houses consisting of two- and three-bedroom duplex apartments (furnished with the same professional care as the houses). Rent for housing facilities was fixed at 12% of salary to the point of an established maximum. Each family paid for

electricity and telephone use and hired its own servants. To ensure that the landscaped house lots were kept green and healthy, IRRI furnished water free of charge and, also, lawn and garden fertilizer. The free fertilizer provision stopped in 1975.

TRANSPORTATION

Rather than have the families bring their automobiles to the Philippines, with the necessity of clearing each vehicle through customs and licensing and insuring it for the individual owner, and considering also that many of the Asian staff did not own a car, it seemed best that IRRI provide an automobile for each family. The cars, insured by IRRI, were maintained and serviced without charge, with staff members, however, buying their own gasoline and oil. Extra cars were maintained in the pool for official use, and departments with field experiments had pickup trucks assigned to them. The director and associate director each had two cars, one for family and a second for official use. Drivers from the motor pool were available on request for either official or personal trips. In the latter instance, the driver's time was charged to the staff member.

SECURITY

Drilon, as executive officer, stated that without question it would be necessary to have round-the-clock security guards at both the staff housing area and the research center, including roving guards for the experimental fields. While the area was by no means crime ridden, the general prevalence of rural poverty and its accompanying petty thievery would make a place as modern and well-equipped as the IRRI complex an obvious attraction to burglars. Small guardhouses at the entrance to both areas were manned at all times. Wortman and I made the decision at the start that the guards would not carry firearms. This was a bit hard on the pride of the men on duty, in view of the conspicuously armed guards at the adjacent College of Agriculture. Our reasoning, however, was that a man who didn't carry a gun couldn't shoot anyone. If London did not arm its bobbies, we argued, why should IRRI arm its guards? Later the regulations were modified sufficiently to permit one handgun to be kept inside each of the two guardhouses but not carried by the guards.

Despite the roving security guards that were assigned to the research area and to the staff housing compound, occasional thefts (chiefly of such easily marketable items as television sets, transistor radios, cameras, and typewriters) did occur. Moreover, Bradfield had problems with people from nearby villages stealing sweet potatoes from his multiple cropping plots near the back fence of the experimental fields. By the time IRRI was in full operation (1963-64),32 security guards were required to man the three 8-hour shifts. There was a head security guard, but Drilon was responsible for the operation of the security system. Having been an officer in the Philippine armed forces, he put the patrol through weekly drills and had the group participate in athletic games to keep physically fit.

On the subject of security, early on there was criticism (among several Americans as well as others) of the fact that the IRRI housing area was fenced in, when a sentry on duty would seem to suffice. The reason for the enclosure was not to preserve exclusiveness but to ensure a measure of privacy; not primarily to ward off prowlers and other wrongdoers but to prevent (without incivility) access to residential property by the sightseers that flock to Los Baños and Makiling National Park on weekends and holidays. IRRI's housing area adjoins the Park and, without a fence between, would have been just one more attraction to be visited, to serve as picnic ground and ball park, to be examined and photographed from every angle. This situation was especially acute in the early years, when the Institute complex was the object of intense curiosity and before the development of the neighboring campus of the College of Agriculture made impressive buildings and fine housing an accepted part of the Los Baños scene.

EDUCATIONAL PERQUISITES

Because most of the IRRI senior scientists had young children, IRRI felt obligated to see that educational facilities were available. The original plan was, with respect to elementary education, to enlarge the Maquiling School on the College campus, and to have high school children attend either the Brent (boarding) School in Baguio City or, if parents preferred Philippine schooling for their children or wanted them closer to home, the College-operated high school on campus. IRRI spent $80,000 on improving and enlarging the Maquiling School, the construction being done in April-May 1961, by D.M. Consunji, Inc., whose crew was already working on the IRRI cafeteria-dormitory building. In addition, IRRI contributed $5,000 annually toward the operating cost of the school.

Such were the available school facilities until late 1964 when, after McClung had arrived to take Wortman's place, new arrangements began to evolve. The McClungs sent their daughter to Brent School and their son to Maquiling. Because Mrs. McClung was a highly experienced teacher, the couple was more than usually sensitive to school standards. Concerned that the boy's education was not advancing satisfactorily in Los Baños, they finally decided to send him to the American (now International) School in Manila. McClung as associate director had two cars and the family vehicle was used for the Manila round trip 5 days a week. The reports of the American School were so good that other parents soon became interested in sending their children to Manila. Before long, IRRI agreed to provide free transportation to and from school in Manila, and the group gradually increased to the extent that more and larger vehicles were required. The arrangement continues today and includes transportation for children from kindergarten through high school.

In fairness to the Maquiling School, it must be mentioned that there were children of IRRI staff and other international families at Los Baños who found their attendance at that school no detriment to their later educational progress at home. Adapting perhaps to the disadvantages (primarily arising from the

standard of English used), they were able to benefit from the advantages of Philippine culture offered by the campus schools.

IRRI's educational benefits (under the subsidization policy in force in the mid-l960s, as shown in Appendix 10) included reimbursement for half of the educational costs (tuition, fees, and cost of textbooks) for each child of a senior staff family, from kindergarten through secondary school, and the cost of one round-trip passage a year for children who were undergraduates at colleges or universities abroad.

PENSION AND SAVINGS PLANS

The Rockefeller Foundation had a retirement plan with the Teacher's Insurance Annuity Association (TIAA) that applied only to the Americans among IRRI's senior professional staff. Therefore, some similar perquisite had to be established for the non-Americans, who could not be covered by that plan. The original arrangement, discussed with Harrar and Hill in New York in November 1961, was for the Institute to carry its own pension plan. The scheme worked out and followed for some years was that IRRI deducted 5% from the monthly salary of each non-American senior staff member and made an equal contribution itself. It then deposited the combined amount in a savings account at the First National City Bank in New York. When the staff member left the Institute at retirement age or earlier, he would receive the full amount of the contributions, plus the accumulated interest. None of the funds in the savings account could be withdrawn before the staff member left IRRI nor could the account be used as collateral for a personal loan.

In 1969, this earlier plan was discontinued for a new one. It was found that if IRRI worked out an agreement with the International Institute of Education (IIE) in New York for the latter to pay the salaries of the senior staff, that organization could provide both group insurance and a pension plan. Thus, the TIAA system was used for all U.S. citizens, while the non-U.S. citizens were provided with a pension plan with the American International Reinsurance Company in the Bahamas (the carrier for IIE). The benefits of the plans were similar. If an IRRI scientist worked for 20 years, he or she on retirement, at age 65, would receive an annual pension of about half the average salary for the last 3 years of employment.

In 1965, IRRI initiated a retirement plan for all permanent employees who were not senior scientists. It was an optional savings plan whereby IRRI contributed 2.5% of the employee's monthly salary and an equal amount was deducted (obligatorily) from his or her pay.

In 1970, the plan was liberalized in its present form, IRRI contributing 7.5% of the salary of all non-senior staff employees on the regular payroll. This is a direct bonus and does not require a contribution from the employee. However, an employee may request the treasurer to deduct any specified additional amount from his salary as a further contribution to the retirement/savings plan. As with the first scheme adopted for senior staff, when the employee either retires or leaves the Institute for another reason he or she will be paid, in lump sum, the total amount contributed plus interest.

TRAVEL SERVICES

To free IRRI scientists from routine concerns so that they could give full attention to their research, travel arrangements (always time-consuming) obviously had to be handled for them. Thus, a reputable travel agency was needed to work out routing, make reservations, purchase tickets, obtain visas, and ease the travelers through exit and entry inspections at the Manila airport. Several travel firms were tried at the beginning but IRRI soon settled on Jet Travel, Inc. for its dependable, personalized, and obliging service. With radiophone communication with the personnel in IRRI's Manila office, it was no inconvenience for IRRI to use a Manila concern for its travel requirements. Today the Institute makes use of two travel agencies (one of which is still Jet Travel), each with permanent representatives stationed at IRRI in Los Baños.

HOME AND STUDY LEAVES

At the time that IRRI was established, the Rockefeller Foundation had a home leave policy that entitled everyone stationed abroad to 2 months of leave every 2 years, with 2 weeks of local leave during the off year. First-class travel was allowed for the staff member and family because the long hours of air travel in those pre-jet days made the extra leg room and seating comfort prime considerations.

IRRI at first followed the same policy, until it became clear that 2 months was too long a period for a scientist to be away from his work, and often too long for him to maintain the expense of feeding and lodging the family during its stay abroad. Consequently, it was decided that all senior professional staff from a country other than the Philippines would have one month of home leave annually and that travel for the staff member and his family would be economy class. At about the same time, the Rockefeller Foundation changed its policy to allow annual one-month home leave. The senior Philippine staff were allowed 30 days of vacation annually.

Before any of the senior professional staff had been at IRRI long enough (6 years) to qualify for it, IRRI established a policy of study leave. The only requirement was that the individuals select a place of study where they could improve themselves professionally. Full salary during the study leave and travel expenses for staff members and family were provided from the Philippines to the study destination and return. Living costs while away from his post were the staff member's own responsibility.

Almost 100% of the IRRI senior staff have taken advantage of the study leave perquisite. It has provided an opportunity for them to take refresher courses, to work elsewhere with specialists in their fields, and to write books. Drilon used his first study leave to get an extra degree right in the Philippines. That degree prepared him for a career outside of IRRI, including appointment to important positions in the Philippine Government.

TAKING CARE OF VISITORS

Even before IRRI's buildings were completed, a steadily increasing flow of visitors began. They could be divided into several categories:

1. visitors of state, such as monarchs, presidents, prime ministers, cabinet members, and others;
2. high officials in foreign assistance organizations such as the United Nations agencies, the World Bank, the Asian Development Bank, and foreign aid organizations in many of the developed countries;
3. heads of other agricultural research institutions and their scientists; and
4. tour groups (IRRI had become a regional attraction) and schoolchildren.

The IRRI administrators did their best to take care of these visitors with minimum disturbance to the scientists. The director and associate director took responsibility for showing the Institute to those in categories 1 and 2, and a Filipino was hired for the Office of Communication to handle the general tour groups and schoolchildren. Category 3 people were usually interested in visiting with the scientists individually to learn about their research first hand. If so, a schedule was set up and they made the rounds of laboratories and offices for a day or two.

Almost every week, there were interesting and often distinguished people from abroad staying at IRRI for several days, usually at the guesthouse. Whenever possible, a dinner for such visitors was held at the director's or associate director's residence, with staff couples present to add to the congeniality of the occasion and to give them a chance to meet with the honorees socially. Staff members knew that they were not at all obliged to entertain visitors but were certainly free to do so when they chose. This they did frequently, particularly when the visitors were of their own nationality.

The entertaining of important people was not without humorous incidents. In 1962, for instance, one of the distinguished visitors was the President of Mexico, Adolfo Lopez Mateos, who, with a considerable entourage, spent a few hours at IRRI. During lunch I was seated beside one of the cabinet members in the President's party. Because I had some facility in Spanish, we started our conversation in that language. Wondering, however, whether his English might not be better than my Spanish, I asked, "Do you speak English?'' "A leetle," he responded. Then, just to make conversation, I asked, "When did you leave Mexico?" "I leeve there all my life," was the reply. From this I concluded that my Spanish comprehension was better than his English and we continued our exchange in his native tongue.

When the Board of Trustees convened, special efforts were made to take care of them properly. Each trustee was met at the airport by a principal officer of IRRI, usually the director or associate director. A dinner was given at the director's house (on occasion at the associate director's as well), and a larger banquet-type affair to which all senior staff and their wives were invited was held at the Institute dining room. After-dinner speeches, kept short and affable, always included remarks by the Board Chairman and frequently by another trustee as well. On one occasion, I caused an outburst of mirth when I unintentionally introduced General Romulo as "President of the University of New Hampshire" (rather than of the University of the Philippines)! My wife privately felt that this slip was less mortifying than hers had been when, in making one acquaintance known to another at an important Manila function,

One of IRRI's first distinguished visitors was the President of Mexico, Adolfo Lopez Mateos, who came to Los Baños on 21 October 1962. He (in dark suit) listens to an explanation of IRRI's soil chemistry studies by Wortman (hidden by Ponnamperuma). To the right are Chandler and Moomaw. In the center is Salvador P. Lopez, Secretary of Foreign Affairs, who later became President of the University of the Philippines and an IRRI Board member.

An early visitor to IRRI (mid-1961) was Father Hesburg, President of Notre Dame University. From left to right Wortman, Chandler, Father Hesburg. and Paulino Garcia (an IRRI Trustee].

she inadvertently introduced the brother of a past President and historic hero of the Philippines as "Dr. Macapagal," instead of "Dr. Magsaysay," a name as unmistakable to Filipinos as their own.

The trustee banquets always ended with a special cultural program at the auditorium with local musical and dancing talent featured.

On the day the Board met, the professional staff were invited to join the trustees at lunch so that all might become better acquainted. Such associations among administrators, trustees, and staff helped promote a feeling of Institute solidarity and of working for a common purpose.

On 26 October 1966, U.S. President L.B. Johnson was brought to IRRI by President Marcos of the Philippines. Here they are being shown a stand of IR8, IRRI's first named variety. Left to right: Jennings, Beachell, Chandler, President Marcos, and President Johnson.

MAINTAINING ESPRIT DE CORPS AND HIGH PRODUCTIVITY — KEEPING ON TARGET

Administrators naturally differ from one another and may accomplish the same objectives in different ways. What is stressed by one may seem less important to another and yet the general goal is often the same and may have about the same chance of attainment. What follows is my attempt to assess and describe what my associates and I in administration did to make the Institute an exciting and rewarding place to work. Clearly, mistakes were made and the going was not smooth every step of the way. Nevertheless, it is fair to state that IRRI staff morale was high and that the program was a true success.

In my view, a good administrator was one who inspired the personnel to perform at their best, who continually pointed out, sometimes subtly and sometimes emphatically, that the success of the program depended on the

Princess (now Queen) Beatrix of the Netherlands visited IRRI on 23 November 1962. Her visit lasted only 30 minutes, so Chandler and Wortman gave her a quick tour of the Institute.

Mr. John D. Rockefeller, 3rd, visits IRRI on 29 August 1967 and is received by Director and Mrs. Chandler.

contribution of each individual in the organization. This philosophy I aired in my talks before and conversations with employees of all ranks. My point was that those who judged IRRI would base their opinions on whatever contact they happened to have with it. If they received a letter with grammatical or typographical errors or if they observed that the grounds were not neatly maintained or that the drivers were careless and over-relaxed, they might assume that the Institute's research program was slackly run as well. I stressed the importance of doing a quality job in every department and operation and urged all to take pride in helping IRRI establish a first-class reputation.

McClung (left) and Beachell (right) show rice field experiments to two officials from Pakistan.

United Nations Secretary General U Thant visited IRRI in April 1970, accompanied by Secretary of Foreign Affairs Carlos P. Romulo (left). Romulo was an IRRI Trustee 1963-1968.

I frequently reminded the scientists that they were the backbone of the Institute, their work its very purpose, and that administration existed because of them and not the other way around. The administration was there to facilitate their efforts while imposing as few restrictions as possible. I believed that management as an end in itself was nonproductive and that the function of administration was coordination more than control.

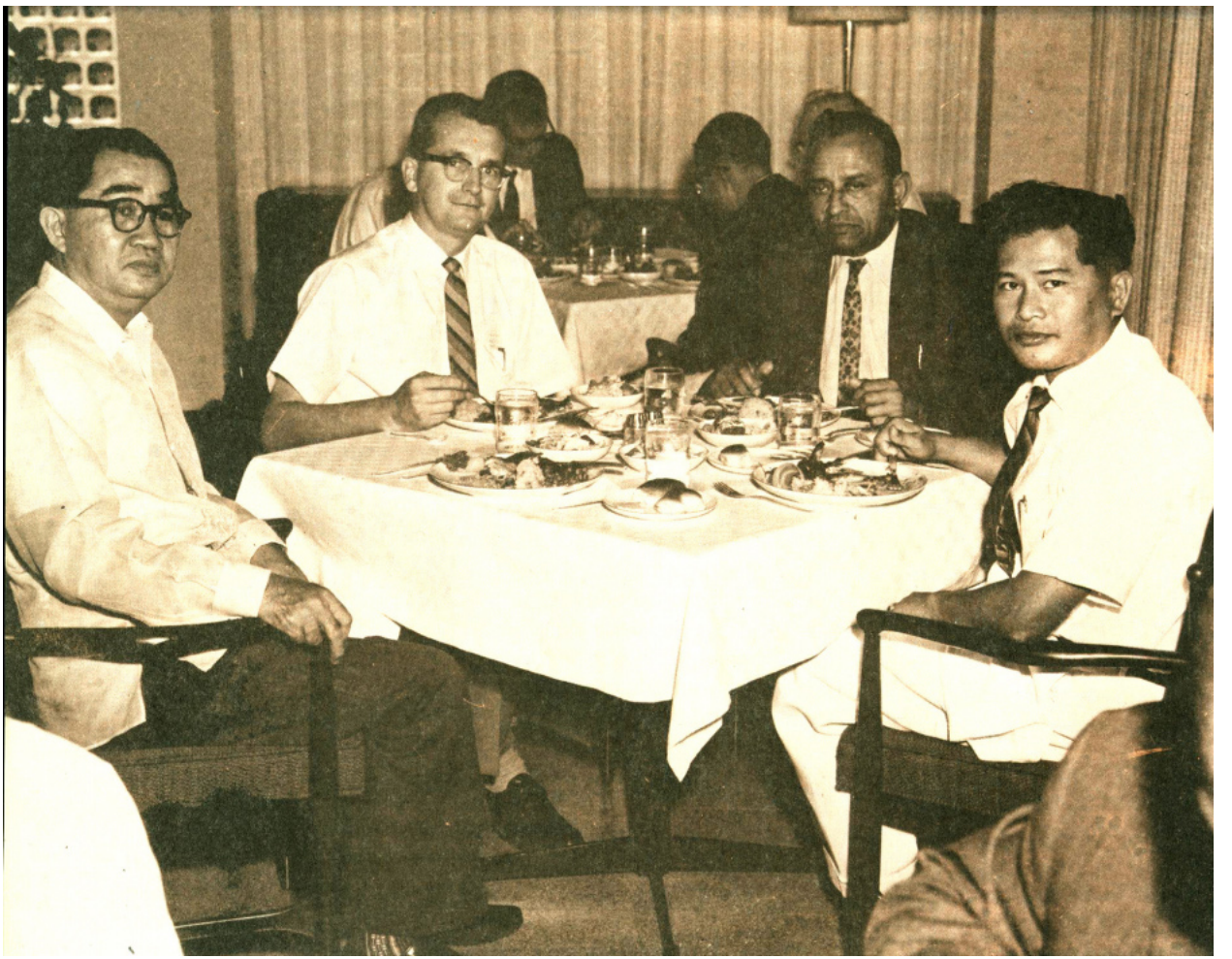
Obviously, any organization needs a chief administrator who can make, quickly and well, decisions affecting overall policy. My associates and I, however, attempted not to make decisions that belonged to others, instead allowing department heads, individual scientists, and others to make those choices that were logically theirs. I believed that the administrator who felt he should enter into day-to-day operational decisions was making a serious mistake, by keeping the staff from developing the full zeal for their programs that they otherwise would have. My feeling was that everyone had to believe that his job was important and to know that he was free to make a considerable range of decisions without continually referring to higher authority. C. Northcote Parkinson (of *Parkinson's Law* fame) once wrote something to the effect that if a staff member is not permitted to make important decisions, soon he will believe that the minor decisions allowed him are important (and, one supposes, will require additional time to be proved important).

Although the annual budget for each department had to be approved by the chief administrators, it was thoroughly discussed with department heads, each of whom was given a statement of the funds available for the department. As long as a department kept within the total, it was free to spend the money as it deemed best.

My colleagues and I tried to maintain an atmosphere of trust in the administration and to reduce the gap between the head office and the rest of the staff. Contributing to this atmosphere were such practices as keeping the director's door open at almost all times (wisely or unwisely, considering the tendency of an administrator's desk work to multiply at the slightest sign of neglect!), thus denoting a willingness to talk to any employee about anything at any time; going to office or laboratory to see the scientist rather than having him or her come to Administration; and agreeing to go to the field whenever a staff member had something interesting to show or explain.

Such practices, I felt, constituted not interruptions of the administrator's work but an essential part of it. (On the other hand, such practices were easier to follow at a time when the Institute was relatively small. To adhere to them in an organization of IRRI's present size and complexity is less feasible.)

In furthering trust in the administration, the staff were kept informed of any developments in the way of finances, policy matters, and the arrival of distinguished visitors. Although staff meetings were not held on a regular basis, they were called whenever it seemed that there were enough important matters for discussion to warrant the interruption of regular work. Except for such items as individual salaries or personal matters, about which staff members had consulted the Director, there were no secrets between administration and the rest of the staff.



IRRI made an effort to have the Trustees and several staff get acquainted. Here, clockwise from the left, Gozon, Moomaw, Damle, and Drilon sit together at a luncheon on 5 February 1962.

Together, such policies as just described contributed to a strong *esprit de corps,* which in turn was of prime importance in keeping IRRI's productivity high.

The need for good morale was not confined to the research center, of course, but extended as well to IRRI families, for the home atmosphere naturally affected the work accomplished at the Institute.

Considerable emphasis was placed on group entertainments of one kind or another. In a Philippine environment getting up a party of any size on whatever short notice presented no problem. Every hand, it seemed, was talented at transforming workaday areas into tropical bowers. Music makers, dancers, singers, and innovative party planners emerged from among IRRI personnel whenever the need arose. For large dances at the service building, popular groups of musicians were hired from Manila. Food appeared in wide variety, often with *lechon* (roast pig), the star of the menu.

In the early years, IRRI used its own talent for entertainment. Here Ruby Castro and Ben Vergara dance at a May 1963 party in the Service Building.

IRRI held a despedida for the Wortmans on their departure from IRRI in April 1964. Here Wortman is shown congratulating IRRI's chef, Primo Ruzon. The Chandlers accompany the Wortmans through the buffet table line.

At such times — whether *bienvenidus* (welcomings), *despedidas* (farewells), holiday parties, or department "bashes" — the many couples attending represented a cross-section of IRRI. Such activities are by no means confined to the past, the difference today being that because of the expansion of the Institute the number of participants is much greater.

On a less general scale, Thanksgiving, Christmas, New Year, and (embracing the various nationalities and persuasions) United Nations Day Celebrations were planned by the staff wives and held at the housing area.

Concerts and other cultural presentations were given in the auditorium at special times such as when symposium participants or IRRI's outreach family

were present. The professional talent included Vijji Lakshima De Datta, who had been a classical Indian dancer and film star, and the earlier mentioned Nancy Breth, pianist. Mercy Drilon presented her well-trained young dancers, from College and Institute families, who performed a versatile repertoire of ballet, hula, and Tahitian dances. Younger generation talent also included the Ous' son, Shukong, at the piano.

Art shows, arranged for the most part by Lina Vergara and featuring already famous or up-and-coming artists of the Philippines, were held in the lounge of the cafeteria-dormitory building. Films were shown weekly at the auditorium, with tickets issued to College as well as IRRI personnel — and with both groups booing cheerfully when projection or sound proved imperfect.

Lest the impression be given that entertaining and being entertained were the main interests of the wives of IRRI staff members, it must be emphasized that in addition to their family responsibilities, many were involved in local charitable or educational causes. Some pursued postgraduate studies at the University of the Philippines. Others taught — Margo McClung, for example, 5 days a week at the International School in Manila, Avelina Salacup and Justina Vega at the College of Agriculture, and Lydia Santos at the University Rural High School. Jinny Barker coached a group of swimmers at the College and after obtaining (despite her seeming lack of brawn) her brown belt in judo (in Japan) gave on-campus lessons in that manly art. Mercy Drilon raised pedigreed dogs and orchids and, a dancer herself, gave inspiring instruction (as noted) to others. Almost always there were self-improvement activities, organized by the wives themselves, such as studying Tagalog or another language, giving and receiving cooking instruction in the various national cuisines, taking lessons in painting and flower arranging, and improving one's swimming and tennis. Although the availability of maids freed the wives from routine housework, they did their individual and collective best to use their time constructively and thereby forestall the classic ennui of compound dwellers.

PROGRESS TOWARD THE COMMON GOAL

IRRI scientists, as pointed out in the next chapter, were not required to submit project outlines before starting a new study, and reports of research findings had to be submitted only once a year. To many research administrators, this would seem to be a rather loose way of running a scientific program. The purpose of such policies at IRRI, however, was to relieve the scientist of as much routine work as possible so that he would devote more of his energy to developing new information and less of it to time-consuming paper work. Again, IRRI was small enough during the first decade so that maintaining close communication between the administrators and the scientists was relatively easy.

When asked how IRRI administration kept the research program on target yet allowed the staff enough freedom so that they would not feel that their powers of initiative and creativity were being stifled, I have no better answer

today than when, addressing the same question at IRRI's 10th Anniversary celebration on 21 April 1972, I stated:

"We consider that a challenging and stimulating atmosphere is maintained at the Institute through a continual dialogue among scientists and administrators alike emphasizing the exciting potential that exists for increasing the yield and quality of rice in the tropics. Discussions at the two weekly seminars, in the laboratories, in the corridors, and in experimental fields center on this theme. Furthermore, at an early stage the results of the research program demonstrated that although major advances were possible, the problems engendered by a complex biological system are ever changing and their solutions challenge all the ingenuity that the scientist can muster."

The director and the associate director attended all seminars, symposia, and conferences, except of course when they were traveling, and thereby kept in close touch with IRRI's program. They not only attended the Thursday and Saturday seminars but chaired them and entered into the lively discussions that usually took place. The practice is continued today by the current administrators — as indeed are many of the other activities discussed in this section.

As is expected in any organization, differences among staff members arose from time to time. The director felt it was his duty to attempt to settle such misunderstandings, usually in private conversations with the individuals concerned and generally with beneficial results. I was perhaps overly frank in my criticisms of the staff when I felt that improvements could be made (tact not being a strong point in my native state of Maine), but I was always honest and sincere. Moreover, once the difficulty was settled, the matter was dropped and not mentioned again.

Although staff morale was generally high, IRRI was not free from personnel problems. The junior scientists, for instance, mostly Filipinos, had their complaints. They questioned their opportunities for advancement in an organization in which foreign Ph Ds held most of the major posts. They formed a Junior Researcher's Association, which provided an opportunity to discuss their problems among themselves and to bring issues to the director.

I met with the group onseveral occasions, as did McClung and others. It was explained that IRRI's system of having only one to three senior scientists to a department—and those of international background — seriously limited the opportunities for research assistants to become senior scientists even if they completed their studies for the Ph D degree. The situation was unlike that in a university, where there were many individuals of professorial rank in a department. We pointed out to the research assistants that their salaries were better, on the average, than those at the College of Agriculture, that they had unparalleled opportunities to conduct research with rice in association with prominent scientists, and that they could gain recognition by publishing papers in Philippine scientific journals. Furthermore, their IRRI experience qualified them for more important positions in other organizations and they were always free to accept an offer if they so chose. Actually (as stated earlier), many of the former research assistants have gone on to better positions in both

governmental and private organizations where they have attained higher levels of rank and salary than would have been possible had they remained at IRRI. Today, I feel that in general, the research assistants at the Institute are happy in their work and are gratified to be a key part of an international center that has developed a worldwide reputation for its achievements.

Although IRRI's senior staff had generally high morale and were enthusiastic about their work, there naturally were certain dissatisfactions. A coterie of senior scientists usually met for a midmorning coffee break, which gave them a chance to air their views (some of which no doubt would have tipped askew any halos the administrators might have been foolish enough to fashion for themselves on the basis of fair judgment and sound policies!). I stayed away from these gatherings, partly because I wasn't much of a coffee drinker and also because I felt the discussions should not be inhibited by the presence of the director.

While on the subject of complaints, one incident is amusing enough to be recalled. On an evening in 1966, Jennings, Tanaka, and Jackson (all fortified by a few drinks) had a talk session at Tanaka's house that went on until midnight. Jennings, one of IRRI's finest scientists, and Tanaka, who was doing an exceptional job as plant physiologist, mutually admired each other's ability and philosophy. Jackson, an excellent editor and science writer, was not really content at IRRI and tended to side with those who were feeling somewhat negative at the time. As the three men became more worked up in their discussions, they decided, shortly after midnight, to awaken the director, let him know what was bothering them, and see what could be done about it.

At their far-from-silent approach, I got out of bed and climbed into my trousers to go down to see what was the matter. Before I could finish dressing, however, Mrs. Tanaka arrived on the scene and marched her husband home — his two confederates trailing behind. Somewhat later, at a cocktail reception at the director's house, I learned from Tanaka the principal cause for the aborted visit. It seemed that Tanaka felt discriminated against because the Americans were hired by the Rockefeller Foundation with different perquisites from those of IRRI-hired non-Americans. I explained that it was Rockefeller Foundation policy not to hire non-Americans on a permanent basis and nothing could be done about that, but that IRRI gradually would move to a policy of direct hire for its entire staff, Americans as well as non-Americans, with the same benefits for all. Tanaka seemed satisfied with the statement and did not bring up the subject with me again — except when he had a martini or two under his belt. Jennings, Tanaka, and Jackson, it must be added, were by no means habitual or heavy drinkers. Like most of the rest of us, they simply tended to be less inhibited after they had had a couple of drinks. In fact, I rather welcomed such spontaneous revelations from the staff as a means of discovering what was bothering them, so that if possible, the situation could be improved.

The event that marked the only real trouble that IRRI had with its employees during the tenure of its first director was a one-day strike that occurred on 5 March 1970. It involved the Filipino employees, from research assistant level

on down to the laborers. The strike was brought on by the devaluation of the Philippine peso from its previous exchange rate of 3.9 pesos/U.S. dollar to a new rate of 5.65 pesos/U.S. dollar. The employees realized that IRRI received most of its funds in dollars and therefore would have considerably more pesos to spend when converting its funds from U.S. to Philippine currency. As a result, the junior researchers asked that they be paid directly in dollars, at the old rate of P3.9/U.S. dollar. The other employees asked to be given raises in proportion to the gain IRRI would make in converting dollars at the new rate.

On the evening of 4 March, Drilon, Pizarro, and Ramos (executive officer, associate executive officer, and associate agronomist-farm superintendent) met with the leaders of the IRRI employees to try to avert the strike, but they were unsuccessful. I was alerted early on 5 March and arrangements were made for Drilon and me to address all employees in the auditorium later that morning. Opportunity was provided for free discussion. I pointed out that the employees were asking for a change in policy that could not be made without approval of the Board of Trustees. I stated further that IRRI spent a considerable amount of its funds directly in dollars, which remained unaffected by the changed value of the peso. However, I told the employees, I would be in New York later in the month, would discuss the problem with Hill, then Chairman of the Board, and would recommend an across-the-board increase in pay for all employees, retroactive to 1 March of the current year. At the same meeting, Drilon and I patiently emphasized the advantages of working for IRRI. I told the gathering that never before joining IRRI had I been part of an organization in which essentially all employees automatically received annual increases in pay. I stressed the achievements of the Institute and the personal pride they all had a right to feel as participants at every level in those advances.

The employees did not work that day but were back on the job the next morning, and IRRI resumed normal operations.

The outcome, after my visit to New York, was that modest increases in salaries and wages were made (effective 1 March). However, the policy of the Institute to pay only its senior scientists in dollars and local employees at prevailing local wage scales, with something extra for quality, remained in effect.

I was disheartened by this concerted move on the part of IRRI personnel, which at the time seemed to me almost a breach of faith. I felt I had worked hard and conscientiously to provide not only good salaries and wages for the Philippine employees but the best of working conditions as well.

It was only later that I realized that one factor (although not the major one, undoubtedly) contributing to the decision to hold a strike at IRRI may well have been a carryover of the "rebellious 1960s" impulse in young adults (such as the junior researchers) to react against authority and to seek self-expression by voicing their grievances and trying to force their settlement. Earlier, the College had experienced — although in minor form compared to that by institutions abroad — a period of student confrontations and clamorous uprisings. At one point, groups of malcontents tried with some success to seal off the campus and generally disrupt college operations. When such actions

affected access to IRRI property, as happened briefly, the Institute's immediate response was to avoid inconvenient delays and the risk of research interference by using little-known back approaches to the center and the housing area, an expedient quickly followed by calmly confronting the blockading students. By being alternately conciliatory, persuasive, and firm, IRRI's administrators and staff apparently convinced the young agitators that the Institute was not the "establishment tool" they thought it to be but a uniquely specialized scientific center working without monetary profit to make their nation self-sufficient in rice and to improve the lot of the Philippine farmer. At any rate, they cheerfully left the scene, taking their slogans with them.

The described incidents of staff dissatisfaction and employee activism were far from the norm and are mentioned to present a better balanced picture of IRRI's operation. No organization is free from personnel problems and IRRI had its share, although to a minor degree. Still, 95% of the time, the Institute functioned without disturbances of any kind and the employees on the whole seemed contented to have steady and interesting work, within an organization of high status. Furthermore, in general, their own economic circumstances improved measurably. On the occasion of the meetings of the Board, for instance, the trustees and director noted with satisfaction the growing number of employee vehicles in the parking areas. When IRRI began its operations, almost none of its Philippine employees, except for senior scientists, had either motorcycles or automobiles, but every year saw more and more motorized vehicles parked on the premises — a sign that IRRI personnel had accumulated enough pay to acquire them. The Institute, it seemed, was somewhat improving the lot of Filipinos other than rice farmers!

Chapter 4

Early Research and training result

IRRI had named its first two varieties, the seed of IR8 had been widely distributed, and the structure of the research program had been well established by the end of 1967. That provides a cutoff date for discussion of the early results of the Institute's program. This chapter covers the important advances made during 1962-67.

Although teamwork had been encouraged at IRRI from the start, during the early years the Institute was organized solely on a departmental basis. Therefore, except for the section on international activities, the achievements are reported by departments as they existed in 1967.

VARIETAL IMPROVEMENT

In 1962, Jennings, Beachell, Chang, and the IRRI administrators agreed that the Institute's rice breeding program should be directed toward developing varieties that were short, stiff-strawed, and fertilizer responsive, that were photoperiod insensitive and thus could be early maturing, and that were resistant to, or at least tolerant of, attack by major insects and diseases. Other refinements were added later as more became known about the needs of farmers and the preferences of consumers, and as the plant physiologists and agronomists expanded their knowledge about the relationships between plant morphology and yield potential.

The work in varietal improvement can be divided into the world germplasm collection, various basic studies, the breeding program, and the distribution of seed from IRRI's successful crosses.

The world germplasm collection

Obviously, it was necessary to have a large and diverse germplasm collection in order to conduct a successful rice breeding program. Jennings started the collection as soon as he arrived in October 1961. He wrote 160 letters requesting seed and received samples from about half of those contacts. A large portion of the early accessions came from the sizable collections of the US. Department of Agriculture, the FAO indica-japonica sets, the substantial collection at Hiratsuka, Japan, and the materials available from Taiwan. By the end of 1962, IRRI's accessions numbered 6,967 which came from 73 countries or territories.

From the outset, each of the accessions that IRRI obtained was grown in the wet and dry seasons and about 50 different characters, most of them morphological, were recorded. Samples (500g each) were placed in storage at low temperature and humidity. Because IRRI could process only about 2,000 acces-

sions at a time, there was a backlog in the first few years. Later, however, the number of annual additions decreased and the scientists were able to keep up with the incoming accessions.

By 1963, the world collection had increased to 9,430 varieties and 1,194 mutants, testers, and other species of the genus *Oryza*. From then on, it grew more slowly, numbering 9,779 in 1964, 9,913 in 1965, and 10,323 in 1966. Compared with IRRI's current collection of nearly 55,000 varieties and genetic lines, the collection in 1966 seems rather small. Nevertheless, even at that time, the Institute had by far the worlds largest single rice collection.

Besides providing the basis for IRRI's rice breeding program, the rices collected were available, on request, to rice breeders everywhere. Requests began coming in as early as late 1962, and IRRI sent out 400 seed lots to 14 countries that year. In 1963, the number of samples shipped — to 26 institutions in 17 countries — jumped to 2,296. In 1965, IRRI sent 1,608 varieties to 56 institutions in 26 countries, and in 1966 the figure was 1,052 varieties to 41 countries. By then (as reported later in the section on the rice breeding program) the Institute was able to distribute varieties it had tested thoroughly as well as progeny from its own crosses that showed great promise. Jennings took charge of the world collection the first several years, and after he left for Colombia in 1967, Chang assumed full responsibility for the project.

Basic research projects

Both Jennings and Chang devoted considerable effort to basic studies of rice. None of this was pure research or research for its own sake but rather a search for the answers to questions that arose as they attempted to breed superior varieties of rice. The studies were so numerous that only a few of the more important can be reported here.

An early project of Chang's was to study the genetics of the inheritance of plant height. Crossing the tall Peta variety with the short-statured variety Dee-geo-woo-gen, he found that in the F_2 generation, three-fourths of the plants were tall and one-fourth were short, thus fitting the Mendelian ratio of 3:1. His studies proved that tallness was dominant over shortness and that short stature was controlled by a single recessive gene. If the inheritance of short stature had been complex, IRRI never could have made such fast progress in its rice breeding program. It is interesting that although Taichung Native 1 was developed in Taiwan in the mid-l950s, the simple inheritance of its shortness was not known until Chang discovered it at IRRI in 1963-64.

One of the first studies made by Jennings sought a quick and efficient procedure for crossing rice varieties. The technique he devised in 1962-63 was to emasculate the florets by cutting the glumes with scissors just below the anthers. This was done in the afternoon before the morning when the plants would be pollinated. Any anthers left after clipping were picked out with forceps. The next morning, panicles of the male parent were shaken over the clipped anthers, and the panicles of the female parent were bagged. This method of making crosses is still used by IRRI plant breeders.

One of the characteristics the breeders were trying to introduce into improved varieties was that of seed dormancy so that the grains would not sprout in the panicle when a prolonged rainy spell came at harvest time. On the other hand, when the breeders wanted to get three generations a year, they needed to break dormancy soon after harvesting so that the seed from one generation could be planted immediately. Jennings worked on the problem and soon found that if dormant seed was placed in an oven at a temperature of 50 °C for 4-5 days, dormancy would be broken in most varieties (a few of the more obstinate ones required as much as 10 days).

Jennings conducted a series of studies on the technique of bulk breeding methods when (as in most of IRRI's early crosses) tall and short plants were crossed. He believed that the bulk method was advantageous for reasons of economy, easy management, low labor costs, and ease of record keeping. However, he felt that superior selections could not be made when tall plants were left to compete with short ones, because the latter would suffer from shading. He demonstrated this in field studies and showed that the bulk method was highly satisfactory if the tall plants were removed as soon as they began to flower. This left the short plants to compete among themselves and superior individuals were selected.

Jennings attributed much of the slow progress in bulk breeding in Asia to the fact that plant breeders did not realize that the varieties with the highest yield potential were the short ones, these being the varieties that either were eliminated or appeared weak and unproductive because of the competition for light that the tall varieties gave. Much of IRRI's breeding work utilized this modified bulk breeding method in the early generations; later generations were then grown in pedigree rows for final selection or rejection.

In 1963-64, Chang devoted considerable effort to studying the inheritance of quantitative characters when tall indicas were crossed with short. He used as his principal cross Peta (180 cm tall) and I-geo-tse (100 cm). He concluded that there were no genetic barriers to selecting from the F_2 generation onward progeny that combined the desirable morphological traits of short stature, short and erect leaves, early maturity, and adequate number of panicles.

Chang also investigated the degree of sterility in japonica-indica crosses, as well as the cytological evidence for such sterility. He studied the inheritance of photoperiodism and of resistance to the rice blast disease and the impact of nitrogen levels and spacing on yield components such as panicle number, number of grains per panicle, and grain weight. All this information helped build a sound scientific basis for the breeding program.

Another development to assist the effort occurred in mid-1964, when Beachell set up a rice grain quality laboratory in the service building so that hundreds of samples from the breeding program could be processed quickly. By the end of 1964, 7,000 samples had passed through the laboratory. The data collected included milling percentage and grain size, shape, translucency, and chalkiness. Cooking quality was based on an alkali digestion test that measured gelatinization temperature and an iodine blue test that reflected the

relative amylose content of the starch. Beachell's experience in Texas especially qualified him to establish and administer this laboratory, the data from which enabled the breeders to discard breeding lines not meeting minimum quality standards.

Another important activity that occupied both Jennings and Chang during the first 3 years of IRRI's operation was basic studies of the causes of lodging and its impact on yield. They investigated the effect of season, of spacing, and of nitrogen levels and concluded that although there was less lodging in the dry season than in the wet, in wide rather than narrow spacing, and at low nitrogen levels rather than high, the only real protection against lodging and the consequent yield losses was to breed rice varieties with thick, sturdy, short stems. By supporting tall varieties such as Peta and MTU-15 with bamboo sticks, Jennings found that tall varieties yielded essentially as well as did lodging-resistant varieties. Moreover, the lodging-susceptible varieties when supported responded well to nitrogen applications, whereas the unsupported plants showed a decided negative response to the addition of nitrogenous fertilizer. This proved beyond doubt that lodging *per se* was the primary cause of low yields when traditional tropical varieties were subjected to modern management methods.

Rice breeding

Germplasm collection and distribution and the fundamental studies provided for the breeding procedures a background that was significant and, in many instances, critical to the success of the breeding program. But the real impact of IRRI on world rice production was a result of the distribution and testing of the genetic lines and varieties developed in its breeding program. Again, for the sake of brevity, only the highlights of that program are sketched here. Because IRRI's first variety, IR8, set new yield records for tropical rice, the process of its breeding and selection is covered in detail.

In late 1962, Jennings and his research aides (later to be known as research assistants) made 38 crosses, 11 of which involved as one of the parents a short-statured variety from Taiwan — either Taichung Native 1, Dee-geo-woo-gen, or I-geo-tse. The other parents were mainly tall tropical indicas or ponlais. The eighth cross among the 38 was one between Peta — a tall Indonesian variety with high vigor, seed dormancy, resistance to several insects and diseases and widely grown in the Philippines — and Dee-geo-woo-gen — a high-yielding, heavy-tillering, short-statured variety from Taiwan. The following description of the cross is largely from an article Jennings prepared for the September 1966 issue of *The IRRI Reporter*.

As a result of the initial cross, 130 seeds were formed. These were planted in pots in the screenhouse and produced the first generation of plants, all of which were tall. Seed from those F_1 plants was sown in the field and produced about 10,000 F_2 plants. These segregated by height according to the Mendelian ratio of 3:l. All tall late-maturing plants were discarded and the short early-maturing ones were saved. Seed from these remaining plants were bulked and planted in the rice blast nursery, where all highly susceptible plants were

removed. From that F_3 generation, 298 of the best individual plants were selected and seed from each was sown separately in the blast disease nursery, thus giving 298 pedigree rows to produce the F_4 seed. Again, the blast-susceptible seedlings were discarded.

From row 288, a single plant (number 3) was selected and, in accordance with IRRI's numbering system, was designated as IR8-288-3. Seed from this single plant was grown as a fifth generation in a pedigree row to produce the basic seed stock of IR8-288-3 (sixth generation), which was sown for multiplication purposes only, without further selection at that time. The seed was uniform enough for trials in other countries, but a couple of years later, Beachell devoted considerable effort to producing an extremely pure strain that would serve as a uniform seed source of IR8 for the future.

Multiplication of seed stock for distribution to other countries for testing took place in early 1965 and the crop was harvested in time to be planted at the beginning of the wet season in late June or early July. Of course, many other varieties or genetic lines were included in the seed lots sent out to other rice experiment stations. These first cooperative trials were conducted by plant breeders in Hongkong, the Philippines, Malaysia, Thailand, and Taiwan. It is to be noted that India, Pakistan, and Sri Lanka had not yet shown much interest in testing IRRI materials. However, that was soon to change.

Included in that early group of varieties and lines were ponlais from Taiwan, some japonica-indica crosses that Beachell had developed in Texas, and, of course, some of the progeny from crosses between short-statured indicas from Taiwan and tall tropical varieties.

The ponlais from Taiwan proved to be low yielding because they were low tillering and highly susceptible to viral diseases. For similar reasons, the U.S. selections did not do well. In all tests, consistently high yields were obtained from the crosses between Taiwan semidwarf indicas and tall tropical varieties, with IR9-60 (a cross between Peta and I-geo-tse) and IR8-288-3 often leading the list. Results in IRRI yield trials were similar.

In late 1965 and early 1966, Beachell made up a group of 303 varieties and genetic lines that showed promise in IRRI trials as varieties to be used directly or as parents to be crossed with local varieties. To be sure that this collection received proper attention, it was sent only to those countries where a Rockefeller or Ford Foundation representative was in residence: Colombia, India, East Pakistan (now Bangladesh), Malaysia, and Thailand. In addition, 300 breeding lines were sent to rice scientists in Mexico, Costa Rica, Dominican Republic, Taiwan, and the U.S. Upon request, smaller sets of breeding materials were supplied to agricultural experiment stations in Australia, Brazil, Cambodia, Ceylon, Central African Republic, Dahomey, Egypt, El Salvador, Fiji, Gambia, Ghana, Guatemala, Guyana, Honduras, Indonesia, Iran, Japan, Laos, Nepal, Nicaragua, Nigeria, Panama, Peru, Philippines, Republic of the Congo, Republic of Korea, Saudi Arabia, Senegal, Spain, Sudan, and the island of Timor. All together, 6,000 seed packets of IRRI breeding lines were sent out. Hence, 1966 marked the year when the worldwide distribution of IRRI's testing and breeding materials became a sizable operation.

During the 1965 wet season, IR8-288-3 and many other promising materials were tested in five countries. The trials were planted at six sites in the Philippines, two sites in Thailand, and one site each in Malaysia, Hongkong, and Taiwan. At the Philippine sites, all the top yields were from the semidwarf lines that came from crosses between the Taiwanese short varieties and tall tropical indicas. IR9-60, IR8-246, and IR8-288-3 were the best, with yields ranging from 3,247 to 6,389 kg/ha. These were wet-season yields and were among the highest ever recorded at the experiment stations of the Bureau of Plant Industry or at the College of Agriculture.

At the Bangkhen Station of Thailand's Rice Department, IR8-288-3 led the entries with a yield of 6,483 kg/ha, nearly twice that of the check variety Leuang Tawng. In Malaysia, IR8-288-3 was again the leader, with a top yield of 6,000 kg/ha.

On IRRI's experimental farm in 1965, 23 varieties or lines were placed in yield trials in January and June. Three selections from IRRI's eighth cross led the list in yield. The highest average yields (kg/ha) for the two plantings were 6,104 for IR8-246, 6,060 for IR8-288-3, and 6,047 for IR8-36.

IRRI scientists not only recorded yields but observed or measured other characters such as days to maturity, number of tillers and panicles, degree of lodging, incidence of disease, seed dormancy, milled rice yields, and gelatinization temperature and amylose content of the starch. When all factors were considered, the scientists judged that IR8-288-3 showed the greatest promise. Therefore, in 1966 they decided to test it broadly and at the same time to multiply the seed as rapidly as possible. Multiplication was done at IRRI during the 1966 dry season.

The seed production effort, conducted by Field Superintendent Ramos, was something of a feat in itself. Only 88 kilograms of pure seed of IR8-288-3 were available in February 1966. Ramos sowed the seed thinly in the nursery beds and then carefully transplanted only one seedling per hill in the field when the seedlings were 21 days old. The plants were widely spaced and covered 13 ha. With an abundant application of nitrogen, careful water management, and good insect control, Ramos harvested 71 t of seed.

In the 1966 international yield trials, IR8-288-3 performed even more spectacularly than it had done in the more limited 1965 trials. The selection yielded 7,034 kg/ha at CRRI in India and 7,753 kg/ha at the All India Coordinated Rice Improvement Project at Hyderabad. Per-hectare yields of IR8-288-3 in other countries were 6,600 kg in Malaysia, 8,000 kg in Mexico, 6,710-8,200 kg in Bangladesh (at 3 sites), 10,248 kg in Pakistan (Dokri Station), and 6,031 kg in Thailand.

In a yield trial of 31 varieties at IRRI in the 1960 dry season, IR8-288-3 topped the list with a yield of 8,236 kg/ha. During the wet season of the same year, it came in second with a yield of 5,377 kg/ha, which was not significantly different from the highest yield of 5,392 kg/ha obtained from IR154-61-1-1, a cross between Taichung Native 1 and Century Patna 231/SLO-17.

While the Varietal Improvement Department was conducting its trials, both the Agronomy and Plant Physiology Departments were using IRRI's best lines

in their field experiments and were obtaining even higher yields of IR8-288-3.

At IRRI staff meetings, the matter of naming varieties was discussed. The policy established was that IRRI would give names to its outstanding selections but at the same time would supply breeding materials to cooperating institutions anywhere in the world. The institutions in turn would be completely free to test, name, and release any IRRI genetic lines as they wished. In naming its own varieties, IRRI's system would be to use the letters IR, followed by the number. The decisions regarding the naming system, and which varieties to name and when, were made by a seed committee at IRRI.

The committee deliberated at some length over the naming of IR8-288-3 because the selection had both good and bad qualities. Its greatest attributes were excellent plant type and high yield potential. It was short and sturdy, had strong seedling vigor, was responsive to fertilizer, was essentially insensitive to photoperiod (medium maturity of 120-130 days), and had moderate seed dormancy and a reasonable degree of resistance to tungro virus disease.

A prime disadvantage was its bold, chalky grain, which detracted from the market appearance of the polished rice and caused considerable breakage on milling. Furthermore, the amylose content of the starch was too high for many Asian consumers, who prefer varieties that have a softer gel consistency and do not harden on cooling. Moreover, it was susceptible to bacterial blight and to some races of the rice blast disease.

After considerable discussion, the IRRI seed committee decided at a meeting on 14 November 1966 to name IR8-288-3 as IR8 and to make a public announcement of it as soon as a description was prepared and approved. The news went forth from IRRI on 28 November 1966.

The naming of IR8 and its widespread distribution throughout the rice-growing world constituted an important event in the history of agricultural development. It opened new vistas for rice yields in the tropics and subtropics and stimulated rice breeding programs in many countries where yields had stagnated at pitifully low levels. Furthermore, although IRRI and many national rice breeding programs have since named or released varieties that have better grain quality and higher resistance to insect pests and diseases, and thus more stable yields than IR8, no variety with a more ideal plant type or a higher true yield potential has been developed.

In 1966 and 1967, another IRRI cross began to appear among the high yielders, especially where insufficient fertilizer had been applied or water control was imperfect. This was IRRI's fifth cross and in accordance with the numbering system, it was designated as IR5-47-2. A cross between Peta and Tangkai Rotan, a Malaysian variety of medium height with sturdy straw, IR5-47-2 was taller than IR8 and at high fertility levels in the cloudy monsoon season tended to lodge. However, it tolerated deeper water than did IR8, withstood drought better, and had greater resistance to bacterial blight and the tungro virus disease. In 1966, IR5-47-2 was the top yielding entry in trials at the College of Agriculture and at the Maligaya Rice Experiment Station in the Philippines. During the dry season that year, it produced a yield of 7,068 kg/ha at IRRI. It did well also in trials in India, Pakistan, and Malaysia. Among

IR8 ready for harvest. This field yielded 8.5 t/ha. Note the upright leaves, short stems, and heavy tiliering.

IRRI's early crosses, it was the only high-yielding entry that did not have as one of its parents a semidwarf variety from Taiwan.

In late 1967, the IRRI seed committee agreed to name IR5-47-2 as IR5. Simultaneously, the farm department at IRRI produced considerable seed for distribution both in the Philippines and in other countries.

In concentrating largely on the development and testing of IR8, the foregoing description of IRRI's rice breeding program does not do justice to the Institute's early efforts to produce superior rice varieties for the tropics. A whole series of lines was developed with a plant type that was similar to IR8's and with one of its parents a popular tall, disease-resistant tropical variety with acceptable grain quality. These were distributed all over Asia and to a large extent in Latin America and Africa. Finding some of these materials excellent for their own requirements, many countries gave them names and released them as national varieties.

When, in 1966, IR8's superior yielding ability was recognized, the variety was used as a parent in more than 70 of the 270 crosses made at IRRI that year. This was done to retain the excellent plant type and fertilizer responsiveness while introducing such characteristics as early maturity and resistance to blast,

bacterial blight, and tungro virus disease, and to such insect pests as the brown planthoppers, green leafhoppers, and stem borers. Much effort was expended to improve the grain quality of IR8 by removing the chalkiness and reducing the amylose content of the starch. As is well known today, IRRI has been successful in attaining most of those objectives.

Distribution and spread of IR8

As stated earlier, IRRI produced 71 t of good IR8-288-3 seed during the 1966 dry season. Its rapid spread in the Philippines and in South and Southeast Asia in 1966-67 was a phenomenon worth reporting in some detail.

Because IRRI was in the Philippines and because it was started as joint venture of the Ford and Rockefeller Foundations and the Government of the Philippines, it seemed fitting that particular attention should be paid to distributing IR8-288-3 among Philippine farmers. The country had been importing rice for years and IRRI felt it should make every effort to assist its host nation in becoming self-sufficient in that vital crop.

One of the chief factors in the rapid spread of the new varieties in the Philippines was the fact that President Ferdinand Marcos was back of the effort. He and some of his staff went to IRRI on 3 June 1966 for his first visit after taking office. I happened to be abroad, but McClung took charge and with Jennings, Moomaw, Golden, and others showed the President around and pointed out the fantastic yields being obtained by the short-statured genetic lines that were emerging from IRRI's breeding program. Amazed to see plots of IR8-288-3 loaded with grain and only 100 cm tall, President Marcos remarked that he had always thought the best rice was the tallest rice. The experienced opened his eyes to the possibilities for increasing rice production in the Philippines.

Marcos was so impressed by his visit to IRRI that he asked that its representatives come to Malacañang Palace on 11 June to explain the Institute's rice improvement program and how its results could be used in the Philippines. By that time, I had returned from my trip and, accompanied by Jennings, Golden, and Drilon, appeared before the President, the Cabinet, and the heads of all government agencies having anything to do with rice research and production in the Philippines. I presented Marcos with a token 2-kg bag of IR8-288-3 and informed him and the entire audience that IRRI had reserved no less than 50 t of seed of that selection for immediate distribution in the Philippines.

At the meeting with President Marcos, the press was in attendance. On 12 June, front-page articles appeared in all the Manila papers. The headline in the *Manila Bulletin* read, "MARCOS GETS MIRACLE RICE." That was the first time that the term miracle rice was used. IRRI scientists never referred to it as such; the term was the creation of the news media and was widely employed among writers from then on. In the Philippines, IR8-288-3 received major attention because of an article written by Napoleon G. Rama in the 6 August 1966 issue of the *Philippines Free Press* entitled, "Miracle Rice — Instant Increase." The writeup included a photograph of Jennings showing IR8-288-3 to President Marcos during his significant visit on 3 June.

The rapid spread of IR8-288-3 (later IR8) in the Philippines was largely due to IRRI's giving 2 kg of seed to any farmer who would come to the Institute to pick up the seed. Ramos, IRRI's farm superintendent (far right), is shown explaining planting instructions that were included with each bag of seed.

Several means of spreading seed of IR8-288-3 (then still unnamed, hereafter referred to as IR8) in the Philippines were used. One was to release word that any farmer who came to IRRI could pick up 2 kg of IR8 seed free of charge. The only requirement was that each farmer leave his name and address. The operation, handled by Ramos, was extremely successful. During the last half of 1966, 2,359 Philippine farmers came to IRRI to get seed. They came by bus, on bicycles, and even on foot. According to the addresses they left, IR8 seed went to 48 of the 56 provinces in the country. Later surveys showed that this distribution had a major impact on the spread of IR8, because most of the farmers who adopted IR8 in 1967 had observed its superior performance on neighbors' fields and asked for some seed to try on their own land.

The largest distribution of IR8 seed in the Philippines was handled through government agencies but with the cooperation of private growers. Soon after

IR8 spread from farm to farm in the Philippines in 1966 and 1967. This photograph taken in Laguna Province in 1966 shows the boundary between fields of two farmers. The one on the left is planted to IR8; the field on the right was planted to Intan, a tall, lodging-susceptible variety, which yielded only half as much as IR8. In 1967, both farmers planted IR8.

the meeting with President Marcos at Malacañang Palace, the Rice and Corn Production Coordinating Council (RCPCC) set up a special seed multiplication program for IR8. The Rice and Corn Administration (RCA) purchased about 50 t from IRRI at a nominal price and the RCPCC distributed it to selected farmers for multiplication. During the 1966 wet season, 43 farmers participated in producing IR8 seed, with a total production of about 2,600 t. In the 1967 dry season, 35 of those same farmers produced nearly 5,000 t of IR8. From then on, there was no shortage of IR8 seed in the Philippines. In fact, some areas had a surplus.

Out of this effort, led largely by Abel Silva of Santa Rosa, Laguna Province, the Seed Grower's Association of the Philippines was formed. A private corporation composed of the larger, more progressive farmers, it sold seed not only in the Philippines but abroad as well. The Association started out growing IR8 and IR5. The officers kept in close touch with IRRI, avidly watching each promising selection, and saw to it that their group got seed of a new variety as soon as it was named.

IRRI supplied seed to the Bureau of Plant Industry, which was the official source of pure seed of all approved varieties in the Philippines. The Bureau had

By 1967, Philippine farmers were obtaining rice harvests from IR8. This crop in Laguna Province yielded more than 5 t/ha — where the same farmers previously got yields of less than 3 t/ha with traditional varieties.

a Seed Board that made all the decisions as to the cultivars that would qualify as official "Seed Board varieties." IRRI had observers on the Board and also supplied foundation or registered seed to the Bureau for distribution to selected cooperating farmers who produced certified seed. To streamline the spread of IR8, the RCPCC did not bother with seed purer than "good" seed. The mechanisms involved in producing certified seed were too complex to allow rapid progress in distributing a new variety, and in the Philippines, even today only a small portion of the rice is grown from certified seed.

In IRRI's home province, Laguna, the dissemination of IR8 had the backing of Governor San Luis. As early as January 1966, San Luis (who is still governor of Laguna) told me that he was anxious to increase rice production in his province, and that Wesley Haraldson of the USAID office in Manila was starting a project called Operation Spread and had offered financial and technical assistance to promote the replacement of the traditional rice varieties with the modern ones along with the necessary changes in management methods. IRRI, pleased to cooperate, provided the basic seed, and its scientists were called upon for technical advice. By late 1967, with Governor San Luis' enthusiastic leadership, 52% of the rice land in Laguna Province had been planted to IR8. Only 18 months earlier, the number of farmers growing the variety could be counted on the fingers of one hand. San Luis was so deeply interested in the new technology that he enrolled in Golden's course in rice production and thus became well-versed in the elements of modern rice production.

Counting, in addition to IR8 and IR5, such improved varieties as C4-63 developed by the College of Agriculture and BPI-76 bred by the Maligaya Rice Experiment Station of the Bureau of Plant Industry, the area planted to modern

rice varieties in the Philippines by the end of 1968 was about 750,000 ha. By 1970, the area had increased to 1.5 million ha, or essentially 50% of the land devoted to rice in the nation. The varietal composition changed, of course, as superior cultivars from the breeding programs became available.

The Philippines became self-sufficient in rice in 1968 and 1969 for the first time in decades, but as a result of bad weather and disease outbreak, it lost this advantage in the early 1970s. During the last several years, however, it has regained its self-sufficiency and is making a major effort to continue to produce a surplus of rice.

Concurrent with the spread of IR8 in the Philippines, sizable shipments of seed were sent to other countries. In 1966, a total of 5.2 t was shipped to Burma, Colombia, India, Laos, Malaysia, Mexico, Pakistan, and South Vietnam. Small samples went to 60 other countries that showed an interest in testing IR8. No attempt is made to outline the spread of IR8 (and IR5) in the various countries, except for brief descriptions of developments in Burma and India — Burma because it was a major rice-producing country that had been isolated from international activities for years, and India because it had the largest rice-growing area among countries except the People's Republic of China, which at that time was not in a position to cooperate with IRRI.

From about 1962, Burma had barred most foreign visitors, except tourists who could visit Rangoon for a 24-hour period. Consequently, IRRI made no attempt to develop a cooperative program with that country.

On 24 December 1965, a trade delegation from Burma came to Los Baños to visit the College of Agriculture. In the morning, Dean Umali mentioned that the International Rice Research Institute was close by. Lt. Col. San Win, who headed the trade mission, said that he and his group would like to see the Institute. At Umali's invitation, I joined them for lunch at the International House on campus and afterward took them to IRRI. At the time, the plots of IR9-60 were looking especially good, and San Win asked whether IRRI would send seed to Burma if requested. I answered affirmatively and San Win said he would talk to the minister of Agriculture in Burma and, if he wished some seed, would be in touch with IRRI.

Within a few weeks, a request was received from Burma for a 45-kg sack of 1R9-60. It was immediately dispatched. Nothing further was heard for about 6 months; then a cable arrived asking for more seed of IR9-60. I replied that a better selection, IR8-288-3, with similar characteristics was available, and IRRI shipped about 100 kg to Burma in time for planting in June 1966.

Although a major rice-producing country, Burma has never been a large user of modern rice varieties. Nevertheless, from the small shipments from IRRI, the country multiplied seed and in 1968 planted about 165,000 ha of IR8. In April of that year, the government invited me to spend 5 days in Burma. During my visit, I gave a talk before a meeting of Burmese scientists and went to their experiment station at Hmawbi. From that time on, IRRI had good relations with Burma. Other scientists from the Institute were invited to visit the country and Burmese research scholars were sent to IRRI. Today, IRRI has a small research team in Burma, and although that country still has a relatively

modest percentage of its rice land planted to modern varieties, the government is making a strong effort to increase rice production and to expand the nation's export markets.

Quite a different story can be told about India. Its interest in short-statured indica rice varieties started in 1964 when S.V. Chalam, a senior agricultural officer in the Government of India, visited IRRI. When shown around the experimental fields, he asked Moomaw, IRRI's agronomist, which rice variety was the highest yielding. "Taichung Native 1," Moomaw replied. Chalam said, "Please give me two kilograms of seed of that variety and I shall plant it in India." He received the seed, it was planted at home and it turned out to be so successful that in early 1965, Ralph Cummings, Sr., then director of the Rockefeller Foundation Agricultural Program in India, arranged to purchase one ton of Taichung Native 1 seed from IRRI. By that time, Chalam had become the manager of the National Seeds Corporation in India. He was able to get 5 more tons of the seed from Taiwan in October 1965, and the following year, the Taiwan Government gave India 60 t of the variety. Chalam was an enthusiastic and industrious agriculturist and did an outstanding job of multiplying and distributing Taichung Native 1 seed in India. By the dry season of 1967, more than a million hectares of the variety had been planted in that country.

By early 1966, IR8 and other IRRI selections were being tested in India. Because the trials showed that IRRI lines generally were more resistant to disease attack than was Taichung Native 1, that variety was replaced by IR8. In mid-December, the Ford Foundation bought 10 t of IR8 seed in the Philippines for India, and in February 1967 the Rockefeller Foundation shipped another 10 t to that country. By 1968-69, India was growing about 2.7 million ha of modern varieties. Concurrently with the introductions from abroad, of course, the country was breeding superior varieties that were multiplied and distributed to farmers. Today, India devotes over 15 million ha of land to modern rice varieties, and for the past several years, has been self-sufficient in that grain. Its success is the result partly of using improved management practices for the newer varieties and partly of having had good monsoon rains in recent years.

Any discussion of the initial varietal improvement operations at IRRI should indicate that, given sufficient time, what the Institute achieved in its early years in all likelihood would have taken place eventually through other agencies and by other means. However, the gains would have come about much later and the spread of modern rice varieties throughout the world would have been much slower. It, took an international, nonpolitical, well-funded organization like IRRI, with a talented and dedicated scientific staff, to have a major impact on and to reinvigorate and stimulate into action many of the earlier established rice breeding programs in tropical Asia and elsewhere.

IRRI has received some criticism for naming its own varieties. I believe, as many others do, that the Institute was correct in naming its released varieties at a time when it was establishing a reputation. Aside from the scientific advantage of international identification of new cultivars and of their use in breeding later varieties elsewhere, IRRI, as the first of the international

agricultural research centers, needed all the prestige it could earn. Although the work of the entire Institute helped build a solid reputation, it was the naming, distributing, and testing of IRRI rice varieties, of which IR8 was the forerunner and the best known, that gave the Institute its widest recognition.

From the start, IRRI did not restrict in any way the use of the breeding materials it distributed. Many national programs have named varieties from genetic materials shipped out by the Institute. Moreover, IRRI varieties were not infrequently given national names in other countries. IR8, for example, was called Padi Ria in Malaysia, Magyaw in Burma, and Peta Baru 8 in Indonesia.

The historic significance of IR8, with its high yield potential under correct management, is that together with the modern wheat varieties created by Norman E. Borlaug and his associates at CIMMYT in Mexico, it constituted an agricultural breakthrough which caused the great wave of optimism in the mid- and late 1960s about the ability to feed the hungry millions in the less developed countries and which was popularly hailed as the Green Revolution.[1]

PLANT PHYSIOLOGY

While the breeders were making crosses, the plant physiologists were studying the characteristics of some of the parental types in order to understand better the morphological distinctions and physiological processes related to yield capacity.

Coming from Japan, Tanaka naturally first thought of comparing the tropical japonica varieties from Taiwan with tropical indicas. In May 1962, he planted Tainan 3, a ponlai variety, and Peta, the indica variety that was to become one of the parents of IR8 and IR5. He took measurements in the stands of the two contrasting varieties: percentage of available light reaching the ground during the growing period, plant height, number of tillers at different dates, time of panicle initiation, date of flowering and of maturity, and the dry weight of the various parts of the plant — panicles, live leaves plus culms, and dead leaves.

Tanaka found some highly contrasting differences between the two varieties. The shorter, lower-tillering, upright-leaved ponlai variety Tainan 3 let much more light pass through to the lower leaves than did Peta. Both varieties had been transplanted on 28 May and at about 1 July, the percentage of light reaching the ground under Tainan 3 was 70%, but was only 20% in the dense Peta stand.

Until about 1 July, the two varieties were about even in plant height, but from then on, Peta kept growing taller while Tainan 3 tended to level off. At maturity, Peta had a height of 200 cm whereas the maximum height of Tainan 3 was 140 cm.

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[1] It is of historical interest that the first known use of the term *green revolution* was by the then administrator of the United States Agency for International Development (USAID) William S. Gaud, who, on 8 March 1968 in Washington, D.C., addressed the Society for International Development on the subject, "The Green Revolution: Accomplishments and Apprehensions."

The maximum tillering stage of both varieties was reached at about the same time (during the first week of July), when Peta had 35 tillers/plant and Tainan 3 had only 20 (the spacing at transplanting time was 30 x 30 cm with 1 plant/hill). The important finding was that although Peta had many more tillers than Tainan3 at the maximum tillering stage, after that the tillers on Peta started dying at a fast rate because of lack of light penetration and only 14 Peta tillers were alive on each plant at maturity. On Tainan 3, however, all 20 tillers were still alive and 83% of them bore panicles.

Panicle initiation took place at the maximum tillering stage in Tainan 3 but was 30 days later for Peta. This meant, of course, that flowering and maturing were much delayed in Peta. Peta took 151 days to reach maturity, whereas Tainan 3 matured 123 days after sowing (102 days after transplanting).

The panicle-straw ratio for Tainan 3 was 0.81; Peta's was 0.57.

An important observation was that although the average stem of Peta produced 21 leaves, by the time it reached the flowering stage only the two uppermost leaves were entirely active, the next two were half dead, and the rest were entirely dead. Each culm of Tainan 3 produced only 15 leaves, but all except the 2 lowest ones were still functioning at flowering time. From these observations, Tanaka correctly concluded that Tainan 3 depended mostly on products assimilated during the ripening stage, whereas spikelet filling in Peta was the result of carbohydrates stored in the straw before flowering.

Tanaka did another series of experiments in 1962, growing Peta, Tainan 3, and BPI-76 at different spacings and nitrogen levels. Peta gave its highest yields at wide spacings and medium nitrogen levels; Tainan 3 and BPI-76 produced maximum yields at maximum (30 x 30) spacing and at higher levels of nitrogen.

In 1963, Tanaka continued his studies of plant type in relation to yield, with variations in spacing, nitrogen levels, and date of planting. It was then that he discovered the great advantage of the Taichung Native 1 plant type and high yields were possible with tropical varieties when grown during the dry season under abundant sunshine instead of during the cloudy rainy season. Planting Taichung Native 1 on 20 December 1962 and harvesting it about 4 months later, Tanaka obtained the unprecedented yield (for the tropics) of 8.23 t/ha.

In that same experiment, he planted a U.S. short variety, Century Patna 231, which Beachell had developed in Texas for direct seeding. It was inherently a low-tillering variety and yielded respectably only when it was closely spaced and heavily fertilized with nitrogen. Its shortness and its stiff stems kept it from lodging but that was not enough. The experiment demonstrated clearly that for transplanted rice, heavy tillering capacity was an important characteristic.

That same year, Tanaka conducted intensive greenhouse studies of mutual shading (the shading of the lower leaves of a plant by its upper leaves and the shading among competitive plants in a rice stand). He demonstrated that mutual shading was a significant cause of a lack of nitrogen response in the tall, leafy, tropical varieties.

Taichung Native 1 is a half-sister of IR8 and has a similar plant type with short stature, upright leaves, and numerous tillers. Peta, although also heavy

tillering, is much taller, has long drooping leaves, and matures later. Tanaka measured the leaf area of the two varieties in the field and found that at the maximum tillering stage, Peta had the highest leaf area index (LAI).[2] But by the time the plants reached the flowering stage, so many of the leaves of Peta had died that its LAI was much lower than that of Taichung Native 1.

The findings just cited seem commonplace information today, but at the time, they represented pioneering work. Tanaka's data gave IRRI scientists an understanding of why the traditional tropical rice varieties were incapable of yielding heavily.

While Tanaka was studying plant morphology and growth responses in relation to yield, Vergara made extensive studies of the response to photoperiod of a collection of rice varieties, including many that were being used as parents in IRRI's breeding program. Rice is a short-day plant, meaning that short day lengths decrease the growth period. Vergara showed that there were great differences in the extension of the growth period when day length was increased artificially. He grew his plants in pots on carts that could be moved about by hand. All varieties were exposed to an 8-hour day in the greenhouse and then wheeled into chambers where artificial light was controlled by a time clock. Varying the total exposure to light from 8 to 24 hours, he recorded flowering delays. Some varieties were so insensitive to day length that the difference in time from sowing to flowering was less than 10 days over the entire range, whereas some of the sensitive varieties exposed to artificial day lengths of 16 hours or more did not flower at all even after 200 and more days of exposure. At that time, IRRI plant breeders were trying to create varieties that were relatively insensitive to day length and Vergara's studies clearly identified the insensitive varieties that could be used as parents.

Vergara later made more basic studies on the photoperiod response, determining the growth period when photoperiod induction took place and the impact of the number of photoperiod-inductive cycles on plant characteristics such as panicle emergence and size. Furthermore, he and Chang conducted cooperative research on the mode of inheritance of photoperiod sensitivity.

From 1964 through 1967, the Plant Physiology Department conducted innumerable studies, some of them basic. Space does not permit either a detailed description or even a complete listing of that research. However, because much of it was being done for the first time in the tropics, some of the basic principles established during that period are listed here:

- Culm length and thickness are the most important factors affecting lodging resistance and nitrogen responsiveness. The ideal culm length for wetland rice production under controlled water supply is about 100 cm.
- Culm length, although affected by environment, is largely a genetic factor. Short and tall varieties have similar numbers of nodes, but in the

[2] LAI is the area of leaves above a unit area of ground. For example, it a rice stand had 6 m^2 of leaf area above 1 m^2 of ground, its LAI would be 6.

short ones the internodes do not elongate to the extent they do in the tall varieties. Furthermore, when nitrogen is supplied to the two contrasting types, the internodes in the short type elongate little but the tall varieties grow much taller, thus increasing their susceptibility to lodging at high fertility levels.

- Short erect leaves are associated with high yield potential and nitrogen responsiveness.
- Although tillering is increased by nitrogen applications, varieties differ greatly in their inherent capacity to tiller, and breeders should incorporate heavy tillering in their short, stiff-strawed varieties.
- Rice varieties that have high yield potential are those that continue to increase in dry weight from flowering to harvest — that is, those that have live leaves and depend largely on carbohydrates manufactured during that period to fill the grain.
- Superior yielding rice varieties have a high grain-straw ratio (about 1.0).
- There is a positive and high correlation between solar energy received by a rice crop from flowering to harvest, and yield. Thus, dry season yields are always higher than those in the cloudy rainy season, provided that irrigation and other cultural practices are properly conducted.
- The LAI for short, stiff-strawed varieties that do not lodge can be as high as 6 to 12 without any reduction in yield.
- Cooperative studies carried out in various environments from Japan to Australia showed that higher yields occur when there is a long period between flowering and harvest. However, this appears to be a function of temperature, and because of the uniformly high temperatures in the tropics, the ripening period remains rather constant, usually varying only between 28 and 32 days.

Those studies had an important bearing on increasing the yield potential of the tropical rice plant. As reported earlier, Tanaka left IRRI in March 1966. Yoshida, who took his place, has continued an imaginative and effective research program.

AGRONOMY

From the standpoint of permanence, the most significant event of 1962 in the Institute's research program was the start of the continuous, high-yield rice experiment. Moomaw and Wortman designed this study, which, in modified form, is still being carried on across the road from the administration building (Chandler Hall).

Maximum yield experiment

Moomaw transplanted two varieties in the field 8 June 1962 — Chianung 242 (a ponlai variety from Taiwan) and FB-121 (a Philippine indica variety). Besides a uniform application of phosphorus, potassium, horse manure, and rice straw, which were plowed under before transplanting, there were 4 levels of nitrogen — 40, 80, 120, and 160 kg/ha. The spacing was uniform at 20 × 20 cm.

It was Moomaw's first experience in growing a crop of rice and he was intensely interested in every aspect of the process. Vergara, at Wortman's instigation, had grown a number of rice varieties at IRRI the previous season, including the ponlais from Taiwan, and Moomaw knew from him that Chianung 242 was lodging resistant and had a high yield potential. Moomaw had asked the Bureau of Plant Industry to suggest a typical local variety, and FB-121 was proposed. It was not made clear to him that the variety was highly sensitive to photoperiod, with the result that 171 days elapsed from sowing in the seedbed (24 May) to harvest (9 November). In contrast, the photoperiod-insensitive variety Chianung 242 was harvested 11 September, only 111 days from seeding.

The average yield of Chianung 242 was 4,739 kg/ ha, and nitrogen level gave no statistically significant effects, The yields from FB-121 were exceedingly low, ranging between 1,168 and 2,855 kg/ha. Because the variety was tall and leafy, as well as late maturing, the plants on all plots lodged and the lowest yields were obtained on the plots receiving the highest fertilizer applications. Thus, the fertility levels were too high and the spacing too close, especially for a wet-season crop.

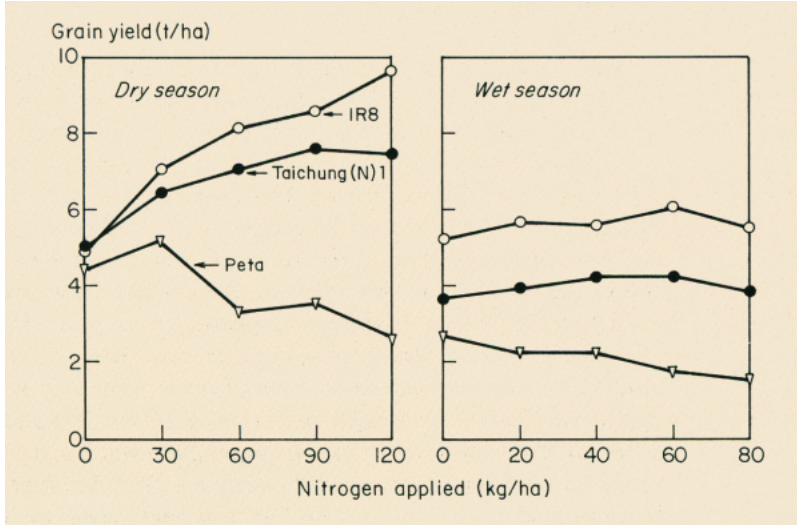
Moomaw learned a great deal from that first maximum yield (later called continuous-cropping) experiment, and the next planting season, he chose a photoperiod-insensitive variety, Milfor 6(2), to replace FB-121.

During 1962-63, Moomaw made no attempt to grow more than two rice crops a year but grew a green manure crop between the two rice crops. By late 1963, he realized that three crops a year could be grown and that on the rather fertile soils of the IRRI experimental fields, there was no need for a green manure crop between rice crops. From then on, Moomaw grew 3 crops every 12 months. By 1966, 3-crop yields totaled 20.2 t/ha, which at that time IRRI considered to be a world record for a replicated experiment. On the average, yields continued to rise until about 1968, remained constant until about 1970, and then slowly declined, probably due to a combination of disease buildup and soil factors.

In the early years, the continuous-cropping experiment had as variables four fertility levels and three water management treatments, as well as several varieties. Later, the water treatments were removed and the main comparisons were of varieties and planting methods (direct seeding and transplanting). The varieties selected soon became the best that the Varietal Improvement Department had to offer, and by 1967, they included IR8, Taichung Native 1, C4-63 (a College of Agriculture variety), and, for the last time, Chianung 242.

Fertility studies

Before 1964, soil fertility studies were included in the continuous-cropping experiment. When De Datta joined the department early that year, the soil fertility program was stepped up. Moomaw continued to look after the continuous-cropping experiment and launched a comprehensive study of the chemical control of weeds in both wetland and dryland rice fields, a study that —with new chemicals coming on the market — would continue indefinitely.



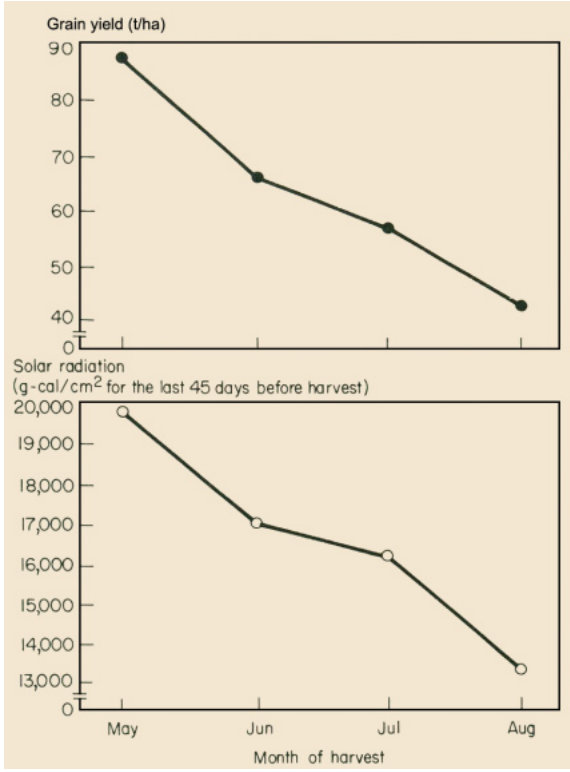
1. The response to nitrogen of two modern rice varieties (IR8 and Taichung Native 1) and of a tall tropical variety, Peta, in the dry and wet seasons of 1966 on IRRI's experimental farm.

The first studies on the response of rice to fertilizer additions were chiefly on IRRI experimental fields or at cooperating stations of the Bureau of Plant Industry in the Philippines. It soon became clear, as reported in the plant physiology section, that the response to nitrogen was greater in the dry season than in the wet and, of course, in either season the short varieties responded more than the tall ones (see figures). In fact, during the wet season it was common to get no response to nitrogen among tall varieties such as Peta.

Unquestionably, during the first few years there was considerable duplication in the field work conducted by the plant physiologists and the agronomists. If IRRI administrators had chosen to have each scientist submit specific projects for approval, this could have been avoided. However, they decided against the requirement, mainly so that the scientist would feel free to attack whatever problems seemed important to him. Moreover, some duplication seemed beneficial because new principles were being established and greater confidence could be placed in the results if similar answers were obtained by more than one investigator.

In 1964, De Datta started a long-term fertility trial using several varieties (which he would replace over time) and various combinations as well as single applications of nitrogen, phosphorus, and potassium. Two crops were grown each year, one in the wet season and another in the dry. The experiment is still going on, and after more than 35 crops there has been no response to any element except nitrogen. However, in similar experiments that De Datta began in 1968 in cooperation with the Maligaya, Visayas, and Bicol stations of the Bureau of Plant Industry, moderate but consistent responses to all three plant nutrients have been obtained.

During 1962-66, the Agronomy Department conducted thorough studies of the interactions among variety, spacing, nitrogen level, and date of planting. It also studied the effect of various sources of nitrogen as well as the impact of time of application. Exhaustive studies were conducted in 1965 and 1966 on the



2. Average grain yield for IR8 and IR5 rice varieties and the solar radiation for the last 45 days before each of the four monthly harvests from May through August.

relations between plant type and nitrogen response, with results similar, of course, to those obtained by the physiologists. As early as 1965, fertilizer trials were placed in farmers' fields, a practice that De Datta expanded over the years. In the 1966 wet season, he obtained a yield of about 7.5 t/ha with IR8 in a farmer's field near Calamba in Laguna Province. It was such on-farm experiments as this that helped persuade farmers in that province to stop growing the traditional varieties and to switch to the modern ones.

The soil fertility studies of the agronomists during the first 6 years were too numerous even simply to list here. They were well conducted, added significantly to the knowledge of nitrogen fertilization of rice, and contributed valuable data on silicon and phosphorus fertilization as well.

In 1966 De Datta got the highest yield yet attained in an IRRI replicated experiment when IR8 produced 10,130 kg/ha—undoubtedlyalso, the highest yield in the tropics.

Water management

Moomaw and De Datta designed practical experiments on water management during IRRI's first 5 years. The earliest study, carried on throughout 1962-64, was part of the continuous-cropping research. Moomaw incorporated three water management treatments into the experiment:

1. continuous flooding,

2. a raised-bed treatment in which the surface was above the water level but the roots could encounter a saturated soil below the bed, and
3. alternate flooding and drying.

There were no appreciable yield differences in the first two treatments, but the alternate flooding and drying procedure tended to decrease yields.

In 1965, the agronomists constructed a set of bottomless metal tanks fed from concrete reservoirs so that they could control the depth of water and the time of application. The experimental equipment allowed them to measure water use. These studies, which were continued through 1967, had 8 treatments ranging from continuous deep (10 cm) flooding to those that allowed the soil to dry out to the point of real moisture stress before it was flooded again. The results of this work showed that the rice plant could yield well as long as the soil was not allowed to become dry. Maintaining a moist soil, in the absence of flooding, did not decrease yields. The ideal treatment from the standpoint of both water use and yield was shallow (2.5 cm) continuous flooding. Another important early finding, during the summer of 1966, was that when plots were bunded but unirrigated, yields were equal to those from fully irrigated plots, whereas unbunded plots of dryland rice gave low yields during the same season. This illustrated the importance of storing water in the paddy for use during dry periods, something Asian rice farmers had known for centuries.

Weed control

Moomaw wasted no time in getting research started on the use of herbicides for weed control in flooded rice. By late 1962, he had assembled 66 herbicides for testing, and by the end of 1963, he was able to report on the performance of about 100 chemicals. He found that MCPA (4-chloro-2-methylphenoxyacetic acid marketed as Agroxone-4) was the most effective, giving about 95% control of broad-leaved weeds and sedges when applied at the rate of 1 kg active ingredient/ ha.

In March 1964, Moomaw conducted the first training course to be given at IRRI — a weed-control short course, attended by 13 scientists from 5 Asian countries, to stimulate cooperative research on chemical weed control. The next year, uniform cooperative herbicide trials were carried on by many of the participants in their own countries.

Moomaw had screened hundreds of herbicides by 1966-67 and had tested their influence on rice yields, comparing them with two hand weedings. He proved that although several herbicides available at that time were as effective as hand weeding in controlling weeds, the cost was often prohibitive. He found, however, that the isopropyl ester of 2,4-D applied 3 days after transplanting gave reasonably good control at low cost, considerably lower than the cost of two hand weedings. Later, beyond the time covered in this chapter, other more effective herbicides at affordable prices became available.

Moomaw recognized the importance of weed control in upland (dryland) rice and began studying that problem in 1963. The earliest results were not too impressive, but in 1967, a yield of 4,160 kg/ha was obtained in a dryland crop of IR5 rice treated with a preemergence application of pyriclor and molinate,

compared with a yield of only 1,079 kg/ha from an unweeded plot. Since then, De Datta has obtained excellent results with new and less expensive materials. Even today, however, weed control in dryland rice needs further improvement.

Studies of management systems for rice

Moomaw and De Datta were aware that a total management system for rice was necessary for high yields. After analyzing their earlier results with spacing, seeding methods, time of planting, fertilizer responses, and water management, they decided to impose, on the optimum soil and water management methods, three levels of insecticide and herbicide application. The studies of these chemical treatments used three varieties and five levels of nitrogen. Costs and returns were analyzed for several combinations of variables.

Although the highest yields were obtained with IR8 under the most intense management, the greatest net profit was obtained with high nitrogen applications but with the lowest amounts of insecticide and herbicide. These first experiments in developing total management systems, although preliminary, are of historical interest because they paved the way for more comprehensive research (as described in Chapter 7) to be conducted later by agronomists, agricultural economists, and statisticians.

Experiments with dryland rice

IRRI has often been criticized for concentrating its early research on wetland, irrigated rice. It did so because the quickest and largest gains in production could be realized under that type of management. The point must be made, however, that research with dryland rice definitely did take place at IRRI from 1963 onwards, although at a low level compared to that with wetland rice.

The work with dryland rice in 1963 was limited to studies (mentioned previously in this chapter) of the effect of herbicides on weed control, the conclusion being that no chemical herbicide existed that could control weeds adequately in dryland rice seeds without at least one hand weeding. In 1964 and 1965, the work was expanded to include studies of row spacing, variety, and the timing of chemical sprays, including the use of directed spray techniques.

In 1966, 4 years after his arrival, De Datta ran his first field experiment studying the time of nitrogen application on dryland rice. He used Palawan (a Philippine dryland rice variety), IR52-18-2 (a line from IRRI's breeding program), and IR8. A drought occurred at the panicle initiation stage and bacterial blight attacked the plants. Consequently, yields were low (mostly between 1 and 2 t/ha) and it was impossible to reach firm conclusions as to the proper way to split applications of nitrogen fertilizer for dryland rice. Similar experiments carried out in 1967 had better results. The newly named IR5 variety was substituted for IR52-18-2, but the two other varieties were the same as in the 1966 studies. The remarkable yield of 6,191 kg/ha was obtained with IR5 when 60 kg nitrogen/ha was applied between the panicle initiation and booting stages. This was the first evidence IRRI had of the value of IR5 as a dryland

variety. The yield of IR8 under the same treatment was 4,796 kg/ha and that of Palawan 3,644 kg/ha.

In 1967, IRRI agronomists conducted other experiments on dryland rice, including varietal trials, rate of seeding, row spacing, and mechanized seeding. On IRRI's experimental fields, these studies (and those in 1966) showed that the Institute's short-strawed, heavy-tillering varieties outyielded the recommended Philippine dryland varieties such as Palawan, Azucena, and Milfor 6(2).

Multiple cropping

Although IRRI received its first recognition for multiple cropping research after Bradfield launched his program in 1965, the earliest work at the Institute with crops other than rice was done by Moomaw in 1962-64. He had studied dryland crops on tropical soils in Hawaii and believed that for the well-being of the rice crop alone, some crop rotation should be practiced. Therefore, he immediately started looking for legumes that could be rotated with rice (in connection with the maximum yield experiment already described) and simultaneously sought species that could stand flooding for short periods.

He established a legume nursery in 1962, planting seeds that he had obtained from the Philippines, Taiwan, Cambodia, and the US. He found that species of the genera *Sesbania* and *Crotolaria* were the most promising as green manure crops and that only *Sesbania sesban* and *Phaseolus lathyroides* could stand extended periods of flooding.

In 1963, Moomaw grew mungbean, soybean, and cowpea at different spacings to determine the optimum for seed production and tested 15 leguminous species for yield and nitrogen content as green manure crops.

In 1964, he continued those studies and screened a group of sorghum varieties from the College of Agriculture and from the Rockefeller Foundation's program in India. It was Moomaw who first reported at IRRI that sorghum could stand flooding far better than maize and that higher yields could be obtained in the ratoon crop than in the first crop from seed.

By 1967, Bradfield had worked out a system of multiple cropping, combined with intercropping, so that — in a 12-month period on a given tract of land — one crop of rice, followed by a crop of soybean, then of sweet potato, another crop of soybean, and a final crop of sweet maize, could be grown. He experimented on crop timing (always starting with rice at the beginning of the rainy season), on bed preparation, on fertilizer application, and on weed and insect control. All of this was done on about 2 ha of land, which seems small in comparison to that available for such research at IRRI today. Nevertheless, Bradfield laid an excellent foundation for the greatly expanded program that IRRI developed after his retirement. Furthermore, his enthusiasm for the cropping systems he worked out and his belief in their validity attracted the attention of Canada's International Development Research Centre, which provided substantial support for the enlarged multiple cropping program. (Bradfield's early work had been funded largely by a grant from the Rockefeller Foundation.)

SOIL CHEMISTRY

During his first 5 years at IRRI, Ponnamperuma conducted literally hundreds of fundamental studies on the chemistry of flooded soils. His work embraced such investigations as the influence of flooding on the redox (oxidation-reduction) potential, on pH, and on the amounts of ferrous iron, ammonia, phosphorus, silicon, molybdenum, zinc, and copper in the soil solution. He studied the losses of nitrogen by denitrification, the formation of toxic substances from the decomposition of organic matter, and the influence of submergence on carbon dioxide levels. He examined the chemistry of the acid sulfate clays that are so extensive in Southeast Asia and that occur also in other tropical rice-growing regions. Using large metal drums in which water levels could be accurately controlled, he investigated the impact of various water regimes on the chemical properties of soils.

Most of Ponnamperuma's basic studies were conducted in pots in the greenhouse, although in 1963 he ran a field experiment, in cooperation with Moomaw, studying the effect on yield of the duration of submergence prior to planting, with and without added organic matter. He found that 2 weeks of submergence were optimum, even when as much as 7.4 t of a mixture of rice straw and fresh leaves of *Leucaena glauca* per hectare was incorporated during land preparation. Interestingly, no significant differences in yield were obtained when an equal amount of nitrogen was applied as ammonium sulfate, indicating that amount of nitrogen, not source, is the important factor.

Ponnamperuma's thorough and complex studies of the chemistry of flooded rice soils cannot even be touched upon adequately here. In brief, however, his work revealed that when a dry soil is flooded, the following changes occur during the first 3 to 4 weeks:

- The oxygen supply decreases almost to zero except in a thin layer at the soil surface.
- The pH of acid soils increases, whereas that of calcareous soils decreases, thus tending to bring most soils to harmless degrees of either acidity or alkalinity.
- Iron is reduced from the ferric to the ferrous form, and large amounts of soluble iron are released into the soil solution.
- The supply of available nitrogen, phosphorus, silicon, and molybdenum increases.
- The availability of zinc and copper decreases.
- Harmful quantities of toxins, such as organic acids, ethylene, and hydrogen sulfide may be produced, and under certain conditions the soluble iron quantities may build up to toxic levels.

The findings showed that most of the changes that take place after flooding are beneficial to the growth of rice. This information helped develop the thinking of other IRRI scientists, for several of them questioned the need to follow the time-honored practice of flooding and even thought it might be harmful.

SOIL MICROBIOLOGY

MacRae arrived at IRRI in mid-1963 and thus got a late start. By 1964, however, he had developed a sound research program in soil microbiology with three principal areas of concentration: studies of the interactions between rice roots and microorganisms in the rhizosphere (the soil within a few millimeters of the rice roots), nitrogen transformations in submerged soils, and pesticide residue studies.

Some of the more important findings of MacRae during the 3.5 years that he spent at IRRI follow.

- The rhizosphere contains high populations of microorganisms that fix significant quantities of atmospheric nitrogen. The numbers of these organisms are highest during the first 3-4 weeks after transplanting, and decrease steadily after that period.
- Exudates from rice roots contain at least four carbohydrates and eight amino acids that nourish the microorganisms in the rhizosphere.
- When a dry soil is flooded, the nitrate nitrogen content decreases to a low level during the first week of submergence. Despite the anaerobic status of flooded soils, however, the conversion of ammonia to nitrite and nitrate nitrogen does occur in the thin surface layer of soil where some oxygen is able to penetrate. The nitrate nitrogen formed in such soils soon may be lost through denitrification.
- When nitrogen fertilizer is applied to the surface of a flooded soil, large losses of ammonia result from volatilization. The losses are greatly reduced when the fertilizer is thoroughly incorporated in the soil during land preparation.
- The application of the gamma isomer of benzene hexachloride (BHC) as a systemic insecticide in the irrigation water greatly increases the growth of the green and blue-green algae, because the insecticide kills many of the small crustaceans that feed upon the algae.
- BHC is broken down by anaerobic soil microorganisms in submerged rice fields so that 30-50 days after its application, almost no residues remain in the soil. This rapid degradation was in contrast with results obtained elsewhere in previous studies in aerobic dryland soils, where BHC residues persisted for periods ranging from 3 to 11 years.
- Diazinon (another systemic insecticide) behaves like BHC and no residue problems arise from its continued use in flooded rice fields.

It was a significant finding that BHC and diazinon are degraded much more rapidly by microorganisms in anaerobic than in aerobic soils.

PLANT PATHOLOGY

In 1962, Ou devoted most of his time to testing varieties from IRRI's world collection for resistance to the rice blast disease, using a nursery design that he had developed while working for FAO. In the planting plan for the nurseries, single rows of a variety known to be susceptible were alternated with two rows of the varieties to be tested. In addition, two or three rows of the susceptible variety were planted around the entire outer edge of the nursery. The suscep-

tible varieties served as checks and ensured that there would be abundant spores of the blast disease in the nursery so that no variety could escape exposure to the disease.

That first year, Ou not only screened thousands of varieties from the world collection but helped the Varietal Improvement Department set up its own nurseries so that it could test the many genetic lines from the breeding program.

Beginning in 1963, Ou made arrangements to establish rice blast testing nurseries in many cooperating countries. Furthermore, during an international symposium on the blast disease at IRRI that year, FAO asked the Institute to take full responsibility for its international rice blast testing program, which Ou had originally started. That year, also, Ou and cooperating scientists in other countries selected 250 rice varieties for wide screening tests. Included were 38 differential varieties from Japan, the US., and Taiwan and 100 varieties that had been tested in 1962 in the FAO program. The rest of the 250 varieties had been selected by IRRI because of their resistance to the physiologic races that existed in the Los Baños area. Forty sets of the uniform blast nurseries were sent to 15 cooperating countries in 1963. The following year, the number of cooperating countries increased to 20 and remained at about that level through 1967. The varietal composition of the nurseries changed greatly as resistant cultivars were identified.

According to the results sent back to IRRI, several varieties proved to be resistant to all but two or three of the races of blast encountered in the entire testing program. Such varieties as Tetep, Carreon, and Tadukan were widely used in IRRI's breeding program, as well as in national programs, to incorporate broad-based resistance to blast in the improved varieties.

Without doubt, Ou's research on the rice blast disease was the most thorough and comprehensive of any such studies in the tropics and subtropics. He not only screened many thousands of varieties to identify superior breeding materials but conducted countless fundamental studies of the disease, such as the effect of nitrogen nutrition on the severity of disease attack, the mode of inheritance of blast resistance, methods of culturing the causal organism, the correlation between leaf blast and neck rot resistance, the distribution of airborne spores, the chemical control of the disease, the standardization of race numbers, the seasonal variation in physiologic races at IRRI, and the races originating from single lesions.

During the early years, Ou did considerable work as well on two other fungal diseases of rice — stem rot and sheath blight.

IRRI pathologists (as mentioned in Chapter 2) recognized the presence of viral diseases during the first year of the research program. Ou had demonstrated, as early as 1962, that leafhoppers of the genus *Nephotettix* were vectors of a viral disease that he tentatively called orange leaf. In 1963, he described four viral diseases that occurred on IRRI's experimental fields: orange leaf, tungro, yellow dwarf, and dwarf diseases. By 1964, after many studies and observations, he concluded that the disease he had called yellow dwarf in 1963 was instead a tropical viral disease transmitted by the brown planthopper

Nilaparvata lugens. He named the disease *grassy stunt.* Ou concluded by then that the grassy stunt and tungro diseases were the most serious, and the virus research program of IRRI was directed to them in the next several years.

When Ou was traveling in Malaysia in 1964, he noted that the *penyakit merah* disease of rice had symptoms similar to those of the tungro disease. Until then, no one had called the former a viral disease, suspecting rather that it was caused by adverse soils. To prevent the introduction of a possible new virus into the Philippines, Celestino T. Rivera, IRRI's assistant virologist, was sent to Malaysia to conduct transmission studies in close cooperation with Malaysian scientists. The group proved beyond all doubt that the disease was caused by a virus and that it was transmitted by the green leafhopper (*Nephotettix impicticeps*). They showed further that the list of susceptible and resistant varieties was essentially the same as that for the tungro disease. The conclusion was that *penyakit merah* and tungro were the same viral disease of rice.

The program was strengthened in 1964 by the arrival of Iida, who helped IRRI recognize the importance of the group of viral diseases and the advisability of having a resident virologist. Accordingly (as stated in Chapter 2), in 1965 Ling joined the IRRI staff as virologist.

Ling conducted numerous basic studies on the vectors transmitting tungro and grassy stunt. He worked out methods of screening for resistance, studied the time of feeding by the vector in relation to infection, and observed the time between feeding and the outbreak of symptoms. Both Ling and Ou suspected that the *mentek* disease of rice in Indonesia, which, like *penyakit merah* in Malaysia, had been attributed to various causes, was a viral disease. To pursue the matter, Rivera was sent to Indonesia in 1967 to work with local scientists and do transmission studies. The results showed that *mentek* was a viral disease transmitted by the green leafhopper and that rice varieties reacted to it in the same way as to the tungro disease. The conclusion, therefore, was that *mentek* and tungro were the same disease.

The identification of the nature and cause of the *penyakit merah* and *mentek* diseases of rice was a signal advance, because laborious studies of those maladies had been carried out for decades without conclusive results.

Ling's invaluable contributions to the knowledge of the viral diseases of rice in the tropics cannot be given detailed attention here. His careful, step-by-step studies of these diseases have provided rice scientists with a sound understanding of their nature, symptoms, and control.

IRRI pathologists, from the outset, worked on bacterial leaf blight and bacterial leaf streak, the two important bacteria-caused diseases of rice. Although the Japanese had studied both, little research had been conducted under tropical conditions.

During the first 5 years, Ou and his associates carried on many fundamental studies of these two main bacterial diseases. They accurately described the symptoms, worked out practical methods. of inoculation with the causal bacteria, screened thousands of varieties for resistance to the diseases, estimated yield losses, and studied variations in virulence of different isolates of the bacteria.

From the start, there was close cooperation between plant breeders and plant pathologists at IRRI. Varietal resistance is still the primary means of controlling all diseases of rice in the tropics whether fungal, viral, or bacterial.

ENTOMOLOGY

Pathak turned his attention first to the control of the rice stem borers. In 1962, he identified the three species most common in the Los Baños area — Chilo suppressalis (the most prevalent), *Tryporyza incertulas,* and *Sesamia inferens.* In greenhouse tests to determine whether there were variations in resistance to the insects, he found that when the plants were exposed to large numbers of the insects, the percentage of infested stems ran from as low as 8.4% to nearly 50%. This gave Pathak hope that varieties of rice could be bred with at least partial resistance to the stem borers. However, because such varietal control was only a possibility, he devoted more immediate effort to studying means of chemical control.

By 1963, he had shown that certain foliar sprays applied every 10 days could effectively control stem borer infestations and double yields over those of the control plots. He learned, however, that if the larvae got into the stems, foliar sprays would not kill them. Fortunately, that same year he tested several systemic insecticides and discovered that timet and the gamma isomer of benzene hexachloride (BHC) gave excellent control not only of the stem borers but also of other harmful insects such as stem maggots and mole crickets. Because BHC had lower mammalian toxicity than timet, Pathak concentrated his studies on BHC for the following 2 years.

During 1964, he and his research assistants conducted many fundamental greenhouse studies with BHC, including such topics as the mode of action of the insecticide, the optimum rate of application, and the duration of residues in the plants. In addition, he studied the effect of BHC on fish in the rice paddies, determining that amounts up to 2 kg active ingredient/ha did not harm those commonly raised in paddies.

It was in 1964, also, that the entomologists started working on the green leafhoppers and the brown planthoppers. IRRI's experimental fields were first severely damaged by the brown planthopper in 1964. By then, it was known that the green leafhoppers were vectors of the tungro virus disease. BHC controlled the planthoppers but not the leafhoppers. However, sevin proved effective against the green leafhoppers and when applied with BHC gave adequate control of the leafhoppers, planthoppers, and stem borers.

In 1965, emphasis was placed on varietal resistance to the rice stem borers. Pathak, who had been screening the world collection for resistant rice varieties since 1962, selected 1,351 for further study. About 60 of these were chosen for additional research because they not only showed some resistance to stem borers but had reasonably good plant type (not too tall or leafy) and were somewhat resistant to the rice viruses. From that group, Pathak selected a few varieties for intensive studies of the causes of resistance. He looked at such factors as ovipositional preference, silica content, chemical factors, and diame-

ter of stems and other morphological characteristics. Resistant varieties showed lower percentages of larval survival, lower larval and pupal weights, and slower rate of larval growth. There was a strong negative correlation between silica content of the rice varieties and the number of deadhearts in the plants (the first sign of stem borer damage). It was shown that the mandibles of larvae feeding on varieties with a high silica content became badly worn, whereas those of larvae feeding on low-silica plants appeared to be unaffected. Plants with thin culms seemed to have lower infestation rates.

Pathak concluded that the nature of varietal resistance to the stem borer was complex. An initial screening of more than 9,000 varieties from the world collection found none to be immune to stem borer attack, despite considerable variation in the degree of susceptibility. To this day, no modern rice variety has been bred that has more than medium resistance to the rice stem borers.

By 1966, the entomologists, although still working with BHC, discovered that diazinon was a more effective insecticide against the pink stem borer, the green leafhopper, and the brown planthopper. Unfortunately, however, within a few years the brown planthopper developed resistance to that insecticide.

In the same year, Pathak discovered that an Indian variety, TKM6, was consistently more resistant to stem borer attack than were most other varieties. It showed considerable resistance as well to the brown planthopper, the tungro virus disease, and bacterial blight; however, it had a weak stem and was tall and leafy. It was used, nevertheless, by the entomologists and the plant breeders as a parent in crosses with short, stiff-strawed varieties or lines.

One cross that turned out to be particularly successful was that between TKM6 and (Peta/Taichung Native 1). In tests in 1967, many of the selections from that cross in the F_4 and F_5 generations proved to be resistant to stem borers and other insects and to several diseases as well. In 1969, one of those selections was designated as IR20 and was the first IRRI-named variety that had a truly broad spectrum of resistance to insects and diseases. Although it inherited a rather weak stem from its TKM6 parent and thus could not stand heavy applications of nitrogen, its disease and insect resistance and its superior grain quality nevertheless made it popular in South and Southeast Asia for several years. Indeed, it was a signal advance for IRRI.

In 1966-67, Pathak screened more than 1,000 varieties for resistance to the brown planthopper, which was becoming a major pest wherever 2 or more crops of rice were grown annually. Although TKM6 showed significant resistance to the brown planthopper, in 1967 the entomologists discovered that another Indian variety, Mudgo, was essentially immune to attack by that insect. Because Mudgo was tall and leafy and had poor grain quality, it was not useful as a variety, but its high resistance to the brown planthopper made it a most valuable parent in IRRI's rice breeding program. When Pathak crossed IR8 with Mudgo, he discovered that 75% of the F_2 population were resistant to brown planthopper attack and 25% were susceptible. Thus, resistance, like short stature, conformed to the Mendelian ratio of 3:l.

By 1967, Pathak had worked out an excellent method for rapid screening of varieties at the seedling stage for resistance to both leafhoppers and planthoppers, a method still being used by IRRI.

AGRICULTURAL ENGINEERING

Johnson got his research under way (as mentioned in Chapter 2) in early 1963, after the construction of IRRI's 80-ha experimental farm had been completed. During the next 4 years he worked principally on:

- testing and modifying equipment for wetland preparation,
- modifying the design of a cone thresher,
- measuring irrigation water use and losses, and
- studying the relationships between spacing and yield components.

Johnson realized that heavy-textured rice soils in Asia were normally plowed and harrowed while flooded because animal-drawn equipment required too much draft to prepare the land when dry. He felt, however, that animal power was inefficient and that ways should be found to do the job with tractors. He devoted a great deal of effort to testing and redesigning existing equipment for wetland preparation. Working with tractors ranging in size from small Japanese 2-wheeled power tillers to 36-hp 4-wheeled tractors, he determined the optimum ratio for traction and flotation for various size tractors and designed and tested some 10 different types of lugs. He measured the physical soil constants for the Maahas clay soil on the IRRI farm. He tested the scheme of using two 36-hp tractors together by removing the front wheels of each unit and hitching the front of one to the back of the other in a pivot arrangement. In this way he had a power source with 4-wheel drive, center pivoting action, power steering, and weight balance to prevent the elevation of the front end. He also developed wide rotary tillers driven from the power takeoff of 4-wheeled tractors.

From farmers and extension workers, Johnson learned of the demand in the rice belt of Central Luzon for a simple, low-cost, high capacity contractor-type thresher. He was attracted by a cone-type thresher developed by W.F. Buchlele at Michigan State University. As reported earlier, Johnson and Prince Devakul, the visiting engineer from Thailand, worked on improving the cone thresher. They attempted to reduce choking, to increase the feeding rate, and to simplify the construction of the thresher so that it could be mounted on a tractor and operated from the power takeoff.

Although three separate models incorporating those features were built between 1963 and 1965, it was impossible to improve the thresher sufficiently to recommend its use in the humid tropics, largely because of poor separation of straw and grain and, also, high power requirements. The project was therefore dropped.

A substantial grant from USAID and the arrival of Khan in 1967 renewed the effort to develop rice threshing equipment. In 1967, prototypes of both table- and drum-type threshers were built, paving the way for later superior models.

From 1963 through 1966, Johnson studied water losses by evapotranspiration and seepage on IRRI's experimental farm, He found a high positive correlation between solar radiation and evapotranspiration, with the loss from this source amounting to more than 8 mm on a hot sunny day and to less than 2 mm on a cool cloudy day. Along with the agronomists and physiologists, he found a high correlation between solar radiation and dry matter production of rice.

Johnson's background and interests made him part engineer and part agronomist. During the 4 years that he devoted to research at IRRI, he conducted precise studies of the relationships between spacing and yield components. Although research in this category was being carried out by the agronomists and physiologists, Johnson used unique planting designs that permitted him to develop accurate mathematical equations for expressing the relationships between planting density and yield components. In a dryland direct-seeded experiment, for example, he obtained positive correlation coefficients of 0.99 between the land area available to each plant and both the number of panicles and the total grain weight per plant. The seeding density was such that the space per plant ranged from only a few centimeters to 500. He conducted similar experiments with transplanted rice. In one such study, he used 41 spacings ranging from 1 to 400 plants/m^2 and developed mathematical relationships between spacing and such factors as leaf area index, light transmission ratio, and yield components.

CHEMISTRY

The work in the Chemistry Department fell into two categories — biochemistry and cereal chemistry, which are discussed separately here.

Biochemistry

Akazawa, the head of the Chemistry Department, arrived in mid-1962. His previous training and experience were in basic biochemistry and he continued working in that area at IRRI. During his 2 years at the Institute, he concentrated mostly on studying the nature of the enzymatic mechanism of starch formation in ripening rice grains and the characteristics and changes of Fraction I protein in the rice plant.

A brilliant chemist, Akazawa contributed to the knowledge of the basic biochemical processes occurring in the rice plant. Such findings, although not directly applicable to IRRI's problem-oriented research program, were nevertheless of lasting value to other scientists engaged in similar pure research.

When Natori replaced Akazawa in 1965, he studied primarily the function of the amino acid histidine on the growth and development of the rice plant. Through water-culture techniques, he demonstrated that rice plants developed normally when the sole nitrogen source was any of the common amino acids, with the exception of histidine. When fed histidine only, the plants developed normally until they reached the reproductive stage. From that point on, no starch accumulated in the spikelets; thus, there was no grain formation. At harvest time, the histidine-fed plants had only 80% of the dry weight of the

plants fed with ammonium sulfate. This led to a series of basic studies on the nature of histidine-induced sterility in rice plants. Again, such studies were of scientific interest and value. But because rice plants in nature do not grow in a medium where the only source of nitrogen is histidine, Natori's research had no practical application in IRRI's goal to increase the productivity of the rice plant.

After Natori returned to Japan, IRRI decided to concentrate on cereal chemistry, which had a direct bearing on developing varieties of rice with superior grain quality.

Cereal chemistry

During the 6-year period (1962-67) covered in this chapter, Juliano conducted hundreds of studies of the physicochemical properties of the rice grain. By investigating the composition of the proteins and starch, he was able to characterize fully the chemical properties of rice and to relate them to eating and cooking quality and nutritional value.

He analyzed IRRI's world collection of rice varieties for protein content and concluded initially that because the variations ranged from 5.6 to 18.2%, there was hope of developing improved varieties with a genetically high protein content. Although the project was pursued industriously by both the cereal chemist and the plant breeders, it was not finally successful, chiefly because a high negative correlation between protein content and yield was found.

To determine the preferred eating and cooking quality, Juliano analyzed the leading varieties from some six Asian countries. In addition, he ran tasting panels in cooperation with the Department of Home Technology of the College of Agriculture. He concluded from those studies that the amylose and amylopectin contents of the starch 1argely determined the cooking and eating quality of rice. The higher the proportion of amylose (and consequently the lower the proportion of amylopectin), the greater the tendency of the rice to cook dry and fluffy and the greater the resistance of the grain to disintegrate even after long cooking. It became clear that the rice-eating population of the Philippines and Indonesia preferred a medium-amylose rice. IRRI's early varieties were too dry-cooking and tended to harden excessively when they cooled. After the first 2-3 years, IRRI's plant breeders made a strong effort to create some varieties that would meet the quality preferences of Filipinos and Indonesians. The first variety to meet the requirement was named IR24 in 1971 (the cross having been made several years earlier).

The broad scope of Juliano's work in cereal chemistry can be surmised from the following partial list of the topics it covered: the amino acid content of rice proteins, fatty acid content of the lipids of rice, changes in the cooking and eating quality during storage, methods for testing rice quality, physicochemical studies of rice starch and rice protein, amylose and eating quality of rice, grain hardness and grain structure, changes in physicochemical properties during ripening, endosperm capacity, nutritive value of rice, parboiling and grain properties, relationships between starch gelatinization temperature and other properties of the grain, and the protein content of wild species of rice.

Without question, IRRI's research in cereal chemistry not only advanced decidedly the world's knowledge of the cooking and eating and the nutritional qualities of the rice grain but pioneered in certain aspects of the studies.

AGRICULTURAL ECONOMICS

Ruttan arrived at IRRI in May 1963. During the first 6 months, he traveled in Asia to get acquainted with the rice industry and outlined the research and training program he intended to pursue. In addition, he initiated three research projects:

1. an economic analysis of the results of insecticide experiments,
2. a comparison of the impact of yield per hectare and area planted on rice production in Southeast Asia, and
3. the implications of national rice marketing and pricing policies in Southeast Asia.

The last two were major projects and were continued through 1966. The results provided an extremely valuable set of data on the sources of output growth in Southeast Asia during the previous half-century, the most intensive studies being conducted in the Philippines, Thailand, and Taiwan. Ruttan showed that the only Asian country that depended solely on increased yield per unit area of land for its expanding rice production was Taiwan. In the other countries, yield had remained rather constant, at least during the past 2 decades, and increases in production came from bringing more land into rice cultivation. He concluded, further, that up to that time, variations in environmental factors (soil, season, water, and weather differences) rather than varieties or cultural practices determined the yield differences that occurred. Ruttan predicted accurately that the decade of 1960-70 would be viewed by historians as the closing of the land frontier in several important rice-growing countries of Asia and that further increases in production would have to come from the use of improved varieties and better cultural practices, including more irrigation and wider use of fertilizer. He also deduced, from his market and price studies, that rapid growth in productivity was not likely until farmers exhibited both a hectarage and a yield response to changing prices, something that has occurred only in limited areas up to 1965.

Barker joined the IRRI staff at the time when IR8 had been widely distributed in the Philippines and elsewhere. He therefore launched a sizable farm survey in the Philippines to study changes in yield, cultural practices, and costs and returns associated with the adoption of new varieties. In the survey, conducted in the provinces of Pampanga and Bataan, data were recorded separately for the following individual or groups of varieties: IR8, BPI-76, other Philippine Seed Board-approved varieties, and local non-Seed Board-approved varieties.

The results of the study indicated that there were no consistent yield nor income differences between farms that planted Seed Board varieties other than IR8 and BPI-76 and those planted to local varieties. However, farmers planting either IR8 or BPI-76 recorded significantly higher yields, cash outlays, labor inputs, and net returns than did farmers who grew other varieties. Barker also

found that, by and large, owners operating their farms tended to do better than tenant farmers operating on a 50-50 division with their landlords.

Barker also made a study of Rizal Province, where IR8 was being planted extensively. The harvests of 200 farmers planting IR8 in the 1967 dry season were compared with those of 127 who planted Binato, a tall, leafy variety introduced from Thailand. The group planting IR8 obtained an average yield of 5,852 kg/ha; the group growing Binato had 3,165 kg/ha. Although the farmers who grew IR8 spent more on inputs, they showed a net profit of ₱1,615, compared with ₱921 for the Binato growers. The area planted on each farm was about the same (0.64 ha) for the two groups.

A third study was made in Laguna Province. A group of 155 predominantly tenant-operated farms was surveyed. The farms had been visited earlier in studies conducted by the College of Agriculture and previous records of performance were available. Barker divided the farmers into three groups — adopters of IR8, nonadopters, and partial adopters.

Except for one season, when typhoons severely damaged the rice crop, the results obtained were similar to those of the other surveys, with IR8 producing higher yields than local varieties and at greater costs of inputs. Laguna farmers were disappointed in the low price they received for IR8, for the millers discounted it because of low grain quality. Nevertheless, most farmers who had adopted the variety did so because they expected higher yields and, having achieved that, said they would rather wait for the next improved variety than return to the traditional varieties and cultural practices.

The described surveys were mainly on irrigated farms. That the modern varieties became fully acceptable to farmers in the Philippines is evident, for today essentially 100% of the rice area with controlled water supply is planted to modem varieties (though IR8 itself is no longer popular in the Philippines).

Barker made a study of the optimum economic level of nitrogen application, based on fertilizer experiments by IRRI's Agronomy Department both in Los Baños and at the Maligaya Rice Research and Training Center in Central Luzon. He set the arbitrary dividing line between profitable and unprofitable at a benefit-cost ratio of 2.5:l. He then determined where the cutoff point for IR8 and for local varieties would be if nitrogen from 0 to 120 kg/ha were applied at 30-kg increments. He concluded from the studies that in the wet season, the optimum dose of nitrogen would be 60 kg/ha, but in the dry season, 120 kg/ha could be applied with a comfortable profit margin. As expected, the tall tropical varieties did not respond profitably to more than 30 kg/ha in the dry season and usually gave the highest profit during the wet season when no fertilizer was applied.

Another project that Barker undertook in 1966-67 was to study the economic relationships between rice yield and such cultural practices as land preparation and weeding. The general conclusions were that under the conditions on IRRI's experimental farm, yields did not increase above a certain minimum of land preparation, which was three passes with a carabao and comb harrow or one pass with a harrow drawn by a 6-hp 2-wheeled tractor. However, he found that the better the land preparation, the fewer the weeds that had to be

removed later. This reduction in weeding was evident up to five harrowings with the 2-wheeled tractor. Beyond that, further land preparation had no effect on weed population.

STATISTICS

In addition to advising the research staff on their statistical problems, Oñate devoted much of his time to working out sampling techniques for field experiments and farm surveys. That interest is evident in the following list of his research projects: variability and size of sample, sampling plant height and tiller count, sampling for stem borer attack, estimating losses from stem borer damage, estimating leaf area, size and shape of plot, estimation of rice production in farmers' fields, number of replications in field experiments, multivariate analysis in rice research, and collection of rice statistics at the farm and household level. The information gathered from these studies was eminently helpful to the scientists, particularly the agricultural economists who were involved in farm surveys.

OFFICE OF COMMUNICATION

Even as late as 1967, the Office of Communication encompassed the activities now handled by the Office of Information Services and by the Rice Production Training and Research department. Although overlapping somewhat in the early years, the two groups of activities are taken up separately in this section.

Information services

In his first year (1963) at IRRI, Byrnes and his staff edited the 24 papers presented at a symposium on rice genetics and cytogenetics and the 28 papers from a symposium on the rice blast disease. In addition, they handled all arrangements with the printers for publishing the papers on book form.

That year, also, Byrnes organized and supervised the Institute's first Field Day, to which were invited heads of various government, educational, and business organizations. He helped the scientists prepare visual aids to tell the story of their research results. The field day was an extremely successful event attended by 116 people. A follow-up survey of the reactions of the participants revealed that they were particularly impressed with the field experiments and the accompanying displays of explanatory materials. Mentioned most frequently were the field plots featuring improved varieties and stem borer control and the display on the nature of lodging resistance.

Later, Byrnes started the bimonthly publication *The IRRI Reporter,* which is still printed quarterly, supervised the production of an IRRI film entitled *Harvest of Energy,* and handled the editing and publication of a series of IRRI technical bulletins. Moreover, he gave seminars explaining the principles of the science of communication, particularly in relation to interpreting scientific results for the extension worker and the farmer.

In short, the information services of the Office of Communication handled (as is generally true today, but on a broader scale) all editorial work for all

printed material emanating from the Institute, undertook all negotiations with printers and publishers, organized field days and group tours of the experimental fields, prepared releases for the mass media, handled all photographic work and the operation of all projection equipment at seminars and other public meetings and conferences, maintained an art section for preparing graphs and other illustrative materials for scientific papers and publications by the staff, and continuously managed a set of demonstration plots to show visitors the latest findings of IRRI scientists.

Byrnes found time to conduct some communications research, chiefly through IRRI research scholars and graduate students from the College of Agriculture who majored in communications and did their thesis problems under his direction. Two important studies that had a bearing on transferring IRRI's technology to farms were:

- identifying the subject matter that extension specialists considered essential in rice production and devising a test system capable of measuring verbal knowledge and understanding with respect to such subject matter, and
- analyzing the adoption of IR8 by a group of 75 farmers in a Philippine village. In the second year (1967) of this study, when a large majority of the farmers were growing IR8, 70% said they had changed from the traditional variety to IR8 after they had seen it growing in a neighbor's field and realized that it was yielding better than the old variety.

Rice production and training program

Byrnes and Golden worked closely (as described in Chapter 2) in getting the rice production and training program off to a strong start. In 1965, Golden was running a year-long course for extension workers in the Agricultural Productivity Commission in the Philippines. The participants spent the first 6 months in training at IRRI and the last half of the year were placed, in teams of two, in practical production situations throughout the country. There, closely supervised by Golden, they made all the management decisions connected with growing a crop of IR8. In 1966, the same sort of course was held, but the participants came from many agencies in the Philippines, both government and private. By the end of that year, a sufficient number of Filipinos had been trained to provide the Philippine agencies with enough qualified teachers to run their own training courses. At the start, the courses were conducted by the College of Agriculture, but soon other agencies ran them as well. In 1967, IRRI gave its first really international 6-month rice production training course, with 35 participants from 6 countries—Sri Lanka, Bangladesh, Pakistan, Indonesia, India, and the U.S. (Hawaii). The Institute continued to offer short courses in tropical rice production and to include in almost all of its training courses a few selected Filipinos.

The important feature of all the courses, whether for 6 months or less, was that each trainee spent at least half of his or her time performing every operation necessary to produce a crop of rice. At graduation the trainees not only had done all that the farmer would need to do to get a high rice yield but

also were able to identify every major insect pest and disease of rice and to recognize nutritional deficiencies as well.

Golden kept in touch with the Philippine graduates of his practical training courses and worked out cooperative arrangements with them to conduct applied research trials to test Institute findings. This work began in 1964-65 and at that time emphasized the use of BHC for stem borer control. In 1967, Golden and his assistants conducted 40 fertilizer trials with IR8 in cooperation with the Agricultural Productivity Commission. They also arranged for cooperative trials with the Bureau of Plant Industry to test various insecticides in 16 provinces of the Philippines. In addition, Golden ran 23 variety trials with 9 varieties or genetic lines in each experiment. He often obtained yields of 5 to 7 t/ha from IR8 and IR5. These experiments helped to spread the new technology and gave the extension agents the confidence they needed that rice yields could be greatly increased on farmers' fields.

An IRRI rice production training course in action. In 1966, Governor San Luis of Laguna Province enrolled in the course. Here he is shown learning how to use a comb harrow drawn by a carabao.

The 10 graduates of IRRI's first Rice Production Training Course pose with Chandler, Byrnes, Golden, and F.D. Gorrez, administrative assistant, after graduation 6 July 1965. All trainees were employees of the Philippine Commission for Agricultural Productivity. From left (front row) are Arturo Pesayco, Rodolfo Escalada, Pedro Agcaoili, Gorrez, and Golden. Second row: Saturnino Ronquillo, Antonio Balneg, Lolita Lim, Chandler, Leticia Baluyot, Byrnes, Erlinda Alconcel, Eddie Chu, and Gregorio Bautista.

IRRI's applied research trials in the Philippines led to the development in 1968-69 of the *minikit,* a package that gave the farmers a set of all the inputs — from the seed of an improved variety to fertilizer and insecticides — necessary to get high yields. The idea caught on and by the early 1970s was being used in many other countries of South and Southeast Asia and Africa.

SYMPOSIA AND OTHER INTERNATIONAL ACTIVITIES

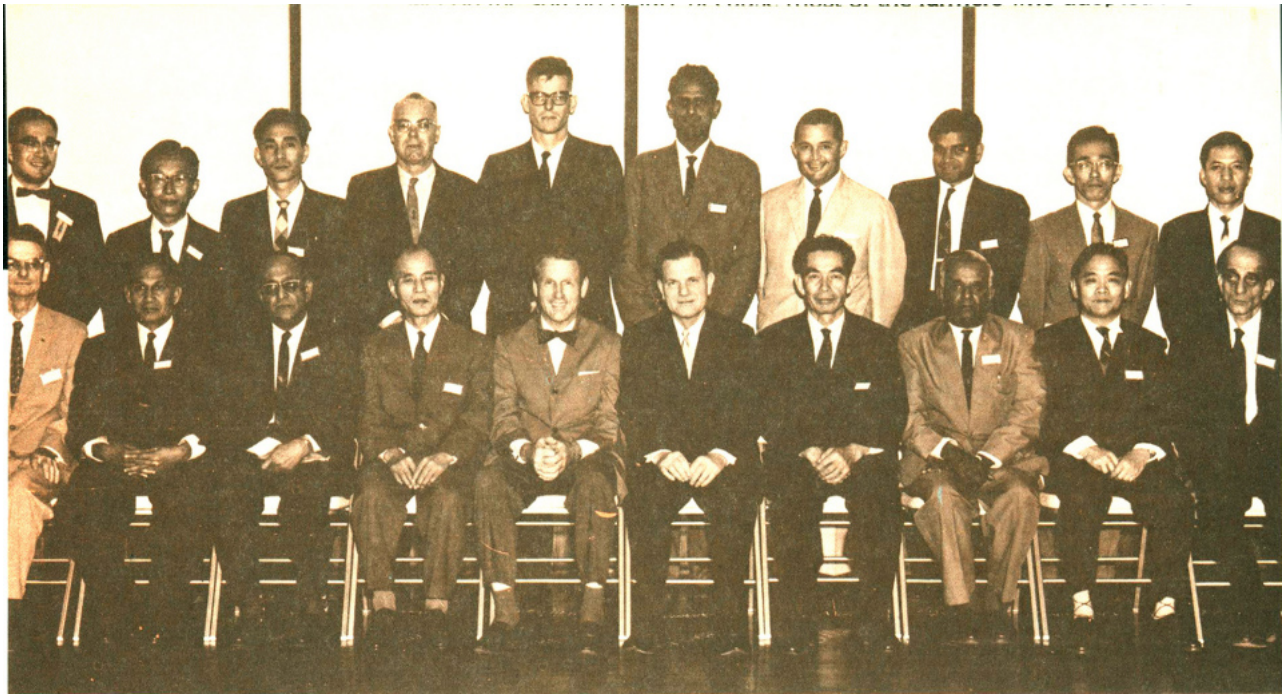
During 1962-67, IRRI held several symposia on specific scientific disciplines and started its outreach program in five countries.

Symposia

The concept of holding periodic conferences or symposia on the various scientific disciplines as applied to rice was incorporated into the earliest plans for IRRI's program. It was Wortman, however, who started these assemblies at an early stage of the Institute's development. Financial support for all the conferences through 1967 came from the Ford Foundation.

The principal reasons for holding symposia were to bring together the world's most knowledgeable scientists on a given subject, to arrange for the presentation of well-prepared and exhaustive (occasionally exhausting!) papers on the various aspects of a given discipline, to identify priority areas of future research, and to publish the proceedings in book form.

In preparing for a symposium, the first step was to invite to IRRI half a dozen or so experts in a given field to plan the program. Together with the staff members concerned, they outlined the scope of the conference and decided



Participants in IRRI's first symposium, held 4-8 February 1963, on rice genetics and cytogenetics. Left to right (seated): N.E. Jodon, R.H. Richaria, N. Parthasarathy, T. Morinaga, R.F. Chandler, Jr., H.H. Kramer, H. Kihara, K. Ramiah, H.W. Li, S. Sampath. Standing: T.T. Chang, H.I. Oka, K.L. Ying, M.T. Henderson, P.R. Jennings, R. Seetharaman, S. Wortman, S.V.S. Shastry, M. Takahashi, C.H. Hu.

which scientists to invite to present papers and how many to invite as participants.

Preparations started many months in advance of the meeting. Scientists were asked to send in their papers several weeks before the conference so that they could be edited and duplicated before the event took place. A well-known scientist was asked to moderate the sessions and there was adequate opportunity for free discussion.

The first symposium took place 4-8 February 1963, on the subject of rice genetics and cytogenetics. It was moderated by H. H. Kramer of the University of Nebraska and was attended by 102 persons from 26 institutions in 9 countries. The program consisted of 24 invitational papers, plus a report of the formal discussion and a resumé of the entire conference. Chang took care of many of the organizational details; and he and Jennings, with the help of H. I. Oka and S. Sakamoto on the Japanese treatises, edited the invitational papers before the meeting began. The proceedings were published by the Elsevier Publishing Company of Amsterdam. The symposium marked the first time in history that the world's experts in the genetics and cytogenetics of rice had been brought together.

In July 1963, IRRI held a symposium on the rice blast disease. It was organized by Ou with the assistance of several consultants and moderated by Jennings, whose original training had been in plant pathology. The program consisted of 28 invitational papers, 6 discussions, and a resumé. The conference was attended by about 50 scientists who came from 17 institutions and organizations in India, Taiwan, Thailand, the Philippines, and the U.S. The proceedings of this symposium and the later symposia reported here were published by the Johns Hopkins Press.

IRRI's third symposium, on the major insect pests of the rice plant, was held in September 1964. About 100 scientists from 13 countries attended and 36 papers were presented. The sessions were moderated jointly by Leo D. Newsom of Louisiana State University and Reginald H. Painter of Kansas State University. Pathak was the technical editor and coordinated all arrangements for the symposium. A. A. Muka of Cornell University, then a visiting scientist at IRRI, assisted materially in checking scientific details of the papers.

The fourth symposium held in February 1964 was on the mineral nutrition of the rice plant. It brought together about 75 scientists from 18 countries. Tanaka was the coordinator and Ponnamperuma served as moderator. The program consisted of 26 technical papers, along with the usual discussion sessions and resumé.

IRRI's last symposium during the period under discussion took place in April 1967 and covered virus diseases of the rice plant. It was attended by participants from 11 countries, 19 of whom presented papers. Ou and Ling were the technical editors; the moderator was J. C. Walker of the University of Wisconsin.

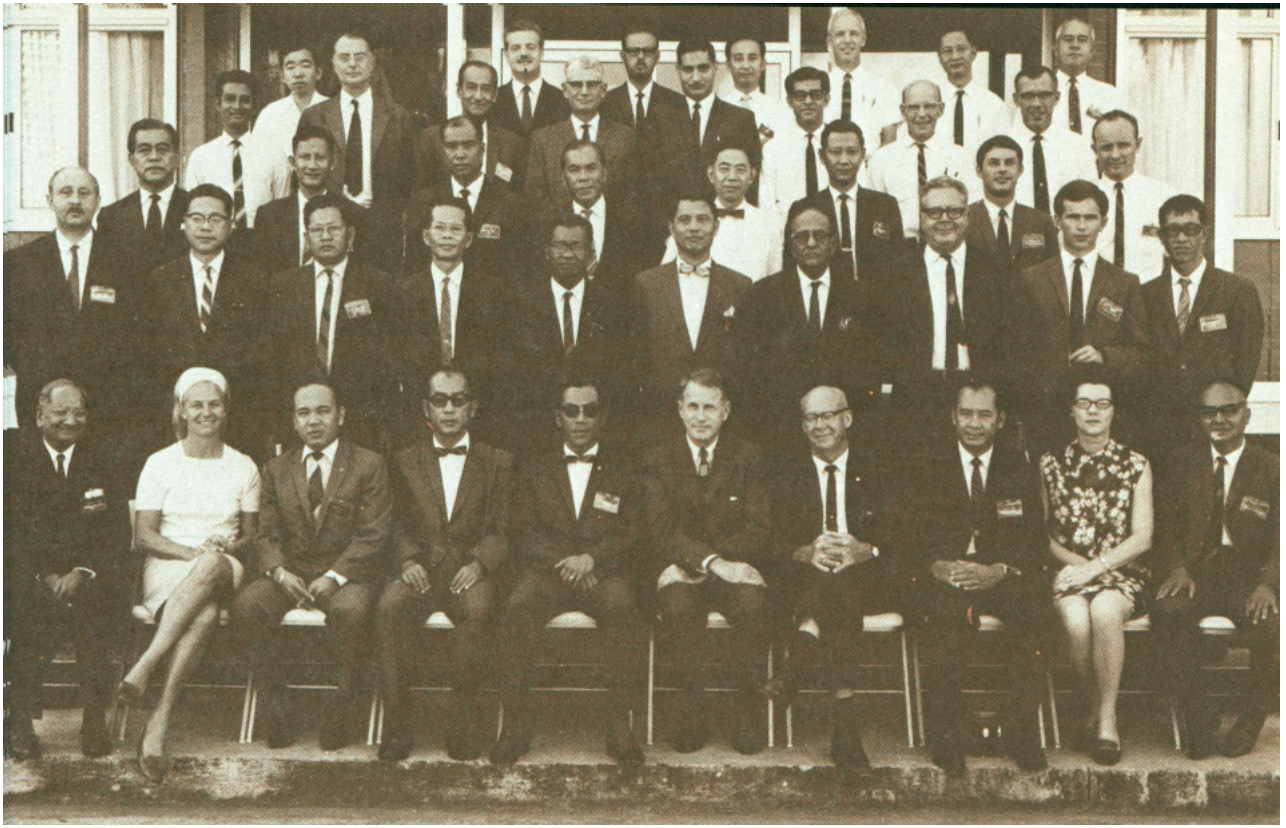
The International Rice Research Conference became an annual event starting in 1968. It provides an excellent opportunity to bring together the world's scientists and it has greatly strengthened cooperative research within national programs. The annual conference also provides participants in IRRI's international networks (especially the International Rice Testing Program) an opportunity to hold annual planning meetings.

IRRI has continued to hold symposia from time to time. The conferences, from the start, have been unqualifiedly successful. The published proceedings are in the libraries of essentially all experiment stations or universities in rice-growing countries around the world. In nations where foreign exchange regulations make purchasing from abroad difficult, IRRI has made the material available to institutions free of charge.

Early outreach programs

Until 1965, IRRI's international activities consisted principally of training courses, distribution of rice seed, extensive travel by IRRI scientists (during which arrangements were made for joint research projects between IRRI and cooperating institutions), and the symposia just described. In addition, IRRI made small grants to institutions in Japan, the Philippines, and Taiwan to carry out fundamental studies in which IRRI was interested but which the other organizations were better equipped to undertake.

The first so-called outreach program involving IRRI was in Bangladesh. In discussions with Institute administrators and scientists, the Ford Foundation decided to have an accelerated rice production program in that country and in 1965 hired a plant breeder, L.P.V. Johnson from the University of Alberta, to handle it. Johnson first spent several weeks at IRRI to get acquainted with the rice breeding program and to pick up genetic materials for testing in Bangladesh. Beachell gave him a set of the 303 varieties that constituted (as mentioned earlier) IRRI's first major international rice testing program.



Row 1. left to right: Kanwar Sain, Mekong; Madeleine C. Blanchet, Mekong; Makham Liengphilavanh, Laos; Prakob Kanjanasoon, Thailand; Boonrod Binson, Thailand; Robert F. Chandler, IRRI; G. Hart Schaaf, Mekong; Nguyen Ngoc Tao, Vietnam; Anne Marie Milindavanij, Mekong; Isidro S. Macaspac, Mekong. Row 2, left to right: M.J. Van Liere, Mekong; Peter Kung, FAO; Cao Van Nau, Vietnam; Trat Quan Tien, Vietnam; Sombhot Suwanwaong, Thailand; Lt. Col. Myo Mint, Burma; N. Parthasarathy, India; Ben-nun Raanan, Israel; G.H. Assen, Mekong; Lykhoua Lyfoung, Laos. Row 3, left to right: Col. Arturo D. Sevilla, Philippines; Aung Khin, Burma; U Khin Mg Tint, Burma; Roem Purnariksha, Mekong; S.H. Ou, IRRI; Ponchai Pookamana, Bangkok; Michel R. Tisserand, Mekong; Randolph Barker, IRRI. Row 4, left to right: S.K. De Datta, IRRI; G. Hauser, FAO, Rome; H.N. Mukerjee. FAO. Bangkok; Henry M. Beachell, IRRI; D.S. Athwal, IRRI; Amir U. Khan, IRRI; D.E. Seaman, IRRI; A.C. McClung, IRRI. Row 5, left to right: S. Yoshida, IRRI; Ch. A. Massaux, Mekong; R.G. Bonnefond, FAO, Cambodia; T. Yoshida, IRRI; S. Johnson, IRRI; K.C. Ling, IRRI; W.G. Golden, Jr., IRRI.

Although Johnson worked for the Ford Foundation, it was understood that IRRI would support him with breeding materials and visits by specialists. Because there was then no experimental area at Joydebpur and the land of the old experiment station near Dacca had been taken over as a site for government buildings, Johnson had a difficult time initiating his program. He finally obtained a tract of land at the Savar Farm, a large, government-run dairy enterprise. There he not only tested many IRRI lines and varieties but was the first to introduce in sizable quantities IR8-288-3 and IR9-60, two of IRRI's promising selections in 1965. Two people who gave great assistance to Johnson in dealing with government officials and launching his program were Haldore Hanson, Ford Foundation representative in Pakistan, and Robert D. Havener, there under a Ford Foundation contract with Michigan State University.[3]

[3] It is interesting to note that Hanson became director general of CIMMYT in Mexico in 1972 and Havener succeeded him in 1978.

Although the Ford Foundation had direct-hired Johnson for its rice program in Bangladesh and similarly placed Rufus K. Walker in Malaysia for a short period, it decided in 1966 to change its policy by providing funds to IRRI, which would hire the rice specialists and support their activities from the Ford funds.

The first arrangement of this type was in Pakistan. Hanson suggested that IRRI use its Ford Foundation grant to employ Kenneth Mueller as a rice specialist to lead the Pakistan accelerated rice production project. Hanson had met Mueller in Iran and learned that he was dissatisfied with what he could accomplish working for a commercial firm there and that earlier he had been a rice extension specialist in California. Mueller was hired and did a first-class job in introducing IR8 in a massive way. The variety was dramatically successful in that environment of high solar radiation and abundant irrigation water. When properly managed, IR8 yielded three to four times as much as local varieties and enabled the country to increase its rice production substantially.

Much of Pakistan's export trade in rice depended, however, upon Basmati varieties, which were in high demand because of their aromatic quality and the characteristic elongation of the grain during cooking. Unfortunately, the Basmati rices had a poor plant type and lodged badly, with resultant low yields. Despite this production constraint, Pakistan's progress in substituting the high-yielding IR8 was held back, because IR8 could not command in foreign markets the price that the uniquely popular Basmati did. Because of genetic barriers, progress in breeding Basmati varieties with short, stiff straw has been slow. Nevertheless, the work has been going forward and improved Basmati types are now available.

IRRI's third outreach program, like the Ford Foundation's original effort in Bangladesh, did not include an Institute-hired person. The Rockefeller Foundation had an agricultural program in Thailand and in 1966 decided to add Ben R. Jackson (who is still with the program) as a rice breeder As with Ford's men in Pakistan, Rockefeller made it clear that Jackson would look to IRRI for full supporting services and that, conversely, IRRI could depend upon Jackson as being its rice scientist in Thailand.

Jackson spent several months at IRRI before starting his work in Thailand and carried a large collection of IRRI materials to his new post. He had not bred rice before but had worked with sorghum and millet in Ethiopia. Before joining the Foundation in 1966, he had been an associate professor of agronomy at Oklahoma State University.

Jackson, who had a pleasing personality and got along well with people, soon worked out a smoothly functioning cooperative program with the Rice Department in Thailand. He tested IRRI's and other breeding materials thoroughly and crossed the better selections with leading Thai varieties. This was the beginning of the program that resulted in the development of the RD series of varieties, many of which combine disease and insect resistance with tolerance for varying water depths, good grain quality, and high yield potential.

The outreach program expanded considerably in 1967 when IRRI entered into an agreement with USAID and the Indian Government to place four scientists at Rajendranagar, near Hyderabad, in the All India Cooperative Rice Improvement Project (AICRIP). IRRI agreed to hire, with USAID funds, an agronomist, a plant pathologist, and an entomologist. In addition, the Rockefeller Foundation assigned Wayne H. Freeman as rice breeder and joint coordinator of the project; S.V.S. Shastry, an Indian geneticist and plant breeder, was the coordinator. Hired to occupy the three IRRI posts were Hillenius ten Have, agronomist, Harold E. Kauffman, plant pathologist (who later joined IRRI in the Philippines), and John A. Lowe, entomologist.

The AICRIP program was a success and continues as such today. One of its primary contributions has been to bring rice scientists from the far reaches of India together at annual conferences and to gain their participation in cooperative research projects. Previous to the creation of AICRIP, Indian scientists tended to work within their respective states and to have little contact with their counterparts in other sections of the country.

In 1967, also, the Ford Foundation decided to enlarge its work with rice in Sri Lanka and Indonesia. As reported earlier, IRRI assigned Moomaw to the Sri Lanka project, and Mueller was moved from Pakistan to Indonesia. Gordon McLean was hired to replace Mueller in Pakistan. That same year, L.P.V. Johnson returned to his post at the University of Alberta and Rufus Walker was assigned to Bangladesh. Thus, by 1968 IRRI had active outreach programs in Bangladesh, Pakistan, Indonesia, Thailand, Sri Lanka, and India.

Although the programs varied in accordance with national priorities, common to all of them were the selection of outstanding young scientists for training at IRRI or elsewhere, the testing and dissemination of improved rice varieties, and the strengthening of local research programs.

CHAPTER 5 Financing of IRRI

The purpose in reporting the funding of IRRI through 1971 is, first of all, to give proper credit to the major donors without whose support IRRI would not have come into being. Secondly, it is to explain the need, since the cost of operating the Institute turned out to be considerably higher than originally estimated, for obtaining assistance from organizations other than the Ford and Rockefeller Foundations. Lastly, some documentation is due certain members of the Board of Trustees and the administrators of IRRI for their efforts to attract other donors several years before the Consultative Group on International and Agricultural Research (CGIAR) existed.

CAPITAL AND OPERATING FUNDS

As reported in Chapter 1, the Ford Foundation contributed a total of $7,150,000 toward constructing and equipping the initial buildings. In 1963, it made a supplementary grant of $360,000 to build the women's dormitory and to purchase additional equipment. Thus, IRRI's capital costs during its first 2 years amounted to $7,510,000, which was provided entirely by the Ford Foundation.

The Institute's operating funds during the first decade or so can be classified as:

- unrestricted core budget funds for general operating expenses, including salaries, supplies, power, water, etc., and
- funds designated for special purposes or projects at IRRI or in cooperating countries.

The 1960-71 grants to IRRI for operating expenses are seen in the table.

Rockefeller and Ford Foundation support

As is evident from the table, the Rockefeller Foundation alone supported IRRI's core budget through 1964. The figures for the first 5 years, however, do not reflect that foundation's full contribution, because they do not include the expenditures for salaries, perquisites, and travel of foundation scientists assigned to IRRI. A rough estimate of that amount is $1,500,000, which, when added to $7,136,000, brings the Rockefeller Foundation's total contribution to IRRI's core budget for the first 12 years to about $8,636,000.

The Ford Foundation trustees approved in 1964 (to become effective in 1965) a 7-year appropriation of $4,900,000 to IRRI to cover one-half of its operating costs over that period. (When Hill was asked why he chose to recommend to the Board a 7-year grant, his reply was, "Well, it's more than five and less than ten.") The amount granted was based on the Institute's current

Amounts and sources of funds (in thousands of dollars) for core budget and for special projects, 1960-71.

Year	Rockefeller Foundation		Ford Foundation		USAID		All other[b] sources	Total
	Core budget	Special projects	Core budget	Special projects	Core[a] budget	Special projects	Special projects	
1960	160						-	160
1961	229						-	229
1962	405			750[c]			-	1,155
1963	515						32	547
1964	625						61	686
1965	635		635	800		360[c]	34	2,464
1966	690		690				81	1,461
1967	715	50	715	430		8	62	1,980
1968	772	168	772	268		104	115	2,199
1969	890	169	890	120	120	277	56	2,735
1970	750	15	750	384	424	243	72	2,638
1971	750	52	750	609	872	290	564	3,887
Total	7,136	454	5,202	3,574	1,416	1,282	1,077	20,141

[a]The USAID figures represent amounts actually received by IRRI. Appropriations were larger. [b]There were no grants to core budget from *other sources*. [c]3-year grants.

needs plus a 7% annual increase. At that time, Harrar and Hill told the trustees of their respective foundations that they expected the annual contribution for each organization to reach a figure of $750,000. There were discussions to the effect that a ceiling of that amount should be established and that every effort should be made to find other donors to share the funding.

The Rockefeller Foundation preferred to make annual grants to IRRI rather than a lump sum contribution for a 7-year period. The effect was the same for they kept on schedule and made the funds available promptly after each appropriation was made.

IRRI's international program was boosted powerfully by two 3-year grants from the Ford Foundation, one for $750,000 in 1962 and the second for $800,000 in 1965. The funds were used for training, for foreign travel of the IRRI staff, for IRRI symposia, and for cooperative research with national programs.

By 1967, Ford began appropriating funds to IRRI for the foundation's rice development programs. This accounts for the substantial sums recorded under special projects from 1967 to 1971. From those grants, IRRI hired and paid the salaries and supporting costs of field staff such as Mueller in Pakistan (and, later, in Indonesia) and Walker in Bangladesh.

The $750,000 ceiling that the foundations placed on their yearly contributions to IRRI was exceeded only twice — in 1968 and in 1969. The first instance resulted from the addition to the operating costs of an item of $69,000 for special equipment and for some remodeling of buildings. (If the $69,000 had been designated for a special project, the contributions of the two foundations that year would have been just about $750,000.)

The reason for the $890,000 each foundation granted in 1969 is quite different and demonstrates how internal politics influence governmental

foreign assistance. In February 1968, W. David Hopper, the agricultural economist in the Rockefeller Foundation's agricultural program in India and a Canadian citizen, was in the Philippines. I talked with him about broadening the financial support for IRRI. Hopper felt there was a good chance that the Canadian Government would be interested. He said he would make arrangements for Maurice Strong, who headed the External Aid Office in Ottawa, and Kenneth Wardroper, the Canadian director of the Asian Development Bank, to visit IRRI. They did so in late April 1968, while I was on a trip to Burma, India, and Bangladesh, and McClung was their host.

As a result of the visit, Canadian interest in providing financial support to IRRI deepened and it was decided that negotiations between IRRI and Canada would go forward with Wardroper as intermediary.

Wardroper and I had a 2-hour conference on 13 May, during which the possibility was discussed of Canada's becoming an equal partner with the Rockefeller and Ford Foundations by contributing $750,000 annually to IRRI's core budget. Wardroper explained that if Canada did this, it would want to receive equal credit with the other donors — representation on the Board of Trustees and an official announcement that IRRI was supported primarily by the Ford Foundation, the Rockefeller Foundation, and the Canadian Government. I agreed to report this information to Hill. As chairman of IRRI's Board, Hill consented to the terms put forth by Wardroper.

On 6 July, Hopper was again in the Philippines and he, McClung, and I met with Wardroper to give him the details of IRRI's current budget and to discuss possible uses of Canadian funds if a grant should be made in 1969.

At that time, IRRI needed additional senior staff. The proposal to Canada was that it provide full support for three scientists: an agronomist to work in the area of soil physics and water management, a plant pathologist to deal with bacterial diseases of rice, and an entomologist to work on insect population dynamics.

The 6 July conference was followed up by Wardroper on 19 July when he came to IRRI and showed McClung, Salacup, and me the draft of his proposal to the Government of Canada for a grant to IRRI.

In August, my wife and I were on a combined home leave and professional trip. On 14 August, by previous arrangement, I flew to Ottawa for a day of conferences with several officials in the External Aid Office, including Maurice Strong, the director-general. The conversations were definitely encouraging. I seconded the proposal that Wardroper had submitted, which asked for $355,000 in 1969 for the enlarged program. Strong asked me to submit a request for that sum in writing, which I did the following day in New York. At that point, Canada seemed ready to become the third major contributor to the International Rice Research Institute.

On 28 October, I was in New York presenting IRRI's 1969 budget estimate to officers of the Rockefeller and Ford Foundations. The foundations had invited the Canadian External Aid Office to send a representative to the meeting and Stewart Peters was present. In the afternoon, I spent an hour with him privately and was told that the Canadian authorities had considered the

matter thoroughly and had decided that a grant in the amount of US$335,000 would be made in 1969. Peters, himself a scientist, said he would immediately start identifying Canadian scientists who would be qualified candidates for the three positions to be supported by the grant from Canada.

On 9 December when I returned from a visit to Bangladesh, I found Wardroper waiting for me at the Manila airport. I naturally expected to be given the good news that the Canadian grant to IRRI had been approved. That was not the case. Wardroper had just returned from Canada where he had found that although the grant to IRRI had the stamp of approval of both the Prime Minister and the Minister of Foreign Affairs, it had not gone through Parliament because several politicians from the wheat-growing provinces opposed it. At the time, Canada had a surplus of wheat, and wheat prices were low. The Canadian legislators felt that the nation should not support rice research, the argument being that the more rice produced, the less wheat Canada could sell to its Asian customers.

Wardroper, after his continuing assurances to IRRI that all was going ahead as intended, was highly embarrassed at the outcome. However, he had a plan for solving the problem. He suggested that Canada increase its contribution to the Asian Development Bank from its current $25,000,000 to $27,500,000, the extra $2,500,000 to be earmarked for IRRI over a 5-year period. Apparently, the proposal had been discussed when he was in Ottawa and had the approval of the appropriate authorities.

I was again in New York in January 1969, talked with Peters by telephone, and made arrangements to go to Ottawa on 13 January and to visit several Canadian universities to interview possible candidates for the new posts at IRRI. My contact in Ottawa at that time was C. Fred Bentley, who was serving for a year as an officer for the Canadian International Development Agency (CIDA). He showed me the draft of a letter he had prepared for Strong's signature, outlining the terms of a grant from the Canadian Government to the Asian Development Bank in the amount of $2,750,000 for 5 years, starting at $400,000 for the first year and ending at $800,000 for the fifth year (also with the expectation that support would continue indefinitely after the 5 years had passed).

Arrangements had been made with deans of agriculture at universities in Alberta and Saskatchewan and at the University of Guelph and Macdonald College and I visited those institutions 14-17 January and interviewed likely candidates. IRRI eventually hired two Canadian scientists, V. Arnold Dyck, entomologist (still at IRRI, as previously stated), and Keith Krupp, a soil and water physicist, who was completing his Ph D degree at the University of California, Davis, and whom I interviewed there on a later trip.

When I returned to IRRI later in January, Wardroper urged me to order Canadian-built automobiles for the prospective new staff members. This was done, though no funds had yet arrived.

Not to make a long story longer, when I — in New York in October 1969 — presented IRRI's 1970 budget to officers of the Ford and Rockefeller Foundations and USAID and a representative of CIDA from Canada, I was told that

money from Canada would be forthcoming in 1970. Since 1969 was certainly well along at that point and no Canadian funds had been received, the foundations upped their joint appropriations to $1,780,000 for that year and, so to speak, bailed IRRI out of its difficulties.

Canada, presumably for internal reasons, was unable to arrange the grant to the Asian Development Bank, a second disappointment to IRRI on that score. However, beginning in 1972, that country became a strong financial supporter of the Institute, its contributions growing annually until in 1979, for example, CIDA gave more than $1,000,000 toward IRRI's core budget and IDRC provided over $337,000, largely for the cropping systems program.

Back in 1970, however, USAID, rather than Canada, had become IRRI's third major donor, a development outlined in the following section.

U.S. funding

By 1963, when IRRI was only 2 years old, the Rockefeller and Ford Foundations were urging IRRI administrators to seek financial support from other organizations as well. Consequently, that year Wortman and I prepared two proposals to USAID requesting grants for segments of IRRI's program.

In November 1963, Leona Baumgartner from USAID, Washington, visited IRRI and expressed confidence that the agency could help, particularly in the training program.

On 8 April 1964, I spent the entire day at USAID headquarters in Washington talking with Frank W. Parker, James Blume, Erven Long, Clifford Willson, and Baumgartner, each of whom had responsibilities in agriculture or science. As I went from office to office, I did my utmost to get USAID to contribute to IRRI's core budget, but received a negative reply each time. In retrospect, it seems simply a case of the time not being right. For many years, USAID (and its predecessor, ICA) had a policy opposed to supporting rice research and training abroad when the U.S. produced a surplus of that grain for export. (Thus, Canada's wheat-growing interests were not the sole governmental obstacle to the broadening of IRRI's funding!) Moreover, USAID (and other donors as well) felt that with two large foundations supporting IRRI, additional help was not sorely needed.

In 1965 (as reported in Chapter 2), USAID made its first grant to IRRI for research on farm and equipment power requirements in Asia. The grant, for $360,000, was to be used over a 3-year period. Although IRRI and USAID considered this to be a special project grant, under the classification system used by CGIAR today it would probably be called a restricted core grant.

In December 1965, Parker from USAID, Washington, visited IRRI, and I spent the day with him touring the Institute and acquainting him with IRRI's entire program in an effort to persuade him to recommend that USAID support a portion of IRRI's continuing program — but to no avail. Parker insisted that any help from his agency had to be applied to a new project. At that time, however, all staff houses were occupied and IRRI was not in a position to add scientists; rather, it needed additional funds to take care of rising costs on projects already under way.

In Washington in June 1966, I was back at USAID talking with A.H. Moseman (who by then had joined the agency as assistant administrator), Douglas Caton, Erven Long (again), and John Wilson. Discussed principally were the terms of the agreement (described earlier) with USAID, the Government of India, and IRRI to place four scientists in the All India Rice Improvement Project in Hyderabad. It was expected then that the agreement would be signed by all parties within a month (Hill to sign for IRRI in order to facilitate matters). Because of complications in getting full agreement between the two governments, however, it was a year later before the document was signed and before IRRI could hire scientists to go to India.

USAID's interest in supporting IRRI increased in 1968 after John C. Bullitt, assistant administrator for Southeast Asia, visited the Institute in April of that year. His enthusiasm was so keen that I wrote Hill suggesting he follow up the visit by calling on Bullitt in Washington.

As a matter of fact, special credit is due both Hill of the Ford Foundation and Wortman of the Rockefeller Foundation for their determined efforts to persuade USAID to change its policy and provide nonproject support to IRRI. Earlier, in October 1967, at a New York conference of officers of the Ford and Rockefeller Foundations, with me present, Hill had expressed the opinion that the director of IRRI was too busy and too far away from the source of U.S. funds to be expected to raise new money from that direction and that he, Hill, would be willing to devote considerable time to fund raising especially from USAID (Washington) and UNDP (New York).

Hill pursued the matter vigorously, exploring every avenue of possible USAID action, and when I was in New York on 8 January 1969, I discussed with him the draft of a letter I would write to USAID asking for a grant of $400,000 for the fiscal year 1970 and, also, for a letter of intent from the agency indicating continued support to IRRI for at least 5 years. Hill had already had many discussions with USAID officials and knew that the deadline for any proposal was 20 January. He was also aware that there was a good chance that USAID would soon liberalize its policy.

During the same period, Wortman was talking to USAID officials about core budget support not only for IRRI but for CIMMYT as well. Both Hill and Wortman were anxious to move fast, for they knew that William S. Gaud, the USAID administrator, was about to leave office, along with many others of the outgoing Johnson administration.

In telephone conversations with USAID officials, Wortman learned that Hill had provided all the information the agency needed on IRRI but that it required more background on CIMMYT. Wortman canceled a trip to Nigeria for the week of 12 January, summoned Edwin J. Wellhausen, the director of CIMMYT, from Mexico, and the two spent 5 days in Washington working with USAID officials preparing documents which, when signed by Gaud, would provide general, nonproject support for IRRI and CIMMYT in 1969-70. Obstacles to rapid action, such as security checks, were overcome; and on 16 January, Gaud slipped out of a farewell reception in his honor and signed the document. So it was Gaud, the man who first used the term green revolution

in a public address, who pioneered in authorizing USAID to provide general support to IRRI and CIMMYT. Although his profession was law, he understood thoroughly the importance of agriculture in the developing countries.

John A. Hannah succeeded Gaud and was entirely sympathetic to the new policy. Soon core support was extended by USAID to all the international centers (IRRI, CIMMYT, IITA, and CIAT), and in 1973 USAID agreed to provide up to 25% of the core budgets of all the centers that came under the CGIAR umbrella.

Back in 1969, however, it took considerable time for the governmental wheels of USAID to start turning. Even as late as 27 October 1969 at a budget conference in New York, the USAID representative stated that the agency had placed $350,000 in its 1970 program designated for IRRI but that further study was required before discussions with the Institute could take place. On 12 November, back in the Philippines, I had a meeting with Thomas Niblock, the new deputy director of the USAID Mission to the Philippines, who declared that USAID was ready to support IRRI's core budget but would prefer to have the money used for training, agricultural engineering, multiple cropping, and soil and water studies. I agreed that the funds could be restricted to activities USAID wished to support.

In 1970 and 1971, IRRI's problem with the USAID grants was a matter of timing. There was such a lag between the time when a grant was made and when the money was actually received that IRRI had serious cash flow problems during the latter part of each calendar year. For example, in December 1971 I was still trying desperately to get the funds released for the last half of the year, but without success. Thus, a short-term loan from the First National City Bank became necessary.

Funds from other sources

Grants to IRRI from *all other sources* came to more than a million dollars between 1963 and 1971. About half of that amount was accounted for by a grant from the Netherlands in 1971 for a cooperative project in Indonesia, with funds to be available over a 5-year period.

The first grant to IRRI from outside the Ford and Rockefeller Foundations was from the National Science Development Board of the Philippines. In January 1963, about $25,000 (₱103,440) was given, to be used over a 3-year period to investigate the viral diseases of rice.

In the 9-year period from 1963 to 1971, manufacturers of fertilizers, herbicides, insecticides, and the like, or organizations representing them, provided a total of $162,398 for IRRI projects studying the use, generically, of such products as theirs. The largest grant ($10,000) was from International Minerals and Chemical Corporation.

The principal noncommercial grants (besides the one from Netherlands) were received from the National Science Foundation (Washington, D.C.) for the description and preservation of the world's rice germplasm; from the National Institutes of Health (Bethesda, Maryland) for the screening of rice varieties for amino acid content; and, in 1971, from Japan, its first contribution

CHAPTER 6

Creation and funding of other international centers

When IRRI was founded in 1960, neither the Ford Foundation nor the Rockefeller Foundation envisaged establishing similar institutes for research on other crops or on animals. IRRI's research and training program was patterned in many ways after the Rockefeller Foundation's agricultural programs in Mexico, Colombia, Chile, and India. Nevertheless, a number of features of IRRI's setup and program were unique. Its international staff, its concentration on a single major food crop, its apolitical and autonomous nature, the adequate support it received from two private foundations, and the freedom given to its administrators and scientific staff to make decisions quickly without referring them to donor authority, were policies that proved sound and that led to the Institute's early recognition as a successful venture.

THREE INSTITUTES ADDED

After IRRI had been in operation for only 2 years, the two foundations began studying the possibility of creating other institutes based on the IRRI pattern. By 1967, three additional centers were at least formally organized, with directors and boards of trustees appointed. They were the International Maize and Wheat Improvement Center (CIMMYT, for its Spanish name, *Centro Internacional de Mejorarniento de Maiz y Trigo*) in Mexico, the International Institute of Tropical Agriculture (IITA) in Nigeria, and the International Center of Tropical Agriculture (CIAT, for its name in Spanish, *Centro International de Agricultura Tropical*) in Colombia.

Discussions between the two foundations concerning the three new ventures took place more or less simultaneously, but they are presented in this section in the order of the dates of formal organization.

The International Maize and Wheat Improvement Center (CIMMYT)

The Rockefeller Foundation closed out its formal Mexican Agricultural Program in 1962, but at the request of the Mexican Government, a small group of foundation scientists remained in Mexico working with local counterparts at several experiment stations. These field staff members included Edwin J. Wellhausen and Elmer Johnson, maize breeders; Norman E. Borlaug, wheat specialist; John S. Neiderhauser, potato specialist; Reggie Laird, agronomist; and Delbert Myren, communication specialist.

Although a precursor of CIMMYT (and of that name) was formed under an agreement signed on 25 October 1963 by Harrar, then president of the

Rockefeller Foundation, and Julian R. Adame, the Mexican secretary of Agriculture, it was a limited operation with outside support from only the Rockefeller Foundation.

After Wortman became director for agricultural sciences of the Rockefeller Foundation in 1965, he visited Mexico and subsequently reported to the officers and trustees of the foundation that CIMMYT could not be a world agricultural research center with the effectiveness of IRRI with such inadequate facilities and with financial support from only one donor. He proposed to the foundation that a new agreement be worked out reconstituting CIMMYT as a private corporation in Mexico but with the privileges and characteristics of an international organization, free to receive funds from any source. At the time these discussions were taking place, the Ford Foundation indicated informally that it would be willing to join the Rockefeller Foundation on an equal basis in supporting the new center (as they were doing at IRRI).

Wortman's proposal met with the approval of the trustees of the Rockefeller Foundation and on 12 April 1966, an agreement was signed between the foundation and the Government of Mexico, the foundation making an initial appropriation to the new CIMMYT in the amount of $441,000. The following year, the Ford Foundation contributed $494,000 toward the center's core budget.

The group of Rockefeller Foundation scientists that remained in Mexico became the nucleus of the CIMMYT staff, with Wellhausen as director. With adequate initial support from the two foundations, and later from many other donors as well, CIMMYT has developed the world's largest wheat and maize improvement program. As IRRI did with rice, CIMMYT created short, stiff-strawed, fertilizer-responsive, and disease-resistant varieties of wheat that greatly increased production not only in Mexico but in India, Pakistan, Turkey, and elsewhere. These successes won Borlaug the Nobel Prize in 1970; and that same year, CIMMYT and IRRI shared the UNESCO Science Prize.

International Institute of Tropical Agriculture (IITA)

In October 1963, Harrar, Hill, and Bradfield visited Nigeria to explore the possibility of establishing an agricultural research institute patterned after IRRI but dealing with various crops important to tropical Africa. After holding discussions with government officials and visiting several universities, they decided that Ibadan would be the best site.

In the spring of 1964, Hill and Harrar brought to their respective boards of trustees a proposal to establish IITA in Ibadan. Both foundations took action to provide up to $750,000 annually for a period of 7 years, beginning whenever the institute became operational.

Although the Rockefeller Foundation appointed Will M. Myers as the director-designate of IITA on 1 January 1965, the institute did not become formally organized until July 1968, when its Board of Trustees met for the first time. By then, Myers had been appointed vice president of the Rockefeller Foundation and the Ford Foundation engaged Herbert Albrecht to succeed Myers as IITA's director.

The Ford Foundation assumed full responsibility for constructing and equipping IITA, at a cost that was then estimated to be $10 million. However, by the time construction was completed in 1972, the cost had mounted to essentially double the original estimate. Nigeria's civil war and the attendant difficulty in getting building materials unloaded from ships at Lagos contributed substantially to the delays. Although the Ford Foundation provided the construction funds, the Government of Nigeria made available about 1,000 ha of land.

Unlike IRRI and CIMMYT, IITA was to work on a group of tropical crops, including cowpea and other grain legumes, sweet potato, and yam. It was to cooperate with IRRI on rice research, with CIMMYT on maize, and with CIAT on cassava. In addition, it was to give particular attention to research on cropping and land management systems to replace shifting cultivation — that is, to develop systems of permanent cultivation for the humid tropics.

The Ford and Rockefeller Foundations established IITA independently of other organizations, but by the time the research program got under way in 1970, CIDA and IDRC of Canada came in as joint partners and USAID joined the effort with contributions similar to those of Ford and Rockefeller. By 1971, IITA's total budget (core and special projects) amounted to $2,136,000, comprising equal contributions from Ford, Rockefeller, Canada, and USAID.

In 1970, Moomaw (as previously reported) was transferred from IRRI to IITA. Having been at IRRI from the start, he was of great assistance in getting the new institute's program organized and launched.

From 1971 onward, IITA thrived financially, having a budget similar to IRRI's and CIMMYT's. There are those who question the contribution that the multicrop centers such as IITA will make toward increased food production, feeling that significant progress can be made only when a research center concentrates on one or two principal crops. However, when the resources available to IITA are compared with the rather meager support provided for national research programs in African countries, IITA's existence is seen to be fully justified. The large number of African scientists and extension technicians trained at IITA, and at the other centers, is having a pronounced impact on the quality of African agricultural research and extension and offers hope of expanding food production in the long run.

International Center of Tropical Agriculture (CIAT)

As in Mexico before CIMMYT was formally organized, the Rockefeller Foundation had a cooperative agricultural program in Colombia, from 1950 onward, consisting of research on cereal crops (maize and wheat) and potato, programs with beef and dairy cattle, sheep, swine, and poultry, and studies of animal diseases and nutrition. By 1966, the foundation had spent a total of $6,230,000 in Colombia and had a group of dedicated and experienced scientists in residence.

Encouraged by the early successes of IRRI, the Ford and Rockefeller Foundations began, around 1966, to explore the possibility of establishing an international agricultural research center in South America.

In 1966, Lewis M. Roberts of the Rockefeller Foundation and Lowell Hardin of the Ford Foundation prepared a prospectus for an international institute in Colombia. In October of that year, they presented to the two foundations a report entitled, "A Proposal for Creation of an International Institute for Agricultural Research and Training to Serve the Lowland Tropical Regions of the Americas." In December, in response to that document, the Board of Trustees of the Rockefeller Foundation appropriated the sum of $250,000 toward the establishment of "an international agricultural research institute in Colombia." At that time, the Ford Foundation had not yet made its decision to join the Rockefeller Foundation in the venture, and until 1969, the latter was the sole supporter of CIAT for both capital and operating costs. The foundation's contribution for buildings and equipment amounted to $4,218,000. In 1969, the Kresge Foundation contributed $750,000 for construction costs. In 1969, also, the Ford Foundation became an equal partner with Rockefeller in providing the operating costs for CIAT. By 1970, two more donors, the Kellogg Foundation and USAID, had joined the supporting organizations; and, of course, after the CGIAR was formed, other donors came into the picture.

U.J. Grant, previously head of the Rockefeller Foundation's Colombian program, was CIAT's first director. Other Rockefeller Foundation scientists in Colombia were retained as the initial staff. CIAT's research program took a number of years to become stabilized, one cause being the delays in constructing the physical plant. Another reason for the delay was the fact that the foundation's original program, which had been going on for many years, was an extremely diversified one and consequently it was difficult for the staff members who had been engaged in its many activities to give them up. Yet there were those involved in the decision making for CIAT who felt that the program must be concentrated on a few major thrusts if it were to have a strong impact on crop and animal productivity.

CIAT's early research program had the following components: cassava, beef cattle, swine, maize (in cooperation with CIMMYT), beans (*Phaseolus* sp.), and rice (in cooperation with IRRI). Furthermore, it initiated studies in agricultural economics, rural sociology, and, of course, the key element in all international research centers, training.

After continuing debate, CIAT's program gradually became more concentrated and today has four major components: dry beans, cassava, rice, and tropical pastures. CIAT has worldwide responsibility for *Phaseolus* beans and, in all regions except Africa, for cassava. Rice activities are restricted to Latin America but depend partially on IRRI for technical cooperation. In addition, although outside of the main program, CIAT, in cooperation with CIMMYT, serves as a base location for maize improvement activities in the Andean region.

CIAT's outreach program started slowly, perhaps because so many of the staff had come from the Rockefeller Foundation's country program, which naturally had concentrated on Colombian problems, and consequently took a while to become involved with research in other countries.

CIAT's earliest success was its rice research and training program, which Jennings developed from his experience at IRRI and even earlier in Colombia. The CIAT program was further influenced by IRRI in that not only Jennings but Byrnes, Johnson, and McClung moved from there to CIAT, bringing the knowledge and experience they had gained from working at the oldest of the institutes within the network of international agricultural research centers.

THE FOUNDING OF THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH (CGIAR)

By 1968-69, it was apparent that the financial requirements of the four international agricultural research centers already established by the Ford and Rockefeller Foundations would exceed the $3 million annual allocation ($750,000 to each center by each foundation) that the foundations had told their trustees would be the maximum amount that would be requested for the support of the centers. Furthermore, as these institutions prospered (particularly IRRI and CIMMYT at that stage), the suggestion was being made by agricultural development authorities that the same pattern be followed for centers to specialize in several other important crops and animals. Although the ideas on such needs had not crystallized at that time, it became obvious to both foundations that if such expansion did occur, other foreign assistance organizations would have to carry the major financial burden.

Wortman at the Rockefeller Foundation was deeply interested in seeing the work of the international agricultural research centers, both current and future, receive adequate support. As a means of achieving this, he conceived the idea of mobilizing the resources of the major governmental and private foreign assistance organizations. First, of course, the interest of those potential participants had to be aroused, and Wortman's proposal to the Rockefeller Foundation was that it invite the heads of all important foreign assistance agencies concerned with agricultural development to a conference at the Bellagio Conference Center, which the foundation maintained in Italy. The idea met with instant approval by Harrar and Myers, the foundation's president and vice president, respectively.

The Ford Foundation was equally concerned about future financial support of the centers and agreed to participate fully in the meeting at Bellagio.

The conference was held in April 1969, with no one knowing what the follow-up would be. As it turned out, a series of gatherings of representatives of development organizations was held and soon dubbed Bellagio I, Bellagio II, etc, which accounts for the headings under which the meetings are separately described in the following section.

Bellagio I

The Rockefeller Foundation's invitation to the heads of major foreign assistance agencies and organizations received a gratifying response. Representatives of 15 national and international donor organizations assembled for Bellagio I for the period 23-25 April 1969 (see photo).

The heads of major foreign assistance organizations were invited by the Rockefeller Foundation to meet at the Bellagio Conference Center, 23-25 April 1969, to discuss problems of agricultural development. This became known as the Bellagio I meeting, being the start of a series of conferences that two years later resulted in the formation of the CGIAR.

Seated, left to right: F.F. Hill, resource person*, the Ford Foundation; Robert S. McNamara, president, the World Bank; Robert Gardiner, head, Economic Commission for Africa; J. George Harrar, president, the Rockefeller Foundation; Paul Hoffman, director general, UNDP; Adekke Boerma, director general, FAO; W.M. Myers, vice president, the Rockefeller Foundation and moderator of the conference. Standing, left to right: Sterling Wortman, resource person, the Rockefeller Foundation; Maurice Strong, president, CIDA, Canada; John A. Hannah, administrator, USAID; R.F. Chandler, Jr., consultant and director, IRRI; Jose Vallega, consultant, FAO; A.C. Wolfe, president, Inter-America Development Bank; Lord Geoffrey Wilson, Ministry of Overseas Development, U.K.; E. M. Martin, head, O.E.C.D.; David E. Bell, vice president, the Ford Foundation; W.D. Clark, consultant, the World Bank; Lowell S. Hardin, consultant, the Ford Foundation; Masao Sawaki, Economic Cooperation Bureau, Ministry of Foreign Affairs, Japan; F. Fournier, Office de la Recherche Scientifique et Technique Outre-Mer, France; Ernst Michanek, SIDA, Sweden; T. Ohuchi, Asian Development Bank; K.L. Bachman, consultant, FAO.

*The terms "resource person" and "consultant" refer to the function of the individual at the conference and not to his position in his own organization.

Harrar as president of the Rockefeller Foundation served as host and Myers[1] as vice president moderated the sessions. Wortman and Hill served as resource persons and each presented a major position paper. I gave an illustrated talk on advances in rice research at IRRI, as an example of what an international agricultural research institute could do to increase the yield potential of an ancient and vital crop.

The results of this conference were published by the Rockefeller Foundation under the title, *Agricultural Development: Proceedings of a Conference, 1969*. The proceedings contain the full text of the two position papers and a summary of

[1] In 1970, to the deep regret of his associates, Will M. Myers died.

5. During the discussions, the participants envisioned a worldwide network of international agricultural research centers that would carry on comprehensive research and training programs with the major food crops, and also attack the serious animal production problems of Africa.

Bellagio III

The recommendations of the agricultural representatives at Bellagio II were passed on to the heads of their organizations. In April 1970, the latter (essentially the same group that attended the Bellagio I meeting) met again at the Bellagio Conference Center to consider the recommendations of the Bellagio II gathering.

Two principal actions emanated from this third meeting:

1. Agreement was reached that feasibility studies should be undertaken to cover the five areas that the Bellagio II group felt could justify an international research effort.
2. Approval was given to a proposal that a consultative group be formed, to consist of donors interested in supporting a network of international research centers.

Major credit is due Robert S. McNamara, president of the World Bank, for the proposal to form a consultative group. In October 1969, he wrote to the director general of FAO and to the administrator of UNDP suggesting a joint program to support international agricultural research through a mechanism by which the three agencies could mobilize, on a long and continuous basis, the resources required to maintain the existing centers and to develop new ones. McNamara indicated that he had in mind the establishment of four to six new institutes or programs over the next 5 years.

The responses from FAO and UNDP were favorable and thus the matter was brought before the assistance agencies represented at the Bellagio II meeting.

Bellagio IV

The feasibility studies requested at the Bellagio III meeting were undertaken, largely by Rockefeller Foundation staff members. On 3-4 December 1970, the Bellagio Group met again to hear and discuss reports on four of the five topics suggested for study. To save travel time, the meetings were held at the Rockefeller and Ford Foundations — one day at Rockefeller, the other at Ford. The Group heard the following reports:

1. *An International Upland Crops Program* — by Clarence C. Gray, III
2. *The Food Legumes* — by Lewis M. Roberts
3. *International Laboratory for Animal Disease Research* — by John J. Mc Kelvey, Jr., and John A. Pino; and *Livestock Production* in *Sub-Sahara Africa* — by John A. Pino
4. *Key Needs for Agricultural Water Management Research and Training in the Developing Nations* — by Ellis L. Hatt and W. David Hopper

The most recent plans for the creation of a CGIAR were presented to the Group and received an enthusiastic response.

The CGIAR is formed

At a meeting of the directors of the World Bank, held before the Bellagio IV gathering, authorization had been granted to the Bank to explore with the members of the Bellagio group, in consultation with FAO and UNDP, the feasibility of establishing the CGIAR. As stated, the group responded with definite enthusiasm. Accordingly, the following month (January 1971) the World Bank invited those represented at the Bellagio meetings, and other donors as well, to a conference at Bank headquarters in Washington. The conference was identified as an *lnternational Agricultural Research Meeting.* The response was eminently gratifying. Representatives came from FAO; UNDP; the World Bank; The Asian, African, and Inter-American banks; OECD; Canada's IDRC; the Ford, Rockefeller and Kellogg Foundations; Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, The Netherlands, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States.

The World Bank had prepared a staff paper, which formed the basis for the discussions. There was general agreement that the CGIAR should be formed and that its primary purpose should be to serve as a forum for discussion of needs and for coordination of financial and technical support for international agricultural research and training activities. Furthermore, it was decided that membership in the CGIAR should commit no government agency or private organization to support any specific institution or activity, each donor organization deciding which institutes or programs it wished to support, yet with full knowledge of the actions other donors were prepared to take.

The World Bank offered to provide the Secretariat for the CGIARand would act as a clearinghouse for donor intentions and thus avoid duplication.

At the same meeting, it was decided that a Technical Advisory Committee (TAC) should be formed, composed of distinguished agricultural experts from both developed and less developed countries, to advise the CGIAR on priorities in international agricultural research.

The first formal meeting of the CGIAR, as such, took place in Washington 19 May 1971, and a second meeting was held 3-4 December 1971. At the first meeting, 28 nations and organizations were present, 18 of which (including, of course, the Ford and Rockefeller Foundations) firmly declared that they would become members of the CGIAR.

Although Harrar and Wortman of the Rockefeller Foundation, and David Bell, Hill, and Hardin of the Ford Foundation played important roles in gaining the initial interest of other foreign aid agencies throughout the developed world, it was McNamara of the World Bank who provided the essential impetus to the movement. He envisioned the idea of a CGIAR; developed infectious enthusiasm for the project, influenced FAO and UNDP to join the Bank as sponsors, and assigned some of his most able personnel (Richard Demuth and, later, Warren Baum) to serve as chairmen of the Group.

TAC was formed, with Sir John Crawford of Australia as the first chairman. He was an ideal candidate for the post and TAC got off to an excellent start. FAO agreed to provide the TAC Secretariat at its headquarters in Rome. TAC

After the CGIAR was formed in 1971, the center directors decided to meet informally at least once a year to discuss their common problems. The first meeting was held 12-17 February 1973 at the Bellagio Conference Center of the Rockefeller Foundation. At that time, Cummings had left IRRI to become the director of ICRISAT, and Athwal was the acting director. Seated, left to right: Haldore Hanson, CIMMYT; Colin McClung, CIAT; R.F. Chandler, Jr., AVRDC; Herbert Albrecht, IITA; Ulysses Grant, CIAT; Thanikary, IIE (visitor); Ralph Cummings, ICRISAT; J.S. Kanwar, ICRISAT; Francis Byrnes, CIAT (recorder). Standing: John Nickel, IITA; D.S. Athwal, IRRI; E.B. Oyer, AVRDC; Edward French, CIP; Richard Sawyer, CIP; Michael Ruddy, World Bank (visitor); Myers, IIE (visitor).

Hill, Chandler, and Secretary Tanco escort President Marcos (leftl to his helicopter following his talk at IRRI's 10th anniversary celebration in April 1972.

not only advised CGIAR on research priorities but conducted feasibility studies and periodically analyzed the effectiveness of existing international agricultural research programs.

The achievements of CGIAR are well known and need not be repeated here. The diameter of its umbrella has ever widened. In 1972, the first year of funding, the Group supported five international research centers. By 1976, the network of centers and programs financed through the CGIAR system numbered 11 and financial support had increased fourfold, to $64 million. By 1981, 13 institutes or programs were receiving support from the Group, with a combined budget of about $145 million.[2] Surely not even the most optimistic members of the Group in 1971 envisioned a program of such magnitude and success.

[2] The CGIAR publishes information on details of programs of the 13 agricultural research centers. The booklet, titled *Consultative Group on lnternational Agricultural Research,* is available from the CGIAR Secretariat, 1818 H Street, N.W., Washington, D.C. 20433.

CHAPTER 7

IRRI today

IRRI's main objectives and purposes remain essentially unchanged, but there have been remarkable advances and growth during roughly the past 10 years. Progress of such dimensions can merely be touched upon within the limits of a single chapter and many important achievements have to be omitted. Yet it is appropriate to attempt here to reflect the structure, operations, and scope of the Institute today. Considered first are changes in staff organization, physical plant, and finances, followed by brief reviews of certain major research activities that have undergone significant alteration in size or focus since IRRI's first decade.

STAFF

Administration

Some months after Nyle Brady became the director of IRRI in mid-1973, certain changes in title were made in the administrative staff. Athwal remained associate director. Vega, whose previous title had been assistant director, was named assistant director for training, and Pathak was promoted from entomologist to assistant director of research. Salacup, previously treasurer and executive officer, was given the title of controller, and Hugh T. Murphy was added to the staff as assistant director for administration, taking over the duties of the former executive officer.

Those titles were retained through 1975, when further changes took place. Brady assumed the title of director general, and Athwal of deputy director general. Vega became director, training; Pathak, director, research coordination; and Murphy, director, administration. This system of titles, which provides additional rungs in the promotional ladder for the administrative team, has become general throughout the network of international agricultural research organizations.

Athwal resigned in 1977 (to join IADS, as indicated earlier), and Vega was promoted to deputy director general. A short time later, Dennis J. Greenland was hired as a second deputy director general. Pathak's title was altered slightly to that of director, research and training coordination.

Brady's notably successful leadership of IRRI came to a close in May 1981, when he resigned to become a senior administrator of the United States Agency for International Development (USAID) in Washington and to head that agency's Development Support Bureau. Brady was replaced in 1982 by M.S. Swaminathan.

To return to the mid-l970s, Brady, soon after he arrived at IRRI, placed the executive staff in Administration under the Office of the Director (later, the Office of the Director General). Classified as *Administrative Staff* were the managers of Food and Dormitory Services and Buildings and Grounds, administrative associates such as Atty. Zosimo Q. Pizzaro and Atty. Pedro G. Banzon, and several staff members in top-level assisting positions.

This administrative classification is a logical one and appears to be working out well.

Senior scientific staff

The major change in senior scientific staff since 1972 has been in size. Administrators and other resident professional senior staff numbered 33 in 1972. In 1980, there were 55 permanent senior staff in residence at IRRI, plus an additional 30 in IRRI's outreach programs (the outreach staff in 1972 numbered 18).

The largest increase, on a percentage basis, since 1972 is that in visiting scientists. From IRRI's beginning until 1972, there were only two or three visiting scientists at the Institute at any given time, most of them there for one year. Today, IRRI has about 50 visiting scientists and senior research fellows (no exact figure can be given, as they are continually coming and going). The advantage in such temporary staff additions, of course, is that they bring to the Institute specialized talent and yet do not involve any commitment for the future. Thus, if a budget cut is necessary, the number of visiting scientists can be reduced rather quickly without changing the roster of permanent staff.

The expansion in scientific staff was fairly general throughout the Institute, with two or three members added to most departments. There were a few exceptions, however: the number of permanent senior scientists has remained the same in Soil Chemistry, Soil Microbiology, Chemistry, and Statistics. The staff of most of those departments, on the other hand, have been augmented by visiting scientists.

The scientific staff increase resulted in part from the enlargement of the cropping systems program, in the course of which new staff members were added not only to the Multiple Cropping Department itself but to other departments as well — for example, agricultural economists for cropping systems work were added to the Agricultural Economics Department. Similarly, the entomologist logically was attached to the Entomology Department, and the weed specialist to the Agronomy Department.

The increase in outreach staff from 18 in 1972 to 30 in 1980 is explained by the addition of 7 men to the Indonesian program, by the start of a new program in Bangladesh with 7 scientists, and by new but small programs in Pakistan, Egypt, and Burma. IRRI expects that the outreach staff will remain quite constant during the years ahead, although the countries involved will change from time to time.

In 1977-78, IRRI liaison scientists were named for Southeast Asia, India, South and Central America, and Africa. The liaison scientists assist in devel-

oping cooperative national program — IRRI projects and help coordinate international rice testing activities.

Obviously, the large increase in IRRI's resident staff and visiting scientists was accompanied by an expansion of similar magnitude in the amount of research being conducted at the Institute. Proof of this is the fact that IRRI's *Annual Report for 1972* contained 246 pages, that for 1979 had 538 pages, yet the degree of detail reported remained about the same.

In 1974, a policy change affecting the titles of senior scientists was the addition of the word *principal* to the designated positions of a few of the more senior staff who had been at IRRI for many years. For instance, Ponnamperuma's title was altered from soil chemist to principal soil chemist. Likewise, Ou became principal plant pathologist. This made possible the recognition of superior performance over an extended period.

Other IRRI employees

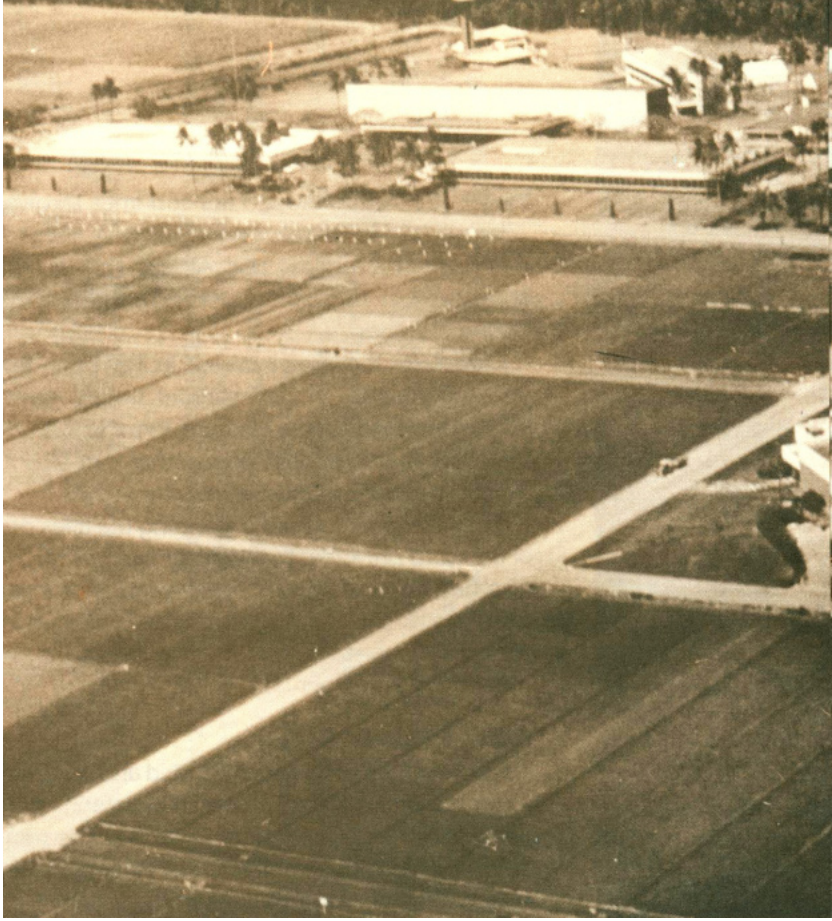
As the research program expanded and as IRRI acquired more experimental land, it was necessary to add research assistants, secretaries, farm laborers, and other personnel. By way of contrast, in 1972 the number of scientifically trained staff below the level of senior scientist (those, that is, with titles of assistant scientist, senior research assistant, research assistant, and research aide) was 134. By 1980, the figure had risen to 320. The total number of employees at IRRI in February 1972 was 735; today (1981) it is about 1,800.

THE PHYSICAL PLANT

Between 1963, when the initial group of buildings was completed, and 1972, certain secondary additions were made to the IRRI complex. They included several greenhouses, more screenhouse space for the plant breeders, expansion of facilities for Buildings and Grounds, new space arrangements in the laboratory and administration buildings, and ten new houses in the staff housing area. The major additions to the complex, however, occurred after 1973.

In late 1974 the Philippine Government was able to purchase 336 ha of land adjacent to IRRI's experimental farm and assigned it to the College of Agriculture and to IRRI. At the time, the College did not need quite so much land as IRRI did and thus saw to it that the latter had the use of more than half the new tract. After the acquired land had been properly prepared for experimental use, the Institute's area for field research increased from 80 to 320 ha. The land was used not only for work with wetland, flooded rice but also for dryland experiments with rice and with the many other crops being studied in IRRI's cropping systems program.

In 1974, too, IRRI's million-dollar phytotron, a gift of the Government of Australia, was completed. It contains 6 glasshouse rooms and 18 growth cabinets — 10 artificially lighted and 8 naturally lighted. Temperature, day length, and humidity can be controlled in each. Interestingly, the original request made in 1971, for a phytotron for IRRI was a relatively modest one.



Aerial view of IRRI in 1981.

However, when Australian engineers studied the project, they concluded that IRRI had not asked for sufficient funds and recommended that their government increase its grant, which it did. The final cost was nearly $1,000,000 — more than three times the amount of the original request.

The largest addition to IRRI's research and training operation to IRRI's research and training operation was the Laboratory and Training-Conference Center, which was dedicated in September 1976. This was the first major addition to the original building complex as it existed in early 1962. The facility has two wings. The laboratory wing now accommodates a part of Agronomy, Entomology, Irrigation Water Management, Multiple Cropping, Plant Pathology, and Statistics. The training-conference wing includes the Department of Rice Production Training and Research, well-equipped study areas for the trainees, a snack bar, and conference facilities. The latter can accommodate 200 persons for a conference but also transforms to three large classrooms for training. The building was much needed for IRRI's increased staff and expanded research and training program.

Another major addition to the Institute's physical plant was the Genetic Resources Laboratory, which was dedicated in December 1977 and, at a ceremony on 24 October 1981, was named the N.C. Brady Laboratory. In its February 1978 issue, *The IRRl Reporter* described the laboratory as "the world's largest, most modern center for the conservation and utilization of rice genetic

materials." The building, which was financed by the Government of Japan and the Asian Development Bank, cost $2.1 million and is a most impressive facility. The second floor houses Agricultural Economics, International Rice Testing Program, and Plant Breeding.

Between 1973 and 1980, IRRI added 10 staff residences to the housing area, built a second apartment house, increased the dormitory space at the research center, constructed apartments for postdoctoral fellows on land provided on the campus of the College of Agriculture, and expanded the guesthouse facilities for the second time (the first enlargement having occurred in 1972). Furthermore, it added a set of greenhouses along Pili Drive beyond the Service Building. In 1981, the phytotron building was enlarged to provide space for a Rice Tissue Culture Laboratory.

During the early ,days of the CGIAR (1973-1976), IRRI, along with other international agricultural research centers, fared remarkably well. Many of the grants it received were unrestricted and applicable to both core budget and capital costs — a favorable circumstance that made possible the improvement of the physical plant during that period. Moreover, some of the CGIAR donors provided funds for a specific building, the Genetic Resources Laboratory being a prime example.

The accompanying aerial photograph shows IRRI's research center as it appears today.

FINANCES

To accommodate the additional staff members and to finance the expanded experimental program and the new construction projects, IRRI's budget has had to be increased substantially. Furthermore, since the beginning of the oil crisis in 1973, inflation alone would have raised significantly the cost of operating the Institute. Rather than trace, here, the increases over the years, comparisons are made between the budgets of 1972 and 1980 only.

IRRI's total budget in 1972 amounted to $4,358,123, of which somewhat less than $3 million was spent for core and capital costs, the remainder being used for special projects and outreach programs. There were eight principal donors that year. In order of the size of contribution, they were USAID, the Ford Foundation, the Rockefeller Foundation, the United Kingdom, the International Development Research Centre (IDRC), Japan, the Netherlands, and the U.S. National Institutes of Health (NIH).

In marked contrast to IRRI's income in 1972, the budget by 1980 had more than quadrupled, totaling $19,263,203. Of this amount, more than $13 million was spent for restricted and unrestricted core budget, the remaining $6 million being used for special projects and outreach programs.

The number of major (giving more than $100,000) donors in 1980 was 20. It is interesting that, with the exception of the Netherlands, the 1980 list included the same donors as in 1972 (see table). However, both the amounts contributed and their proportionate share of the total budget changed considerably.

As is evident, the conspicuous changes between 1972 and 1980 were the marked decrease in the contributions from the Ford and Rockefeller Foundations and the substantially increased contributions from most of the other

A comparison of source and amount of contributions to IRRI, 1972 and 1980.

Source	1972		1980	
	Amount (US.$)	Percent of total budget	Amount (US.$)	Percent of total budget
United States Agency for International Development	1,532,237	35.1	6,929,990	36.0
Ford Foundation	1,229,260	28.2	315,565	1.6
Rockefeller Foundation	810,745	18.6	253,429	1.3
United Kingdom	360,207	8.3	1,148,250	6.0
International Development Research Centre	150,407	3.5	412,907	2.1
Japan	113,694	2.6	2,800,000	14.5
Netherlands	90,950	2.1	—[a]	—
National Institutes of Health	49,803	1.1	13,729	0.1
All others	20,820	0.5	7,389,333	38.4
Total	4,358,123	100.0	19,273,203	100.0

[a] The Netherlands supported IRRI generously with a 5.5-year grant of nearly $1 million in 1975, which happened to expire in 1980. The funds were used for the development of regional rice research stations in Indonesia.

donors. The reduction in funding by the two foundations is consistent with a policy common to both of supporting worthwhile projects in the initial key stages and, after the enterprises have been given a successful start, of diverting foundation resources to other new ventures. The support is decreased gradually and only when the foundations are reasonably sure that other sources of funds, either national or international, are available for continuing the work that has been begun.

The greatest relative increase in contributions among the eight earlier donors came from Japan whose appropriation to IRRI in 1980 was almost 25 times larger than in 1972. The only donor to maintain its proportional support of the Institute through the years is USAID, whose support in 1980 constituted almost the same percent of IRRI's budget as it had in 1972. That means that the amount increased greatly, the 1980 contribution of $6,929,990 representing the largest sum provided to the Institute by a single donor.

The chief donors that started supporting IRRI after 1972 and continue to do so today are the European Economic Community (EEC), the United Nations Development Programme (UNDP), the International Development Association (IDA), the International Fund for Agricultural Development (IFAD), the OPEC Special Fund, and the various foreign aid agencies of Australia, Canada, Denmark, Indonesia (World Bank funds), Philippines, Sweden, Switzerland, and West Germany.

Although the phenomenal success of IRRI's fund raising is partly attributable to the existence of the CGIAR, which mobilized worldwide support for the international agricultural research centers, substantial credit is due Director General Brady for his highly rewarding efforts in persuading donors to make special grants to the Institute.

SOME MAJOR PROGRAM ACTIVITIES

Because IRRI's program today is so complex, an outline of the organizational structure of the Institute precedes here the description of selected key activities.

As it has been from the beginning, IRRI is organized on a departmental basis and a major part of its research program is conducted at Institute headquarters in Los Baños. This broad-based and intensive program is largely of a fundamental nature, involving the development of breeding materials and of techniques and methodology in the numerous areas of chiefly rice research in which IRRI is engaged. Many of the research results — to which literally hundreds of pages in IRRI's latest annual reports are devoted — can be applied broadly throughout the rice-growing regions of the world.

The scientists that are conducting this fundamental research are involved in many of the Institute's other activities, such as international networks and the genetic evaluation and utilization (GEU) program (both described later in this chapter), the training program, and collaborative studies with scientists in national programs.

IRRI's extensive program in communications and information services includes conferences, workshops, and symposia (about 12 a year with a total of

some 600 participants from around the world), and the editing and publication of the research results not only via the annual reports but in many other forms as well (as described later).

IRRI has some 30 scientists assigned to outreach programs in 10 countries or regions: Africa (through IITA), Bangladesh, Burma, Egypt, India, Indonesia, Latin America (through CIAT), Pakistan, the Philippines (treated as a foreign country for outreach work), and Thailand.

Described briefly in this section, as examples of programs that have expanded considerably or that have a new focus, are the following activities: the genetic evaluation and utilization program, the international networks, the cropping systems program, studies of constraints to high yields, agricultural engineering, the publications program, and intensified relations with scientists and administrators in the People's Republic of China.

Genetic evaluation and utilization (GEU) program

After Brady became director (mid-1973), he concluded that IRRI's organization on a strictly departmental basis was less conducive to cooperation among scientists than was desirable. He believed that the development of rice varieties for specific environments would proceed more rapidly and successfully if interdisciplinary teams of scientists were formed to attack the problems.

Separate GEU teams were formed for the following areas of investigation:

- agronomic characteristics,
- resistance to insects,
- resistance to diseases,
- grain quality,
- protein content of grain,
- tolerance for drought,
- tolerance for adverse soil conditions,
- tolerance for deep water and floods, and
- tolerance for extreme temperature.

The disease resistance team, for example, consisted in 1974 of plant breeder Khush and pathologists Ou, Ling, and Kauffman. The members of the protein team that year were Juliano, cereal chemist; Coffman, plant breeder; Chang, geneticist; De Datta, agronomist; and Gomez, statistician. In 1977, the drought tolerance team was composed of De Datta and J.C. O'Toole, agronomists; Yoshida, plant physiologist; and Chang, functioning in this project as a plant breeder.

The GEU teams serve as *think tanks.* In their planning sessions, they develop a research strategy and decide which scientists should pursue the various aspects of the studies to be undertaken.

Obviously, the success of the GEU effort depends on the germplasm collection for new breeding materials and on the international rice testing program for evaluating the progeny of the crossing program.

Although, as mentioned, IRRI maintains its separate departments, the creation of the GEU program has been extremely successful. IRRI scientists cooperated to a considerable degree before the GEU was set up, but such

collaboration was more of a random rather than deliberate arrangement and depended mostly on the inclination of the individual scientists. The more formal GEU organization has given many IRRI scientists an opportunity to become positively identified with the varietal improvement program from which the Institute's greatest renown has accrued. This circumstance, undoubtedly a morale builder, has given the scientists a feeling of unity, of working toward a common goal. It is not possible here to do more than touch upon the major results of the GEU program, the findings of which (as an indication of its magnitude) required 148 pages of the IRRI annual report for 1979. Nevertheless, an idea of the scope of the program can be gained from the following list, although a mere sampling, of some key results.

- The variety IR36, because of its earliness and multiple pest resistance, is now the most widely grown rice variety in the Philippines and has contributed importantly to the recent surge in rice yields in Indonesia.
- IR42 performs well in adverse soils and, in addition, has resistance to most major insect pests and diseases. It frequently had doubled the yields obtained by disadvantaged farmers as compared with the harvest they could expect from traditional varieties.
- IR52 has good drought resistance as well as the other desirable characteristics of modern varieties.
- RD19, a product of the Thailand-IRRI Collaborative Deepwater Rice Project and released by Thailand's Department of Agriculture in 1979, has produced exceptionally high yields in water depths ranging from 1.0 to 1.5 m. It yielded 3.9 t/ha in a farmer's field in Thailand and more than 5.0 t/ha in a trial at IRRI in 1 m water.
- A new selection, IR9884-54-3, has been identified as a salt-tolerant line. In a saline field, it yielded 3.9 t/ha while other modern varieties averaged only 1.9 t/ha.
- In preliminary trials, IR9729-67-3 has matured earlier and yielded more than IR36.
- Several IRRI genetic lines have yielded from 5 to 7 t/ha in areas with cold water and cold temperature. IRRI plant breeders have been attempting to develop cold-tolerant varieties for the past decade and success appears to be near. IR15889-32-1, for example, yielded 7.9 t/ha in cold tolerance tests in Korea, and IR9202 lines yielded between 5 and 7 t/ha in cold tolerance nurseries in both Korea and the Philippines.

Such substantial progress as just cited will continue. IRRI's plant breeders made 4,000 crosses in 1980 alone, and its International Rice Testing Program (IRTP) provided about 1,000 nursery sets to 60 countries. Out of materials sent to cooperating countries from IRRI's breeding program, 85 varieties have been named and released by national programs.

International networks

In 1975, IRRI began establishing a series of international networks to serve as a vehicle for integrating the Institute's research activities with national programs in rice-growing countries around the world. At planning meetings, held

generally at IRRI, projects are devised whose patterns national research scientists have an opportunity to follow in their own programs. Usually, the experiments carried within the network have a degree of uniformity wherever they are conducted.

In 1980, the following international networks were in operation:

- International Rice Testing Program (IRTP)
- Asian Cropping Systems Network (ACSN)
- International Network on Soil Fertility and Fertilizer Evaluation for Rice (INSFFER)
- International Rice Agroeconomic Network (IRAEN)
- International Agricultural Machinery Network (IAMN)

The largest and most widely distributed of the networks is the rice testing program, presented here in some detail. The cropping systems network is described later under the cropping systems program, the agroeconomic network under the discussion of constraints to high yields, and the agricultural machinery network under agricultural engineering.

International Network on Soil Fertility and Fertilizer Evaluation for Rice (*INSFFER*). INSFFER started in 1976 as the International Network on Fertilizer Efficiency in Rice (INFER) and initially consisted of uniform experiments in eight cooperating countries on sources, management, and efficiency of nitrogen fertilizer applications and long-term fertility experiments monitoring fertility changes under intensive cropping. In 1979, the network was expanded to include other aspects of soil fertility, including experiments with azolla and studies in the fertilizer response of deepwater rice, and then assumed its present name of INSFFER.

International Rice Testing Program (*IRTP*). IRTP, the first of IRRI's international networks, is now by far the largest. It provides a means of sharing and testing rice varieties and genetic lines in the worlds rice-growing regions. Participation by national programs is entirely voluntary, yet interest — as indicated in the previous section on the GEU program — is impressively widespread. Almost half of the entries in the nursery sets distributed are from national breeding programs, the remainder being from IRRI's GEU program. The cooperating scientists from Asia and Africa meet at IRRI annually to review the past year's results and to nominate entries for the coming year. Similar meetings are held at CIAT for the Latin American cooperators.

The scope of the IRTP can be seen from the following list of the 17 types of nurseries in operation in 1979:

International Rice Yield Nursery (early maturity)
International Rice Yield Nursery (medium maturity)
International Rice Yield Nursery (late maturity)
International Upland Rice Yield Nursery
International Rice Blast Nursery
International Sheath Blight Nursery
International Rice Tungro Nursery
International Brown Planthopper Nursery
International Rice Gall Midge Nursery

International Rice Stem Borer Nursery
International Rice Observational Nursery (irrigated)
International Rice Arid Region Observational Nursery
International Upland Rice Observational Nursery
International Rainfed Lowland Rice Observational Nursery
International Rice Deepwater Observational Nursery
International Rice Salinity/Alkalinity Tolerance Observational Nursery
International Rice Cold Tolerance Nursery

An important part of IRTP are the monitoring tours. International teams made up of national rice scientists, and including representatives from IRRI, travel at appropriate times to the IRTP nurseries to observe how they are being managed and which entries appear to be the best. Usually, about four such teams are organized annually, each covering a different region.

The IRTP unquestionably is one of IRRI's most important activities, providing as it does the means of testing the world's most promising rice germplasm in so many environments.

The following are a few examples of the IRTP's many significant contributions to rice improvement as described in the Institute's 1979 annual report:

- Several national breeding programs, in addition to the one at IRRI, have developed varieties maturing in less than 100 days as a result of parents identified in the early maturing yield nursery.
- Varieties resistant to several biotypes of the brown planthopper have been identified.
- Varietal resistance to gall midge has remained stable during the past 5 years in India, Sri Lanka, Indonesia, and Thailand.

Asian Cropping Systems Network (ACSN). As reported earlier, until 1972 the Rockefeller Foundation had given considerable support to the multiple cropping work at IRRI, providing the services of Bradfield, who remained from late 1964 until mid-1971, and of his replacement, Harwood, who arrived in February 1972. That same year, the IDRC of Canada took a strong interest in IRRI's multiple cropping research and made a grant of just over $150,000 to support the program. Meanwhile, since 1970, Canada — through CIDA —had provided the services of Gordon Banta as visiting agricultural economist in the Multiple Cropping Department.

By 1973, IRRI began calling its work in multiple cropping a *cropping systems program.* In 1974, the program was expanded to include a network of experimental sites in various agroclimatic zones in South and Southeast Asia. Test sites were selected in the Philippines, Indonesia, Vietnam, and Bangladesh. To handle the increased work load, two scientists were added to the program. Virgilio R. Carangal became ACSN coordinator and Litsinger was added as associate entomologist. In 1975, the staff was expanded further with the addition of Edwin C. Price as associate agricultural economist (Banta having left IRRI in mid-1974), Hubert G. Zandstra as agronomist, Keith Moody as weed scientist, and Richard L. Tinsley as visiting associate agronomist. By the end of 1975, therefore, the cropping systems program was staffed by six senior scientists and had become a major program at IRRI.

In 1976, Harwood resigned and Zandstra took his place as agronomist and cropping systems program leader. By this, time the Asian network had 12 operational test sites: three in the Philippines, four in Thailand, one in Bangladesh, two in Sri Lanka, and two in Indonesia. S.K. Jayasuriya was added as CSN economist in 1979. Zandstra resigned in late 1980 and was replaced by J.W. Pendleton.

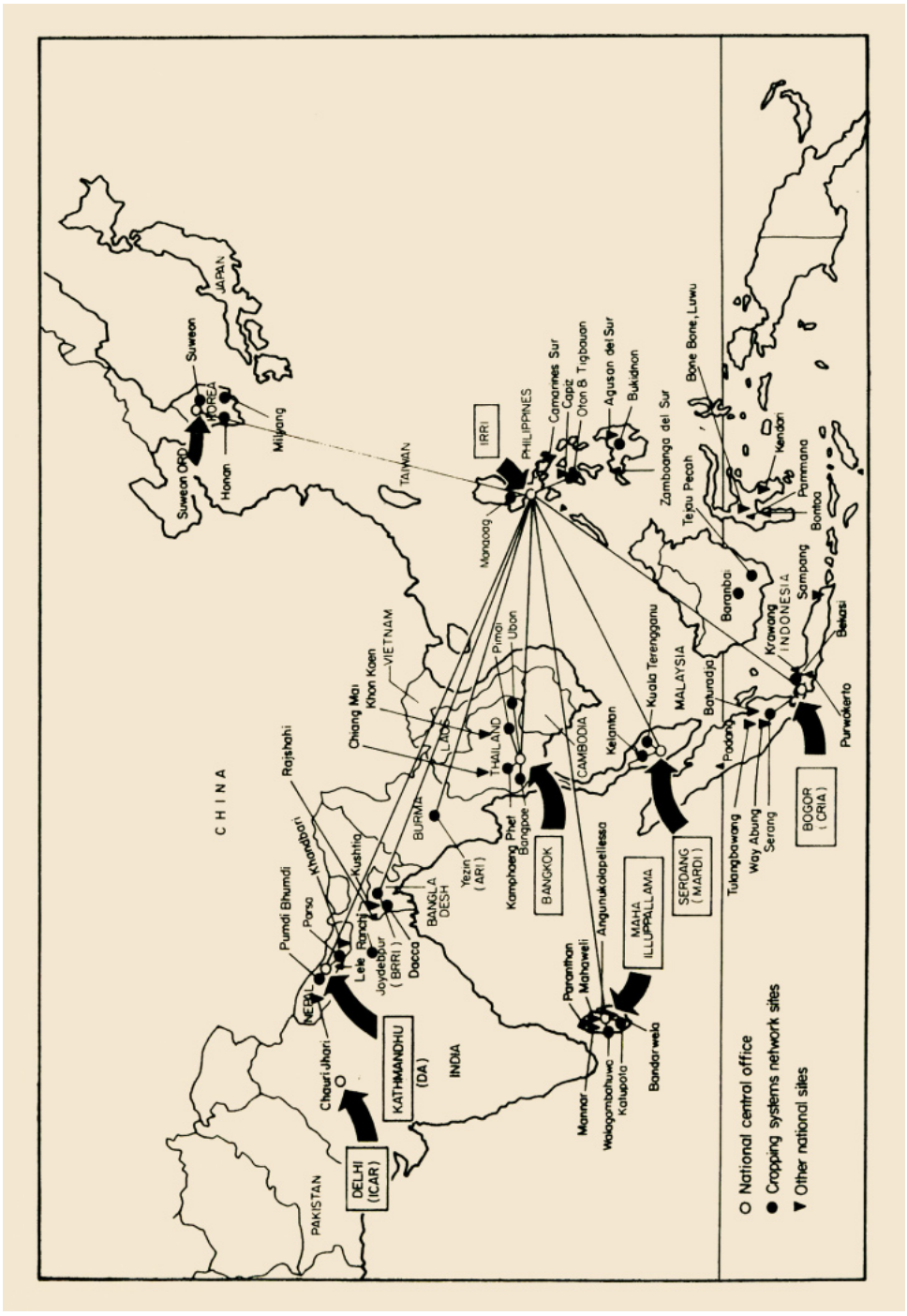
The foregoing background is given to show that the cropping systems program developed from a relatively small two-man operation conducted mostly at IRRI in 1972, to a full-fledged international network by 1975-76.

IRRI's 1979 annual report devotes 95 pages to a description of the cropping systems program, the scope of which is reflected in the following list of the topics discussed:

- Environmental description — an evaluation of cropping pattern determinants, disease surveys, weather pattern classification, and target-area delineation (rainfall pattern, soils, and irrigation systems);
- Design of cropping patterns — studies in Iloilo (Philippines) of the potentials for a second rainfed wetland rice crop, and investigations of yield losses to insect pests on farm plots in Iloilo and in the province of Pangasinan (Philippines);
- Testing of cropping patterns — economic studies of the profitability of varying levels of labor and cash inputs, and the efficiency of insect control methods;
- Component technology development and evaluation — studies of weed, insect and disease control methods, and soil and crop management investigations, including the testing of varieties of rice, mungbean, soybean, cowpea, sorghum, maize, sweet potato, and peanut;
- Applied research and multilocation testing;
- Asian cropping systems network — testing of cropping patterns in the Philippines, Nepal, Korea, Sri Lanka, Thailand, Bangladesh, and Indonesia, including mention of the eighth meeting of the Cropping Systems Working Group, and of the training program in multiple cropping.

This type of work is continuing today and is being conducted by the Multiple Cropping Department and by the cropping systems components in the Departments of Agronomy, Entomology, Plant Pathology, Agricultural Economics, and Soil Microbiology. The research is carried on either on IRRI's experimental farm or at on-farm experimental areas in Pangasinan, Iloilo, the Cagayan Valley, and Batangas; and, of course, some phases are on the network sites in cooperating countries (see figure).

Yield constraints research and network (*IRAEN*). Studies over the years have decisively shown that there are three levels of rice yields. The highest, understandably enough, is obtained in experimental fields where growing conditions are ideal. At the next level are yields from the experiments placed in farmer's fields by research or extension workers. The lowest yields are those obtained by the farmers themselves in areas where there are varying kinds of management and where certain environmental or socioeconomic factors are less than ideal.


CHINA
JAPAN
KOREA
Suweon
Suweon ORD
Honan
Miryang
TAIWAN
IRRI
PHILIPPINES
Camarines Sur
Capiz
Oton & Tigbauan
Agusan del Sur
Bukidnon
Zamboanga del Sur
Tepu Pecah
Bone Bone, Luwu
Kendon
Pammana
Bontoa
Sampang
Bekasi
Purwokerto
Manaoag
Pimoi
Ubon
VIETNAM
Chiang Mai
Khon Koen
LAOS
THAILAND
BURMA
Yezin (ARI)
Kamphaeng Phet
Bangpoe
BANGKOK
CAMBODIA
Kelantan
Kuala Terengganu
MALAYSIA
Baturadja
Padang
Baranbai
Krowong (INDONESIA)
Tulangbawang
Way Abung
Serang
SERDANG (MARDI)
BOGOR (CRIA)
Rajshahi
Khondbati
Kushtia
Pumdi Bhumdi
Porso
Lele
Ranchi
Joydebpur (BRRI)
Dacca
BANGLA DESH
NEPAL
Chauri Jhori
KATHMANDHU (DA)
INDIA
PAKISTAN
DELHI (ICAR)
Paranthan
Mahaweli
Angumukolapellessa
MAHA ILLUPPALLAMA
Monnar
Walagambahuwo
Kalupolo
Bandarwela
O National central office
● Cropping systems network sites
▼ Other national sites

Beginning in 1974, IRRI scientists (agricultural economists, agronomists, and statisticians) undertook a yield constraints project to study the basic reasons for the yields gaps just described. As a first step, they worked out methodologies[1] for measuring the biological and socioeconomic restraints.

Next, IRRI invited cooperating scientists from six countries to a workshop to create an International Rice Agroeconomic Network (IRAEN). By early 1975, the group had produced the design of the experiments and set the procedures for studying the factors constraining rice yields in farmers' fields.

The results of these coordinated studies in the Philippines, Indonesia, Thailand, Taiwan, Bangladesh, and Sri Lanka have been published in two volumes. The first, *Constraints to High Yields on Asian Rice Farms: an Interim Report,* was published in 1977 and a final volume, *Farm-level Constraints to High Rice Yields in Asia:* 1974-77, appeared in 1979.

Since 1977, studies of constraints — conducted jointly by IRRI's Departments of Agricultural Economics, Agronomy, and Irrigation Water Management — have been continued in the Philippines.

Many important conclusions have been derived from both the investigations by the network scientists and the more detailed work in the Philippines, but only a few of them can be mentioned here. Perhaps the most uniform conclusions reached from the various environments under study were the following:

- The yield gap between what the farmers obtained and what resulted from a high level of management on the same farms was usually greater in the dry season than in the wet;
- Fertilizer response was always higher in the dry season than in the wet, provided of course that there was sufficient irrigation water in the dry season; and
- Among the three inputs — fertilizer, insect control, and weed control — the most uniform and largest response was from fertilizer, the second from insect control, and the lowest from weed control.

Somewhat regrettably (considering its vital role), water management was not a variable studied in this project. Although in the study sites selected, either pump or canal irrigation was obtainable, mention nevertheless was made that at several sites, reliable interpretations of yield data were impossible because of inadequate water supply. Realizing that around the world water control is the single most important factor affecting the yield of wetland rice, IRRI since 1980 has included that factor as a variable.

One of the key aspects of the constraints study is that it brought together economists, agronomists, and statisticians from six countries to work on a common project.

Agricultural engineering and the International Agricultural Machinery Network (*IAMN*). In 1972, there were three senior scientists in the Agricultural Engi-

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[1] The methodology part of this study was published by IRRI in 1978 in a booklet entitled A *Handbook on the Methodology for an Integrated Experiment-Survey on Rice Yield Constraints,* by De Datta, Gomez, Herdt, and Barker.

neering Department: Khan, head of the department and agricultural engineer; J. Bart Duff, associate agricultural economist; and Fred E. Nichols, associate evaluation engineer. The department had 11 junior scientists.

By 1981, the department had five senior scientists: Clarence W. Bockhop, department head and agricultural engineer; Duff, Malcato Ariyoshi, and Marvin Nafziger, associate agricultural engineers; and John A. Wicks, associate agricultural economist. The number of junior scientists had grown to 27 from the 11 in 1972. Furthermore, Khan (as previously mentioned) had been assigned to Pakistan to assist in machinery introduction, testing, and manufacture — part of IAMN, which was established in 1975 with agricultural engineers placed not only in Pakistan but in Bangladesh (G.M. Peterson), Burma (J.E. Townsend), Indonesia (Venkat R. Reddy), Thailand (R.C. Fischer), and the Philippines (Robert E. Stickney). The general objective of the IAMN was to encourage the manufacture of IRRI-designed equipment in other countries, to test the equipment thoroughly in each country, to introduce appropriate models to farmers, and to train young agricultural engineers at IRRI. A portion of this work received support from USAID.

At IRRI, work on machinery design and testing continues at a high level. The annual report for 1979, for example, describes the following activities:

- improvement of the design of 6- to 8-hp two-wheeled tillers,
- development of a rotary tiller attachment for the 6- to 8-hp tractors,
- improvement of the multicrop dryland seeder,
- further improvement of a manual 5-row rice transplanter,
- improvement of the hand-drawn wetland rice seeder,
- design of an improved liquid injector for deep placement of insecticides or fertilizer,
- further improvement of IRRI's axial-flow rice thresher, and
- redesigning of IRRI's rice hull furnace for grain drying.

The ultimate proof of the value of this program is the extent to which the IRRI models are being manufactured and sold to farmers throughout Asia. For the past 5 or 6 years, IRRI has had considerable cooperative work going on in the Iloilo area of the island of Panay, particularly in the cropping systems program and in intensified rice production. There has been a tremendous farmer demand for IRRI threshers. In 1975, there was essentially no mechanical threshing of rice in the area. By 1978, more than half of the farmers were using IRRI-designed threshers, mostly of theaxial-flow type. By 1979, more than 80% of the farmers growing irrigated rice in Laguna Province were using the thresher. IRRI provides the designs to local manufacturers who then fabricate all elements of the threshers except the engines.

In Thailand during 1979, more than 2,100 units of the IRRI axial-flow thresher were manufactured and sold to farmers, a 37% increase over the number made the year before.

Although the manufacturers sometimes make slight changes in IRRI design, and the machines developed by IRRI have not always proved as good as (for example) Japanese models, the Institute is continually monitoring its

equipment and has already corrected many defects of its original models. IRRI machinery design, testing, and industrial extension programs are, without question, a real success and have brought to the small rice growers of Asia extremely useful equipment that has saved them much backbreaking labor. The IRRI power tiller, moreover, has greatly reduced the turnaround time for farmers engaged in multiple cropping.

Publications program

IRRI's Office of Information Services (OIS) has developed the largest publications program of any of the 13 international agricultural research centers in the CGIAR system. Although from the start the Institute prepared a detailed and highly informative annual report and published technical bulletins, the proceedings of its symposia, and *The IRRI Reporter* (which started out as a bimonthly publication but later became a quarterly), much of the expansion took place in the last 8 years. To demonstrate this change, comparisons are made here between the program in 1972 and in 1980-81.

In 1972, the only senior staff member of the OIS was Breth, who served as editor and head of the Office. The rest of the department consisted of an assistant editor, a graphic designer, two artist illustrators, one head photographer, two assistant photographers, and a rice information assistant (to handle groups of visitors). Thus, the OIS had a total staff of nine.

Joyce C. Torio replaced Breth as head of OIS in 1974. She left IRRI at the end of 1978. Since 1979, the Office has been headed by Thomas R. Hargrove, who has the title of editor. There are two other full-time editors, Walter G. Rockwood and William H. Smith, and one visiting editor. The total senior staff therefore numbers four, as compared to one in 1972. There are more than 30 junior staff members, comprising two assistant editors, one editorial assistant, one research assistant, ten graphics and design specialists, four illustrators, six printers, and six photographers. Hence, the OIS has more than tripled in size during the 9-year period from 1972 to 1981.

Considering the small staff in 1972, the output was truly remarkable. That year, in addition to preparing the *Annual Report for 1972* (238 pages), the OIS sent out 55,000 copies of IRRI publications, including 28,000 copies of *Field Problems of Tropical Rice* (which has proved to be IRRI's most popular publication with several hundred thousand copies distributed and translations into several languages). In 1972 also, the Office published a book entitled *Rice, Science and Man,* the proceedings of a conference held on the occasion of IRRI's 10th Anniversary Celebration in April 1972. It also published *Rice Breeding,* the proceedings of IRRI's symposium on that topic and the first major symposium proceedings to be published and distributed entirely by IRRI. The 1972 publications of IRRI included the 134-page bulletin *Virus Diseases of Rice,* a *Training Manual for Rice Production, a Manual for Field Collectors of Rice,* and the bulletin *Techniques for Field Experiments with Rice: Layout/Sampling/Sources of Error.* In addition, the OIS issued *The IRRI Reporter* and edited innumerable papers written by IRRI scientists for publication in professional journals.

In spite of this highly efficient operation in 1972 (and the output per person could scarcely be exceeded), the volume of publications emanating from the OIS today dwarfs IRRI's earlier production.

In addition to continuing *The IRRI Reporter,* the Institute now puts out a bimonthly journal, *International Rice Research Newsletter* (first issued in 1976), which contains short articles by rice scientists throughout the world and constitutes the most up-to-date account of current research on rice.

In 1976, IRRI began issuing a new set of publications called the *IRRI Research Paper Series,* which serves as a vehicle for the timely announcement of research findings of the Institute's senior scientists and their associated junior staff. The series has proved to be a popular publishing medium for the IRRI staff and about 10 papers are issued each year. (A complete list of the series from its beginning appears in Appendix 12.)

Besides the three continuing publications just mentioned, the OIS prepares a lengthy (more than 500-page) *Annual Report* from the materials sent in by the scientific staff. Each annual report is preceded by a shorter booklet called *Research Highlights,* which is printed in time to be distributed to the principal donors before the annual centers week sponsored by the CGIAR.

A major responsibility of the OIS is to edit and publish the proceedings of all conferences, workshops, and symposia held by IRRI during the year. As an example of the workload, in 1979 alone the following publications of this type were issued:

- Report of a Rice Cold Tolerance Workshop
- Proceedings of the 1978 International Deepwater Rice Workshop
- Proceedings of the Rice Blast Workshop
- Interfaces between Agriculture, Nutrition, and Food Science
- Proceedings of the Workshop on Chemical Aspects of Grain Quality
- Nitrogen and Rice
- Brown Planthopper: Threat to Rice Production in Asia
- Rainfed Lowland Rice
- Farm-level Constraints to High Rice Yields in Asia: 1974-77

Furthermore, IRRI makes a significant contribution to the rice literature by publishing bulletins and books written by its senior staff. Examples of recent publications of that type are:

Rice: Soil, Water, Land by F.R. Moormann and Nico Van Breemen (1978)

Anatomy of a Peasant Economy by Y. Hayami (1978)

Rice Research and Production in China: an IRRI Team's View (1978)

Rice Improvement by P.R. Jennings, W.R. Coffman, and H.E. Kauffman (1979)

Blue-Green Algae and Rice by P.A. Roger and S.A. Kulasooriya (1980)

Principles and Practices of Rice Production (John Wiley and Sons) by S.K. De Datta (1981)

Fundamentals of Rice Crop Science by Shouichi Yoshida (1981)

In addition to the IRRI publications mentioned here, the Institute's Library and Documentation Center issues annual international bibliographies on rice research and cropping systems. This is an extremely important contribution,

for it undoubtedly provides the world's most complete account of the current literature in those fields.

IRRI's publications program is eminently successful, not only from the standpoint of providing essential information to individual scientists and to libraries but financially as well. Its prices are modest for customers in the developing nations and higher for those in the more affluent countries. For example, the *Annual Report for 1978* sold for $6.00 in the former and $15.00 in the latter. *The IRRI Reporter* and the *International Rice Research Newsletter* are provided free of charge to rice scientists on request.

Cooperation with the People's Republic of China

Although the People's Republic of China is the world's largest producer of rice, during IRRI's early days there was essentially no communication between Chinese scientists and those in the Philippines or in many other countries. IRRI was aware that some of its varieties had moved from the New Territories (Hongkong) into mainland China but had no information about the degree of impact, if any.

The first attempt by IRRI administrators to make contact with agriculturists in China was in late 1971 when an invitation was extended to its Minister of Agriculture to attend IRRI's 10th Anniversary Celebration in the Philippines in April 1972. Although no direct response to the invitation was received by the Institute, word reached the Chinese scientists at IRRI through contacts in Hongkong that the invitation would have to be declined.

At that time, the Philippines had diplomatic relations with the Republic of China (Taiwan) but not with the People's Republic of China. In early 1972, I happened to run into a member of the Taiwan diplomatic corps in the lobby of the Intercontinental Hotel in Manila. Obviously disturbed that the IRRI invitation had been issued, the latter rather indignantly asked me who had told me to invite the Minister of Agriculture from China. No one had told me to do it, I replied; IRRI administrators and the committee planning the 10th Anniversary Celebration had decided, without consulting anyone outside the Institute, to issue the invitation. The Taiwan official appeared not to believe this and went away in an unhappy mood. However, several years later when, on one of my visits to the Philippines, I again met the official, he was most genial, apparently to make up for his antagonism at the earlier encounter. By that time (1976), IRRI was establishing major contacts with China.

The first successful exchange between IRRI and China was in 1972 when seeds of IR20 and other promising IRRI varieties were presented to a Chinese trade delegation by President Marcos of the Philippines. Person-to-person contact between IRRI and China first took place in 1974 when Director General Brady was invited to join a 10-member plant science delegation to China under the sponsorship of the Committee on Scholarly Communication with the People's Republic of China. This group, headed by Sterling Wortman, spent 4 weeks in the PRC from 27 August to 23 September. During the visit, Brady distributed seeds of IRRI rice varieties to Chinese research workers and, in

turn, received genetic materials to take back to the Philippines. Moreover, the visit gave Brady an opportunity to extend a formal invitation to Chinese officials to expand the exchange of rice genetic resources, publications, and scientific personnel.

In March 1976, a group of eight distinguished Chinese scientists and administrators led by Yang Li-Kung, the vice-minister of Agriculture, stayed at IRRI for 3 days. The visit was so successful that it was agreed that the scientists in the Chinese group would return to IRRI the following month for further discussions. These March-April conversations resulted in an invitation for an IRRI team to make a reciprocal visit to China. This took place in October 1976 when an IRRI group, led by Brady, traveled in the PRC for about 3 weeks. The team, besides Brady, was composed of Barker, De Datta, Khush, Ou, Pathak, and S. Yoshida. They visited most of the institutions conducting research on rice as well as rice-growing communes where they could interview actual farmers. It was a most informative and rewarding visit, a report of which (as mentioned earlier) was published by IRRI in 1978 under the title, *Rice Research and Production in China: an IRRI Team's View.*

In 1977 and 1978, three teams of IRRI specialists visited China at different times. In 1978, four Chinese rice scientists spent nearly 8 months at IRRI. During their stay, they participated in a 4-month GEU training course and worked on joint research projects with IRRI scientists. Also beginning in 1978, Chinese rice scientists started attending international conferences at IRRI.

In March 1978, the Honorable Li Hsien-Nien, vice-premier of the People's Republic of China (the highest Chinese official to visit IRRI), made a state visit to the Philippines and was brought to IRRI by First Lady Imelda Marcos and Secretary of Agriculture Arturo R. Tanco.

A milestone in the relationship between IRRI and China occurred in 1978 when Lin Shih-Cheng, a plant breeder at at the Chinese Academy of Agricultural Sciences in Peking, accepted an invitation to join the Board of Trustees of IRRI.

In October 1979, the IRRI Board of Trustees held its annual meeting in Peking. This was followed by an IRTP Workshop and Monitoring Tour in China that brought together 30 scientists from eight Asian nations, an event unprecedented during the past several decades.

An outcome of the contacts with the Chinese scientists has been an intensified interest at IRRI in developing hybrid rice. In September-October 1980, a hybrid rice training course was held at the Hunan Academy of Agricultural Sciences at Changsa, Hunan. This was sponsored jointly by IRRI and the Chinese Academy of Agricultural Sciences. S.S. Virmani, visiting plant breeder, represented IRRI. Rice breeders from Bangladesh, India, Philippines, Sri Lanka, and Thailand attended the sessions.

That same year, Chinese plant breeders worked at IRRI in developing methods of breeding hybrid rice, and Virmani continues to devote essentially all of his time to research in that area. Fortunately, both IR24 and IR26 are excellent fertility restorer parents for hybrid rice and are being used in China

as well as at IRRI. Hybrid rice is planted on some 5 million hectares in China and IRRI scientists are attempting to determine the practicality of its use in the tropics.

Institute scientists gained more from their visits to China than the technique for breeding hybrid rice. Contacts with Chinese scientists awakened the interest of IRRI's plant breeders in pursuing the possibilities of another culture in rice improvement. Furthermore, among the genetic materials brought back from China, a few have possessed the greatly desirable combination of early maturity, high seedling vigor, and good yield potential and are being used as parents in IRRI's breeding program. The agronomists and soil microbiologists gained greater appreciation of the possibilities of substituting organic materials for chemical fertilizer and of the practicality of using azolla in irrigated rice paddies to improve the fixation of atmospheric nitrogen. In 1981, IRRI's Office of Information Services entered into an agreement with the PRC for the exchange of rice literature, and translation of IRRI publications into Chinese began.

IRRI deserves immense credit for the resolute way it opened the avenues of communication between the rice scientists in China and those in other Asian countries. The first step, plainly, was to get representation at IRRI from China. To this, there was considerable resistance at the start because China did not want to send its scientists or administrators to an institution that had several scientists from Taiwan on its staff. But Brady's quiet and diplomatic persistence won out, primarily because he made it clear that the staff members from Taiwan were not chosen because of their country of citizenship but rather because of their competence as scientists. As evidence that the problem is now a thing of the past, all three of the IRRI scientists from Taiwan (Ou, Chang, and Ling) have been on missions to China with the full acceptance by the top officials of that country.

IRRI'S FUTURE

As stated early in this book, it was originally thought that IRRI would have a life of 25 years, with the possibility, however, that it might continue for a second 25-year period. This, of course, was long before the CGIAR was created. Now that a broad base of financial support exists, there seems to be little talk of a terminal date for IRRI or for any of the other international agricultural research centers. It is doubtful, however, that financial support for the centers, particularly those formed back in the early to mid-l960s, will increase substantially other than to allow for inflationary trends. Thus, the size of IRRI's staff and program will probably not increase much beyond the present level. The Institute's specific program thrusts will change with time, no doubt, as old problems are solved and new ones arise.

In looking to the future, IRRI, in 1979 and again in 1981, organized a *long-range planning committee.* From the 1981 report of *A Plan for IRRI's Third Decade,* some of the more important areas selected for future emphasis are listed here:

1. Research to assist farmers bypassed by the modern technology, with emphasis on developing varieties and management practices for a) rainfed rice, both dryland and wetland, b) medium deepwater conditions, and c) areas with adverse physical environments, such as high and low temperatures and poor soil conditions.
2. Investigations of ways of increasing the fixation of atmospheric nitrogen and of improving the efficiency of the utilization of fertilizer nitrogen.
3. Studies of cropping systems research to assist the rice farmer in increasing his year-round income.
4. Socioeconomic studies of constraints to high yields and the consequences of the new technology — research that would involve detailed studies of villages composed largely of rice-growing farm families and, in cooperation with the International Food Policy Research Institute, studies and evaluation of national rice policies.
5. Innovative research to increase yield potentials, such as the development of hybrid rice varieties, mutation breeding, anther culture, and rapid generation advance.
6. Small-farm machinery development and testing.
7. Continuation of training and of research on irrigated rice as high-priority components of IRRI's program, but with the focus on projects in those two areas that are not easily carried on by national programs.

To support these research and training activities, IRRI naturally will continue to have strong library and information services and to communicate with the rice scientists of the world through international conferences, workshops, and symposia. There is no doubt that for the foreseeable future, IRRI will be the global center for the study of the rice plant and that scientists everywhere will look to it for breeding materials, for new information, and as the place to train young rice scientists in all the key disciplines.

The founders of the International Rice Research Institute have indeed seen their aspirations realized in its achievements in advancing rice technology, in notably improving international cooperation among rice scientists, and in its continued commitment to increasing the world supply of a vital food and improving the lot of the farmers who produce it.

Appendix 1

HARRAR'S MEMORANDUM TO RUSK FOR HILL OF OCTOBER 8,1958 FOLLOWS:

Rice is the single most important food crop grown today. It dominates agricultural production in essentially every area of the world which is well adapted to its production and has been extended to and beyond its optimum ecological limits, Most of the world rice production occurs in those areas thought of as being underdeveloped with the result that methods are primitive and inefficient, production is low, and prices relatively high. Although research in rice is in progress in a number of parts of the world, the great advances lie ahead. There are immediate opportunities to make significant benefits in the quantity and quality of rice available each year to feed the ever increasing number of individuals who depend on this crop for sustenance.

The two major types of rice grown today are known as the Japanese type, *Oryza japonica,* or the Indian type, *Oryza indica. Oryza japonica* is better adapted to temperate climates, whereas *Oryza indica* is found throughout the tropics and subtropics wherever rice is grown. Yields vary from as little as 400 to 500 pounds per acre to 3500 pounds or more, and labor requirements range from extremes of a few man-days per acre per year to 300 to 400 man-days per acre. Each year, great economic losses occur as the result of agricultural malpractice including the use of nonimproved varieties, improper soil and water management, inefficient hand labor, and wasteful harvest and storage practices.

It has been estimated that the annual world yield of rice could readily be doubled if scientific and technical information now available could be universally applied. By extrapolation, the total yield might conceivably be doubled again as a result of fundamental research on those problems of rice production which are still only partially understood. While this situation is obviously utopian, it would seem clear that very great improvements in production could be expected as a result of intensification of research efforts and the extension and application of their results.

There are a number of locations where serious research on rice is in progress. Outstanding among these is Japan where work is in progress at many institutions. In India, the Rice Research Station at Cuttack in the State of Orissa is outstanding and the National Rice Research Institute located in Bangkok, Thailand, has been active for sometime but has to date been relatively ineffective. Projects have been undertaken in Burma, Ceylon, Indonesia, and the Philippines, but these have not been especially productive. In this country, significant research is in progress in the States of Louisiana, Texas, Arkansas, and California.

Examination of world production figures on rice in comparison with numbers of so-called rice eaters in the world and their average caloric intake very clearly emphasize the fact that there is an enormous imbalance between demand and supply. This suggests that any well-conceived and effective effort to produce information and

materials could readily be applied over wide areas with benefit to rice yields and would have important social significance. One approach to this objective might be the establishment of an International Rice Research Institute. The object of this Institute would be threefold, namely:

A) To bring together available information on rice and its management,
B) To recruit and organize a group of competent resident investigators who will work on the basic and applied problems of rice production, and
C) To establish international cooperative relations directed towards increasing the effectiveness of research and its general application.

On the assumption that a significant social and scientific contribution could be made through the establishment of an International Rice Research Institute, consideration has been given to the most logical site for such an operation. For a number of reasons, it has been decided that the Island of Luzon in the Philippine Islands is a most logical choice. Many of the reasons are obvious but others might be mentioned which include the fact that the Philippine Islands is an important rice-producing area but one where the demand far outstrips the supply. Average production figures are low, management practices are primitive, and opportunities for research, demonstration, and extension are great. Furthermore, the Philippine Islands has a progressive School of Agriculture located at Los Baños and this Institution has had the benefit of a number of years of association with leading agricultural scientists from Cornell University under an ICA-College Contract. There is in the Philippines an understanding of the need for greatly increased agricultural research and acceptance of the principle of international cooperation. Another asset is the fact that the Philippine Government has friendly relationships with essentially all of the countries in Asia.

An International Rice Research Institute located in Asia could at once begin the study of a broad spectrum of important problems which are involved in rice improvement. Examples of these may be listed as follows:

1) Varietal improvement leading to the development of hybrids which were well adapted to the important rice-producing areas in the region under consideration;
2) Research in the fields of genetics, cytology involving studies of polyploidy induced mutations and outcrosses;
3) Ecological, physiological, and biochemical investigation with respect to the problems of nutrition, growth, and reproduction;
4) Soil physics, soil chemistry, and soil microbiology of paddy soils;
5) The water relationships of rice with reference to the effect of temperature and mineral content on plant growth;
6) The fertility problems of rice production;
7) Studies of the pests and pathogens which attack rice and basic studies of host-parasite relationships and control methods;
8) Mechanization of rice production;
9) The handling and storage of rice;
10) Economic studies relative to all phases of production and marketing.

A number of other aspects of rice research could be mentioned but the foregoing should serve to illustrate some of the sorts of projects which could be undertaken with the expectation that definite benefits would accrue as new methods, materials, and information become available.

If an International Rice Research Institute were to be established in the Philippine Islands, it is assumed that this would be begun modestly but set up in such a way as to be able to expand in response to demonstrated progress.

Presumably, the initial staff leadership might have to come from the West, but at an early stage, Eastern associates could be located and appointed on the basis of demonstrated competence. This would result in the prompt formation of an international team working together in a program of at least hemispheric importance.

A very preliminary estimate of the physical and financial requirements of such a program are as follows:

Buildings

1) One administration and office building,
2) One research center with appropriate installations,
3) One guest house with kitchen and dining facilities,
4) One staff apartment building,
5) Six to eight staff houses,
6) Building reserve fund

Total capital cost for construction (estimated) $2,000,000-2,500,000

Equipment

The equipment item would include:

1) Office and laboratory equipment including special research installations,
2) Vehicles, machinery, shop equipment,
3) Library equipment, books, and periodicals,
4) Furnishings for living quarters,

Total costs for equipment (estimated) $1,000,000-1,250,000

Land requirements

A minimum of 400 acres of land appropriately located and capable of being developed into a first class research area with appropriate installations. It is believed that this facility could be provided by the host country.

Staff

Initially, a staff of three to four specialists should be appointed to supervise the establishment, construction, and organization of the research institute and initiate research projects. Subsequently, specialists in the important disciplines related to rice improvement would be added and eventually there might be a staff of some twelve to fifteen research leaders, plus their junior associates and trainees.

Annual staff costs (maximum of fifteen for salaries perquisites, travel, etc.)
Estimated $300,000

Annual budget in support of research projects
Estimated $200,000

It is expected that the costs of junior staff, trainees and visiting scientists, etc., would be met by the participating countries.

In conclusion, it should be emphasized that this Memorandum is entirely preliminary and based to a large extent on past experience. However, as a result of visits to the Philippine Islands and the other important rice areas in Asia, it is believed that it represents a reasonable basis for future discussions.

(Sgd) J.G. HARRAR

Appendix 2

OVERSEAS DEVELOPMENT
INTERNATIONAL RICE RESEARCH INSTITUTE

Recommended action

Approval of an appropriation of $250,000 for purposes related to the establishment of an International Rice Research Institute, including the possibIe acquisition of land, preliminary plans and designs for buildings, improvements to land, and other developmental expenditures.

Background

Aside from the possibility of all-out nuclear war, two of the most important problems confronting the world today are the related problems of population and food supply. The so-called "median estimate" of world population made by the United Nations demographic office is 6 billion people by the year 2000 compared with an estimated 2.8 billion at the present time. Added to the prospect of staggering increase in numbers is the hard fact that millions of people in the world today have never had a nutritionally adequate diet. At best, the world food outlook for the decades ahead is grave; at worst, it is frightening.

Rice is the most important single food crop in the world. Although the world acreage of wheat exceeds the acreage of rice by a substantial margin, rice yields per acre are usually from two to three times wheat yields with the result that the world rice crop usually exceeds the wheat crop by 10 to 20 per cent. Rice is the major item in the diets of more than one half of the world's population. It supplies 70 to 80 per cent of the entire calorie intake in many countries.

Over 90 per cent of the world's rice crop is produced in Asia, with South America, Africa, and North America ranking next in the order of importance. Small amounts of rice are produced in Europe, the U.S.S.R., and Oceania. As this suggests, most of the worlds rice production occurs in the so-called underdeveloped countries; areas that have been largely bypassed by the stream of modern science and technology. Except for Japan and the United States, production methods in most countries are primitive and inefficient, yields are low, and prices are relatively high.

Although rice research is in progress in various parts of the world, the major advances lie ahead. Great opportunities exist for increasing the quantity and improving the quality of rice for the rapidly growing number of people dependent upon this important crop for food. It has been estimated, for example, that the annual production of rice could readily be doubled if scientific and technical knowledge now available were to be universally applied. Tripling of present production might well be possible from the application of the results of fundamental research on those problems of rice production which are still only partially understood. In any case, it is clear that great improvements in production would result from the intensification of research efforts

and the extension and application of research findings. Research on rice is in progress in a number of countries. Outstanding among these is Japan, where excellent work is being conducted at a number of research centers. In India, the Central Rice Research Institute at Cuttack, in the State of Orissa, is well known for its contributions. Work in other countries of South and Southeast Asia has not been particularly productive. In the United States, research is in progress in the states of Louisiana, Texas, Arkansas, and California, although much of it is of practical nature and applicable primarily to conditions in this country. A rice research station has been in existence for a number of years in Brazil, and work is in progress in Venezuela; Colombia, and Mexico.

Unfortunately, much of the research that has been done in such countries as Japan and the United States is not directly applicable to the heavily populated countries of South and Southeast Asia, where rice is the staple food crop. Although some twenty-five species of the genus *Oryza* have been described in the literature, most of the cultivated rice grown today is *Oryza sativa* L., of which there are two major types: *Japonica* and *Indica*. The *Japonica* type is best adapted to temperate climates such as those of Japan and California, and for this reason most of the best rice research work, both fundamental and applied, has been done on *Japonica.* With the exception of the Central Rice Research Institute at Cuttack in India, relatively little good work has been done on *Indica,* despite the fact that most of the world's rice production is of this type. It is true, of course, that much of the fundamental work on *Japonica* applies to *Indica,* but the fact is that a large and important job remains to be done both in fundamental research on all the more important species of rice and on applied research looking toward the development of improved varieties suitable to the wide range of climatic and soil conditions existing in the rice growing countries of the world. In the latter connection, it is worth noting that rice is produced under a wider variety of conditions and by more varied methods than any other major crop. It has been estimated that more than 8,000 varieties adapted to a wide range of local conditions and tastes are produced in commercial quantities. Contrary to common impression, more than 50 per cent of the world's rice crop is grown without irrigation or a controlled water supply of any kind. It is grown in the lower reaches of the Andes, where climatic conditions are too severe for such temperate zone crops as corn, as well as in the tropics. Yields range from as little as 400 to 500 pounds per acre to 3,500 pounds or more. In the United States, large acreages are planted, fertilized, and weeded by airplane and harvested by combine with as little as two man-days of labor per acre. In most of the world, production methods are still extremely primitive, involving an average of perhaps 200 man-days of labor with extremes as high as 400 man-days.

For more than fifteen years, the Rockefeller Foundation has been concerned with food-crop improvement in certain underdeveloped areas, principally in Latin America. Cooperative operating programs have been established in Mexico, Colombia, and Chile directed primarily toward improvement in the quantity and quality of the cereal grains which supply the basic foods for indigenous populations — principally maize, wheat, sorghum, and barley. More recently, a cooperative program was established in India which is currently directed toward the improvement of maize, sorghum, and millet. In addition, the Rockefeller Foundation is cooperating with the Government of India to strengthen the program of postgraduate studies at the Indian Agricultural Research Institute near New Delhi with a view to providing high-level training for agricultural scientists in India.

From the inception of the Rockefeller Foundation's program in agriculture, it was recognized that the improvement of rice offered an excellent opportunity for making a major contribution to world food supplies. However, it was not considered appropri-

ate to concentrate on rice research in Latin America, where other cereals are of primary importance, although rice improvement is one phase of the current program there. When it was decided to extend their program into Asia, the Rockefeller Foundation recognized that this provided an opportunity to consider ways and means of making contributions toward the improvement of rice production paralleling those already made in the case of wheat, maize, sorghum, and barley in Latin America.

As the overseas development program of the Ford Foundation has evolved, members of the staff both overseas and in New York have become increasingly concerned with food and population problems. Because of the extreme urgency of these problems in South and Southeast Asia, and the importance of rice in the diets of the people in this region, plus the fact that only a limited amount of high-quality rice research directly applicable to conditions in this part of the world is under way, this concern has focused on rice. As the staffs of the Rockefeller and Ford Foundations became interested in rice as the world's most important food crop, it was natural that they should begin to exchange views concerning possible ways and means of increasing the quantity and improving the quality of the rice crop, particularly in South and Southeast Asia. As the result of a series of discussions held over a period of eighteen months or more, it was decided that the two foundations should give serious consideration to supporting the establishment of an International Rice Research Institute dedicated to fundamental and applied research on the rice plant and its culture, the results of which would have application in all of the more important rice growing areas of the world.

Nature of Proposal

It is proposed that the Rockefeller and Ford Foundations jointly support the establishment of an International Rice Research Institute as described below.

1. *Objectives.* The Institute's objectives would be a) to carry on fundamental studies of the rice plant leading to knowledge which would permit varietal improvement from the standpoint of quality, yield, disease and pest resistance, and adaptability; b) to extend information and improved materials resulting from such research to areas where they could be applied with benefits to production; c) to provide training to a selected group of young scientists, principally from those countries of South and Southeast Asia where rice is an important food crop, so that they might subsequently render more effective service to agricultural science and rice production in their own countries; d) to create a research center which would attract scientists from many countries for temporary periods for the purpose of attending meetings, exchanging ideas and information, and participating in research and progress; and e) to assemble in a single location available information and materials on the rice plant and its culture.

2. *Location.* It is proposed that the Institute be located on the Philippine Island of Luzon near the College of Agriculture of the University of the Philippines at Los Baños. It is expected that eventually, substations would be established in other important rice growing areas of the region.

Although the Institute would be located in the Philippine Islands, it is proposed to link it, as opportunity permits, with rice research centers in other countries as cooperating institutions. This association would facilitate the exchange of information, materials, and personnel and would provide effective outlets for research findings and improved breeding materials. The cooperating institutions would also serve as sources of young scientists to be given advanced training at the International Rice Research Institute.

3. *Organization.* It is proposed that the International Rice Research Institute be established as tax-exempt autonomous organization under the laws of the Republic of

the Philippines, with a governing board composed of a) one representative designated by the Rockefeller Foundation; b) one representative designated by the Ford Foundation; c) the director of the Rockefeller Foundation's rice research program at the Institute, who would be designated by the governing board of the Institute as its director; d) one representative from the Philippines; and e) three members selected by the other four.

The Institute would be authorized to establish its own specific policies and purposes; to acquire by purchase, lease, or gift, and to manage land, buildings, and equipment; to make improvements on its property; to dispose of property; to enter into agreements with public and private agencies for the conduct of its program and to receive gifts for this purpose; and to perform other functions necessary to the establishment and conduct of the Institute and its program.

It is contemplated that the Institute would enter into a memorandum of understanding with the Rockefeller Foundation along the following lines: a) The Rockefeller Foundation would undertake to establish at the Institute a rice research, extension, and training program with the general objectives outlined in section 1 above. b) This program would be under the supervision of a director to be provided by the Rockefeller Foundation, his selection to be made in consultation with the governing board of the Institute. The program director so selected would also be designated as director of the Institute. c) Each year, the director, in consultation with the governing board of the Institute, would develop a program and budget to be submitted to the Rockefeller Foundation for the ensuing year together with a request for an appropriation to cover the budget.

Officers of the Rockefeller Foundation estimate that its maximum level of contribution to the program might approximate $700,000 annually, computed at the present official rate of exchange, and that this level might be reached in about five years. This amount would provide for a group of from twelve to fifteen research scientists of eminence in their respective fields plus supporting personnel and services.

Nothing in the proposed memorandum of understanding with the Rockefeller Foundation is intended to prevent the Institute from accepting grants from individuals, foundations, governments, or other sources for purposes in keeping with its program objectives. The expenditures of such funds would be made under the supervision of the director of the Institute for purposes approved by the governing board of the Institute.

4. *Land, buildings, and equipment.* It is hoped that the Philippine Government and/ or the University of the Philippines would contribute land and perhaps some additional facilities and labor. It is estimated that a minimum of 200 acres of land would be needed at the headquarters site and an additional 200 acres at substations. Buildings at the headquarters site would include an administration building, a research and laboratory center, shops, and residential buildings. Equipment would include laboratory equipment, vehicles, and farm machinery. A preliminary estimate of the cost of capital requirements, including irrigation facilities, is $5.5 to $6 million, assuming an exchange rate of two pesos to the dollar. It is proposed that the Ford Foundation's contribution be in the form of a grant to the Institute to finance its capital requirements. Provision might be made for transfer of buildings and equipment to the University of the Philippines if, at some future time, the Institute were to go out of existence.

5. *Proposed financing by the Ford Foundation.* It is proposed that the Trustees of the Ford Foundation appropriate at this time the sum of $250,000 for a foundation-administered project for the following purposes related to the establishment of an International Rice Research Institute as described above: a) possible acquisition of land by purchase, lease, or gift; b) preparation of preliminary plans and designs for buildings and of cost

estimates for buildings and improvements to land, including the construction of irrigation facilities; c) purchase of motor vehicles for the use of project staff during the planning stage; and d) other expenses incident to planning the Institute and developing a firm capital budget to be used as a basis for a grant recommendation to the Trustees of the Ford Foundation at their September or December 1959 meeting.

As soon as the proposed Institute has been chartered and its governing board appointed, it would undertake to negotiate a program operating agreement with the Rockefeller Foundation as described in section 3 above and apply to the Ford Foundation for a capital grant as indicated in section 4.

If and when an understanding is reached with the Rockefeller Foundation with respect to operating arrangements, and a capital grant for land, buildings, and equipment is obtained from the Ford Foundation, it is proposed that such land, leases, equipment, and other assets, except cash balances, as may be held by the Ford Foundation under the Foundation-administered grant recommended in this docket be turned over to the Institute.

Discussion

The proposal to establish an International Rice Research Institute is believed to be highly significant in a number of respects. First, it proposes a direct attack on one aspect of the all important food-population problem. Even if world population should increase during the next forty years by the minimum amount envisaged by the U.N. demographers, it will still be approximately 5 billion by the year 2000 or nearly double the present number. Aside from the prospect of this staggering increase in numbers, there is the further fact that the majority of the world's population does not have anything like an adequate diet.

Second, an International Rice Research Institute of the kind proposed should make it possible to bring to bear an effective worldwide attack on the problem of increasing the quantity and the quality of the world's most important single food crop.

Third, if the proposal for a cooperative project develops as contemplated, it would bring to bear upon the problem of rice improvement the wide experience of the Rockefeller Foundation and its excellent staff of agricultural scientists, who have been working on food-crop improvement in the less developed countries for more than fifteen years.

Appendix 3

MEMORANDUM OF UNDERSTANDING

PREAMBLE

The fact that many areas of the world are deficient in the production of basic foods essential to the nutrition of local populations is of growing public concern. Among those plant products which provide the bulk of the world's food, rice is preeminent; it is the most important cereal and serves as the principal daily food for more individuals than does any other food crop. Unfortunately, however, the annual supply of rice falls far short of needs in many rice-consuming countries and the situation is becoming increasingly serious with progressive population increases. In many areas, rice varieties are unimproved and cultivators make little use of modem techniques of production with the result that yields are far below production potentials.

In view of the importance of rice as a human food and the interest of the Ford and Rockefeller Foundations in contributing to increasing the quantity and quality of available food crops for the peoples of the world, these two foundations and the Government of the Philippines have during the past six months been discussing the desirability of establishing an international rice research institute at an appropriate location. It has now been decided that there is great need for a research institution of this character, that it should be located in Southeast Asia, and that the Philippine Islands could provide an ideal site for its establishment. Negotiations between the Government of the Philippines and the Ford and Rockefeller Foundations have proceeded on the most cordial basis and have now reached the point at which it is deemed desirable to record general agreement in this Memorandum of Understanding. In so doing, it is understood by all concerned that modifications may be indicated as the program develops, and that they may be made after mutual consultation.

PROPOSAL

It is proposed, through the joint efforts of the Government of the Philippines and the Ford and Rockefeller Foundations, to establish in the Philippines an organization to be known as THE INTERNATIONAL RICE RESEARCH INSTITUTE (hereinafter referred to as THE INSTITUTE) to carry on the following kinds of activities:

(1) Basic research on the rice plant and applied research on all phases of rice production, management, distribution, and utilization;
(2) Publication and dissemination of the research findings of THE INSTITUTE;
(3) Distribution of improved plant materials to regional and international research centers where they might be of significant value in breeding or improvement programs;

(4) Development of promising young scientists, primarily from South and Southeast Asia, through a resident training program under the guidance of distinguished scientists;
(5) Establishment and operation of an information center and library which will maintain for interested scientists everywhere a collection of the world's literature on rice;
(6) Organization of periodic conferences, forums, and seminars on current problems and developments in rice research.

ORGANIZATION

It is proposed that THE INSTITUTE be incorporated in the Philippines as an autonomous, philanthropic, tax-free, nonprofit, nonstock organization; that as a benevolent corporation, the term for which it is to exist shall be fifty (50) years from and after the date of incorporation; and that it be operated by a Board of Trustees with members representing the Government of the Philippines and the Ford and Rockefeller Foundations, and members-at-large representing major rice-producing regions of Asia.

It is proposed that THE INSTITUTE be established at Los Baños, in the Philippine Islands, in close association with the College of Agriculture of the University of the Philippines. Its physical facilities will consist of buildings for laboratories, library and field purposes, administration, and staff housing; adequate acreages of land for experimental purposes; and the necessary equipment, machinery, and supplies to support a high-quality program of research.

It is proposed that THE INSTITUTE be staffed by outstanding scientists selected for their special competence in fields directly related to the improvement of rice production. It is contemplated that staff members will be drawn principally from those countries in which rice is a major food crop.

It is proposed to associate with the permanent staff of THE INSTITUTE younger scientists who will receive advanced training and participate in research in fields relating to rice production, distribution, and utilization, after which they will return to their respective countries to provide leadership in local and regional rice improvement programs. It is expected that this training program will be developed in the closest possible association with the College of Agriculture of the University of the Philippines.

POWERS

In furtherance of its general objectives, it is proposed that THE INSTITUTE have the following incidental powers:

(1) To acquire or obtain from any governmental authority, national, municipal, or local, foreign or domestic or otherwise or from any corporation, company, association, or person, such charters, franchises, licenses, rights, privileges, assistance, financial or otherwise, and concessions as are conducive to and necessary for the attainment of the purpose of THE INSTITUTE.
(2) To receive and acquire by donation, grant, exchange, devise, bequest, purchase, or lease, either absolutely or in trust, contributions from any person, firm, or entity whomsoever of such properties, real and personal, including funds and valuable effects, as may be necessary to carry out the objects and purpose of THE INSTITUTE and to hold, operate, use, or otherwise dispose of the same.
(3) To do and perform all acts and things necessary, suitable or proper for the accomplishment of the purpose or the attainment of any or more of the objects

herein stated, or which shall appear at any time conducive to, or expedient for THE INSTITUTE.

APPROVAL OF PHILIPPINE GOVERNMENT

On September 16, 1959, the Cabinet of the Republic of the Philippines approved the proposal to establish an international rice research institute in the Philippines with the cooperation of the Ford and Rockefeller Foundations.

The Cabinet also authorized the granting of a free import franchise which will enable THE INSTITUTE, when chartered, to import into the Philippines, on an automatic tax- and duty-free basis, all equipment and supplies required for the establishment and operation of THE INSTITUTE's program including construction materials and supplies, equipment, machinery, and furnishings, it being understood that the grant shall cover only the importation of goods owned by THE INSTITUTE. However, goods imported and owned by THE INSTITUTE may be imported duty-free even if leased to and used by members of THE INSTITUTE's staff.

In addition, the Cabinet authorized exemption from taxation of the salaries and stipends paid to INSTITUTE employees in dollars.*

FINANCING

THE INSTITUTE is to be financed by contributions of funds and property held absolutely or in trust for its purposes as specified in its charter. The situation with respect to financing is presently as follows:

(1) The College of Agriculture of the University of the Philippines has agreed to make certain lands available to THE INSTITUTE on long-term lease at a nominal rental for the following purposes:
   (a) Site for the main laboratory and office building and for necessary service buildings;
   (b) Housing sites for INSTITUTE staff and workers;
   (c) Lands to be used for experimental and related purposes.

(2) At the June 1959 meeting of the Board of Trustees of The Ford Foundation, a proposal to participate in the establishment of an international rice research institute in the Philippines in cooperation with The Rockefeller Foundation and the Government of the Philippines was discussed. The Board appropriated the sum of $250,000 for purposes related to the establishment of such an institute, including the possible acquisition of land, preliminary plans and designs for buildings, improvements to land, and other developmental expenditures. The Board also agreed to consider a grant for capital purposes when plans for the proposed institute are far enough along to permit making reasonably firm estimates of cost.

(3) A proposal to cooperate with the Government of the Philippines and the Ford Foundation in the establishment of a rice research institute in the Philippines was discussed at meetings of the Board of Trustees of The Rockefeller Foundation in April 1959 and December 1959. In September 1959, the Trustees appropriated $25,000 for purposes related to the establishment of such an institute, and, at its meeting on December 2, 1959, an additional appropriation of $160,000

(*All of the conditions approved by the Cabinet were later embodied in Republic Act 2707, passed by the Third Session of the Fourth Congress of the Republic of the Philippines in May 1960.)

was approved for the same purpose. The Board has agreed to consider requests for funds to cover the operating expenses of the proposed institute in future years.

TERMINATION

It is expected that THE INSTITUTE will carry on its proposed activities over an extended period of years. The problems associated with rice production, management, distribution, and utilization are of such importance and dimensions that it would be impractical to consider the establishment of such an organization unless it were contemplated that it would operate over a long period of time. Experience emphasizes that basic research institutions dedicated to work on important human problems usually become more valuable as they acquire the experience and the excellence which come with sustained and systematic effort. If, at some future date, it is mutually agreed that it would be desirable to terminate THE INSTITUTE as an autonomous enterprise, the land, buildings, equipment, funds, and other assets belonging to THE INSTITUTE will become the exclusive property of the College of Agriculture of the University of the Philippines.

Appendix 4

ARTICLES OF INCORPORATION
OF
THE INTERNATIONAL RICE RESEARCH INSTITUTE

KNOW ALL MEN BY THESE PRESENTS:

That we, all of legal age, and a majority of whom are citizens and residents of the Philippines, have this day voluntarily associated ourselves for the purpose of organizing a nonstock, philanthropic and nonprofit corporation under the laws of the Republic of the Philippines.

AND WE HEREBY CERTIFY:

First: - That the name of the said corporation shall be The International Rice Research Institute (IRRI);

Second: - That the purpose of the corporation is to establish, maintain, and operate an international rice research institute designed to pursue any and/or all of the following objectives:

1. To conduct basic research on the rice plant, on all phases of rice production, management, distribution, and utilization with a view of attaining nutritive and economic advantage or benefit for the people of Asia and other major rice-growing areas through improvement in quality and quantity of rice;
2. To publish and disseminate research findings and recommendations of the Institute;
3. To distribute improved plant materials to regional and international research centers where they might be of significant value or use in breeding or improvement programs;
4. To develop and educate promising young scientists, primarily from South and Southeast Asia, along lines connected with or relating to rice production, distribution, and utilization, through a resident training program under the guidance of well-trained and distinguished scientists;
5. To establish, maintain, and operate an information center and library which will provide, among others, for interested scientists and scholars everywhere a collection of the world's literature on rice;
6. To organize or hold periodic conferences, forums, and seminars, whether international, regional, local, or otherwise for the purpose of discussing current problems.

And in furtherance of the aforesaid purpose, the corporation shall have the following incidental powers:

1. To acquire or obtain from any governmental authority, national, municipal or local, foreign or domestic, or otherwise, as from any corporation, company,

association, or person or other entity, such charters, franchises, licenses, rights, privileges, assistance, financial or otherwise, and concessions as are conducive to and necessary for the attainment of the purpose of the Institute;

2. To receive and acquire from any person, firm, or entity, by donation, grant, exchange, devise, bequest, purchase, or lease, either absolutely or in trust, contributions consisting of such properties, real or personal, including funds and valuable effects or things, as may be useful or necessary to carry out the purpose and objectives of the Institute, and to hold, own, operate, use, or dispose of said properties or valuable things;
3. To do and perform all acts and things as are necessary, expedient, suitable, or proper for the furtherance or accomplishment of the purpose and the attainment of any or all of the objectives herein stated, or which shall appear, at any time, as conducive to and useful for the activities of the Institute.

Third: - That the place where the principal office of the corporation is to be established and located is at Los Baños, Laguna, Philippines;

Fourth: - That the term for which the corporation is to exist shall be fifty (50) years from and after the date of its incorporation unless earlier terminated in accordance with law;

Fifth: - That the names, nationalities, and residences of the incorporators are as follows:

Name	*Nationality*	*Residence*
1. Dr. J. George Harrar Vice-president The Rockefeller Foundation	American	State of New York United States of America
2. Dr. Forrest F. Hill Vice-president The Ford Foundation	American	State of New York United States of America
3. Hon. Juan de G. Rodriguez	Filipino	Manila, Philippines
4. Dr. Vicente G. Sinco President University of the Philippines	Filipino	University of the Philippines Diliman, Quezon City Philippines
5. Dr. Paulino Garcia Chairman National Science Development Board	Filipino	Manila, Philippines

Sixth: - That the number of trustees of said corporation shall be ten (10) and that the names and residences of the trustees of the corporation who are to serve until their successors are elected and qualified as provided by the bylaws are as follows, to wit:

Name	*Residence*
1. Dr. J. George Harrar	U.S.A.
2. Dr. Forrest F. Hill	U.S.A.
3. Hon. Juan de G. Rodriguez	Manila, Philippines
4. Dr. Vicente G. Sinco	Quezon City, Philippines
5. Dr. Paulino Garcia	Manila, Philippines
6. Dr. Robert F. Chandler, Jr.	Makati, Rizal, Philippines
7. Dr. K. R. Damle	New Delhi, India
8. Dr. Hitoshi Kihara	Misima, Japan
9. Dr. P. C. Ma	Taipei, Taiwan (Formosa) China
10. Prince M.C. Chakrabandhu	Bangkok, Thailand

Seventh: - That the corporation shall be established and supported by the Rockefeller and Ford Foundations in cooperation with the Government of the Republic of the Philippines in accordance with the Memorandum of Understanding signed on December 9, 1959, by appropriate representatives of the aforestated Foundations on the one hand and the Secretary of Agriculture and Natural Resources of the Philippine Government on the other hand, a copy of which is hereto attached as Annex "A" and made an integral part of these Articles of Incorporation;

Eighth: - That if the existence of the Corporation is terminated for any reason, all its physical plant, equipment, and other assets shall become the property of the College of Agriculture of the University of the Philippines.

(The above articles of incorporation were filed with the Securities and Exchange Commission of the Philippines on March 8, 1960.)

BYLAWS OF THE INTERNATIONAL RICE RESEARCH INSTITUTE

Article 1
ORGANIZATION

Section 1. -The International Rice Research Institute is organized as an autonomous, nonstock, philanthropic, nonprofit corporation and is designed to attain the objectives embodied in its Articles of Incorporation.

Section 2. - The organization shall be established and its purposes and objectives implemented principally through the support of the Ford and Rockefeller Foundations of the United States of America in cooperation with the Government of the Philippines although financial support will be sought from other sources as authorized in the Articles of Incorporation.

Article II
MEMBERSHIP

The Institute shall have ten (10) members.

Article III
THE BOARD OF TRUSTEES

Section 1. - The Institute shall be administered by a Board of Trustees composed of ten (10) members as provided for in its Articles of Incorporation and in accordance with the Memorandum of Understanding signed by the representatives of the Ford and Rockefeller Foundations and the Secretary of Agriculture and Natural Resources on December 9, 1959.

Section 2. - At each annual meeting of the members of the Institute, ten (10) trustees, who shall always include the Director of the Institute, shall be elected by plurality vote of the members present, to serve until the next annual meeting and until their successors have been duly elected and have qualified. If there is no election at the annual meeting of members, it may take place at a subsequent meeting of members.

Section 3. - The Board of Trustees shall have the following powers and duties:

a. To act as the policy-making body of the Institute and to lay down or approve its program of activities;

b. To pass upon the budget and review the financial condition of the Institute;
c. To review and evaluate the progress reports of the Institute as may be submitted by the Director;
d. To exercise corporate powers in the conduct of the business and control of properties owned or held by the Institute;
e. To delegate any or some of its powers to the Executive Committee hereinafter provided for;
f. To exercise such other powers and to do such acts as may be conducive to the promotion of the purpose or objectives for which the Institute was established.

Article IV
MEETINGS

Section 1. - The annual meeting of the members of the Institute shall be held on the first Wednesday of October every year, unless a different date is fixed by the Board. The annual meeting of the Board shall be held every year immediately following the annual meeting of members. The Board shall hold such regular meetings as it may determine are necessary.

Section 2. - A special meeting of the members of the Institute or of the Board of Trustees may be called by the Chairman or by any three of the members or trustees respectively. The business of any such special meeting shall be limited to the purposes specified in the notice of the meeting.

Section 3. - The meetings of the members and of the Board of Trustees shall be held in the principal office of the corporation, or as far as permitted by law, at such other places as the Board may determine.

Section 4. - Each annual or regular meeting of the members or trustees shall be held on thirty (30) days written notice. Each special meeting of the members or trustees shall be held on ten (10) days cabled or written notice. The notice, which shall state the time and place of the meeting, shall be signed and mailed by the Secretary, or cabled by the Secretary with delivery certified.

Section 5. - At meetings of members of the Institute, a majority of the members, present in person or by proxy, shall constitute a quorum for the transaction of business, except in those cases where law provides for a greater proportion.

Section 6. - At meetings of the Board of Trustees, a majority of the members of the Board, present in person, shall constitute a quorum for the transaction of business.

Section 7. - In the absence of a quorum at the time and place set for a meeting of the members of the Institute or of the Board of Trustees, those present may adjourn the meeting from time to time until a quorum is present.

Section 8. - The following shall be the order of business at the annual and regular meetings of the Board of Trustees:

a. Reading of the previous minutes;
b. Financial report;
c. Report of the Executive Committee;
d. Unfinished business;
e. Report of the Director;
f. New business.

The order of business at special meetings of the members or of the Board of Trustees shall be in accordance with the agenda contained in the notice of such meetings.

Article V
THE EXECUTIVE COMMIITEE

Section 1. - There shall be an Executive Committee composed of five (5) members to be appointed by the Board.

Section 2. - The Executive Committee shall have the duty to implement and execute the policies and decisions laid down by the Board of Trustees, and to exercise the powers and perform the duties delegated to it by the Board.

Section 3.- The Executive Committee shall elect, from among its members, a Chairman who shall preside over all its meetings.

Section 4.- The Executive Committee shall meet at least twice a year. Special meetings may be held upon call of its Chairman or upon request of at least three (3) members.

Section 5. - Any vacancy in the Executive Committee shall be filed from among the other members of the Board by election by the Board, or by the remaining members of the Executive Committee. Any person so elected by the Executive Committee shall serve only until the next meeting of the Board.

Article VI
OFFICERS

Section 1. - The officers of the Institute shall be the Chairman of the Board, the Secretary, the Treasurer, the Director, and such other officers as the Board of Trustees shall see fit to designate.

Section 2. - The Chairman of the Board, who shall be chosen from the Trustees, shall be elected each year at the annual meeting of the Board, or in the absence of election of that meeting, at a subsequent meeting of the Board, to serve until the next annual meeting of the Board. He shall preside at all meetings of the members of the Institute and of the Board and supervise all matters with which the Board is concerned. In the absence or disability of the Chairman, the members of the Institute or the Board, as the case may be, shall designate from among their own number an acting Chairman.

Section 3. - The Secretary, who need not be chosen from the Trustees, shall be elected each year at the annual meeting of the Board, or in the absence of election at that meeting, at a subsequent meeting of the Board, to serve until the next annual meeting of the Board. His powers and duties shall be those customarily incident to his office. The Board may, however, require him to render such report or reports as are necessary or expedient.

Section 4. - The Treasurer, who need not be chosen from the Trustees, shall be elected each year at the annual meeting of the Board, or in the absence of election at that meeting, at a subsequent meeting of the Board, to serve until the next annual meeting of the Board. His powers and duties shall be those customarily incident to his office. The Board may, however, require him to render such report or reports as are necessary or expedient.

Section 5. - The Director, who shall be a staff member of the Rockefeller Foundation, shall directly manage and administer the affairs of the Institute in accordance with the policies and decisions of the Board and instructions of the Executive Committee. He shall be ex officio a member of the Executive Committee.

Section 6.- The Board of Trustees is empowered to create such other offices and designate officers thereof as may be required by the circumstances and as may be necessary to promote the purpose or objectives of the Institute.

Article VII
MISCELLANEOUS

Section 1. - The corporate seal shall consist of a circular design on which shall be inscribed the name of the corporation, the year 1960, and a motif depicting rice or rice planting.

Section 2. - These bylaws may be amended or modified, or any part thereof repealed, by majority vote of all members of the Institute at any annual meeting or at any special meeting called for the purpose.

ADOPTED AND APPROVED in the City of Manila, Philippines, on April 14, 1960, by affirmative vote of all the members present at a meeting called for the purpose.

Appendix 5

FOURTH CONGRESS
OF THE
REPUBLIC OF THE PHILIPPINES
Third Session

Begun and held in the City of Manila on Monday, this twenty-fifth day of January, nineteen hundred and sixty.

(REPUBLIC ACT NO. 2707)

AN ACT TO EXEMPT THE INTERNATIONAL RICE RESEARCH INSTITUTE OR ITS SUCCESSORS FROM THE PAYMENT OF GIFT, FRANCHISE, SPECIFIC, PERCENTAGE, REAL PROPERTY, EXCHANGE, IMPORT, EXPORT, AND ALL OTHER TAXES, AND THE MEMBERS OF ITS SCIENTIFIC AND TECHNICAL STAFF FROM THE PAYMENT OF INCOME TAX.

Be it enacted by the Senate and House of Representatives of the Philippines in Congress assembled.

Section 1. The provisions of existing laws or ordinances to the contrary notwithstanding, the International Rice Research Institute, or its successors, shall be exempt from the payment of gift, franchise, specific, percentage, real property, exchange, import, export, and all other taxes provided under existing laws or ordinances. This exemption shall extend to goods imported and owned by the International Rice Research Institute to be leased or used by members of its staff.

Section 2. All gifts, bequests, donations, and contributions which may be received by the International Rice Research Institute from any source whatsoever, or which may be granted by the Institute to any individual or non-profit organization for educational or scientific purposes, shall be exempt from the payment of the taxes imposed under Title III of the National Internal Revenue Code. All gifts, contributions, and donations to the Institute shall be considered allowable deductions for purposes of determining the income tax of the donor.

Section 3. Non-Filipino citizens serving on the technical and scientific staff of the International Rice Research Institute shall be exempt from the payment of income tax on salaries and stipends in dollars received solely and by reason of service rendered to the Institute.

Appendix 6

IRRI BOARD OF TRUSTEES, 1961-82

J. George Harrar, USA, **1960-62**
Forrest F. Hill, USA, **1960-78**
Juan de G. Rodriguez, Philippines, **1960**
Vicente G. Sinco, Philippines, **1960-62**
Paulino Garcia, Philippines, **1960-63**
Robert F. Chandler, Jr. ,*USA, **1960-71**
K.R. Damle, India, **1960-63**
Hitoshi Kihara, Japan, **1960-63**
P.C. Ma, China, **1960-61**
M.C. Chakrabandhu, Thailand, **1960-63**
Cesar M. Fortich, Philippines, **1960-61**
Benjamin P. Gozon, Philippines, **1961-63**
Tsung Hun Shen, China, **1961-66**
A.H. Moseman, USA, **1963-66**
Carlos P. Romulo, Philippines, **1963-68**
Yoshiaki Ishizuka, Japan, **1964-67**
Ahsan-Ud-Din, Pakistan, **1964-66**
P.N. Thapar, India, **1964-66**
Juan Salcedo, Jr., Philippines, **1964-70**
Jose Feliciano, Philippines, **1964-66**
Ralph W. *Cummings*,* USA, **1967-68,1972**
Sula Dasananda, Thailand, **1967-69**
Fernando Lopez, Philippines, **1967-70**
B.P. Pal, India, **1967-70**
N. Parthasarathy, India, **1967-69**
Glauco Pinto Viegas, Brazil, **1967-69**
M.O. Ghani, Pakistan, **1967-70**
Noboru Yamada, Japan, **1968-72**
Salvador P. Lopez, Philippines, **1969-74**
Sterling Wortman, USA, **1969-70**
Tojib Hadiwidjaja, Indonesia, **1970-73**
S.V.S. Shastry, India, **1970-73**
M.D. Banda, Ceylon, **1970-73**
Clarence C. Gray III, USA, **1971-**
Florencio A. Medina, Philippines, **1971-77**
C. Subramaniam, India, **1971-74**
Arturo R. Tanco, Jr., Philippines, **1971-**
Nyle C. Brudy,* USA, **1973-81**
Tosi Take Iida, Japan, **1973-76**
Virgilio Barco, Colombia, **1973-76**
Ralph Riley, United Kingdom, **1974-77**
Gunawan Satari, Indonesia, **1974-77**
Nurul Islam, Bangladesh, **1974-77**
Sukhdev Singh, India, **1975-78**
Mustafa M. Elgabaly, Egypt, **1975**
Bhakdi Lusanandana, Thailand, **1975-79**
Kaung Zan, Burma, **1975-76**
Onofre D. Corpuz, Philippines, **1975-78**
Tomoji Egawa, Japan, **1977-**
Francisco de Sola, El Salvador, **1977-**
M. Amirul Islam, Bangladesh, **1978-81**
Alban Gurnett-Smith, Australia, **1978-81**
Sadikin S. W., Indonesia, **1978-81**
H. W. Scharpenseel, Federal Republic of Germany, **1978-81**
Lin Shih-Cheng, China, **1978-81**
Norman R. Collins, USA, **1979-**
H.K. Pande, India, **1979-**
Emanuel Soriano, Philippines, **1979-81**
In Hwan Kim, Republic of Korea, **1980-**
Edgardo J. Angura, Philippines, **1981-**
Marcos R. Vega,* Philippines, **1981-82**

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*Served as Director General.

Appendix 7

MINUTES OF THE FIRST MEETING OF THE PROGRAM COMMITTEE, IRRI

Time: April 15, 1960

Place: Mr. J. de G. Rodriguez's residence

Attendants: Chairman of the Committee: Dr. H. Kihara
Members of the Committee: Mr. Juan de G. Rodriguez, Prince M.C. Chakrabandhu and Dr. P.C. Ma

The following represents the consensus of opinion on topics taken up in the discussion:

A. Organization pattern: It is proposed that all the research programs of the Institute be grouped as follows:
   1. Production
      a. *Plant Genetics and Breeding,* including plant genetics, plant breeding, taxonomy, morphology, cytology, preservation and distribution of genetic stocks, method of field experimentation, seed technology, etc.
      b. *Soil Science and Agronomy,* including soil chemistry, soil physics, soil management, fertilizer requirement, cultural practice, water management, crop rotation, etc.
      c. *Plant Protection,* including plant pathology, entomology, microbiology, chemical control, biological control, weed control, etc.
      d. *Plant Physiology,* including plant physiology, meteorology (especially microclimatic studies), etc.
   2. Utilization
      a. *Utilization,* including utilization, storage, preservation, etc.
      b. *Processing of Rice Products and Byproducts,* including chemical and engineering aspects of the processing, etc.
   3. Production and Utilization
      a. *Chemisty,* including chemistry, biochemistry, food technology, utilization, chemical aspect of the processing of rice products and byproducts, etc.
      b. *Agricultural Engineering,* including farm implements, farm mechanization, irrigation and drainage, utilization, engineering aspect of the processing of rice products and byproducts, etc.
   4. Economics
      a. *Agricultural Economics,* including agricultural economics, marketing, statistics, etc.
      b. *Farm Management,* including farm management, production cost, etc.

5. Information, including library, documentation, publication, collection and dissemination of information, printing, etc.

B. Senior Research Scientists: In line with the above organization pattern, it is suggested that senior research scientists of the following subject matters could be recruited as the program develops:

1. Plant breeder
2. Plant geneticist
3. Plant taxonomist or cytogeneticist
4. Plant physiologist
5. Plant pathologist
6. Entomologist
7. Soil chemist
8. Soil physicist
9. Agronomist
10. Agricultural engineer
11. Biochemist
12. Agricultural chemist (processing)
13. Agricultural economist
14. Farm management specialist
15. Information officer

C. Each unit, be it a department, division, office or laboratory, must carry a dual responsibility; i.e., research and training. The educational function of the Institute should always be emphasized.

D. It is proposed that basic studies be emphasized in the research program so that results thus obtained will be useful to all the rice-producing countries. Local program, such as breeding of a particular variety for local purpose, should be left to gubernatorial institutions.

E. It is proposed that as the Institute moves on, it is worthy to consider the appointment of the following officers to be selected from local scientists in certain major rice-producing countries, where there are adequate research programs carried on and where there are abundant materials and information to be collected, to warrant its cooperation and coordination:

1. *Coordination officer* — on coordination of research program and collection of experimental materials.
2. *Information officer* — on collection and translation of rice literatures, dissemination of information for the Institute.

There could be either a coordination or information office, or both, or one officer playing the role of the two, in the appointment from a particular country. They are *not* the employees of the Institute, but they could receive honorarium from the Institute, the rate of which depending upon the load of work to be carried. The Institute will pay their travelling expenses if they are called in for conference or consultation.

F. For the building program of the Institute, it is suggested that:

1. Field houses, service as shed for farm tools and tractors and related accessories, place for hanging materials harvested, and offices for field workers, should be provided.
2. A blackboard should be installed in each laboratory.
3. In crossing-room, if any, a 100% relative humidity in the room must be assured for successful crossing.

It is the wish of those present in the meeting that the above suggestions will be forwarded to the Executive Committee of the Board of Trustees of IRRI for their consideration.

Appendix 8

OVERSEAS DEVELOPMENT

INTERNATIONAL RICE RESEARCH INSTITUTE
CAPITAL COSTS OF ESTABLISHMENT

Recommended action
Approval of a grant of $6.9 million to the International Rice Research Institute at Los Baños, Laguna, the Philippines, for the purpose of financing the capital costs of establishing the Institute.

Background
At their meeting in June 1959, the Trustees approved an appropriation of $250,000 for expenses incident to the establishment of an International Rice Research Institute in the Philippines. The Institute was to be established jointly with the Rockefeller Foundation to carry on a program of research, training, and dissemination of information aimed at increasing the quantity and improving the quality of rice, the world's most important food crop.

Plans for the Institute have been well advanced since the Trustees gave their approval in principle to the project last June. The Rockefeller Foundation has appropriated $185,000 for operating expenses through December 31,1960 and has agreed to consider requests for funds to cover the operating expenses of the Institute in future years. The Philippine cabinet has given its approval to the Institution's establishment as an autonomous tax-free body and has granted it automatic exemption from all duties and taxes on imports and from taxes on the salaries of foreign staff members. A memorandum of agreement outlining the Institute's purposes, organization, powers, privileges, and proposed financing, substantially as they were described to the Trustees last June, was signed in New York in December by the Presidents of the Ford and Rockefeller Foundations and the Secretary of Agriculture and Natural Resources of the Philippine government. This action was reported to the Trustees at the December meeting of the Board.

Of the Ford Foundation's original appropriation of $250,000, $155,000 has since been granted to the University of the Philippines for the acquisition of 69.8 hectares (173.5 acres) of land for the Institute. Added to land to be made available on a long-term lease by the University of the Philippines, this will assure the Institute of the land required for its experimental plots, laboratories, administration buildings, and staff housing. Another $90,000 has been made available by the Rockefeller Foundation for other expenses incident to the establishment of the Institute.

Since last September, the Rockefeller Foundation's associate director for agricultural sciences, Dr. Robert F. Chandler, Jr., has been at work in the Philippines on plans

for the Institute. Mr. Ralph Walker, an eminent architect on the firm of Voorhees, Walker, Smith, Smith and Haines, has been retained as a consultant. Preliminary site plans and building sketches have been received, the first member of the Institute's staff has been hired by the Rockefeller Foundation, and the Institute is shortly to be incorporated.

Nature of Proposal

It is now proposed that the Trustees make a grant of $6.9 million to the International Rice Research Institute for the purpose of financing the capital costs of establishing the Institute. As previously stated, the purposes, organization, and proposed financing of the Institute remain substantially as described in the docket for the June 1959 meeting of the Trustees. Upon incorporation, the Institute is to be operated by a board of trustees composed of representatives of the Rockefeller Foundation, the Ford Foundation, the Government of the Philippines, the University of the Philippines, and eminent scientists with special qualifications in rice culture from some of the major rice-producing countries.

Discussion

The fact that many areas of the world are deficient in the production of basic foods essential to the nutrition of local populations is of growing public concern. Among those plant products which provide the bulk of the world's food, rice is pre-eminent; it serves as the principal daily food for more individuals than does any other food crop. Unfortunately, however, the annual supply of rice falls far short of needs in many rice-consuming countries, and the situation is becoming increasingly serious with progressive population increases. In many of these countries, rice varieties are unimproved and cultivators make little use of modern techniques of production, with the result that yields are far below production potentials.

The International Rice Research Institute would concentrate on basic research on the rice plant and on applied research on all phases of rice production management, distribution, and utilization. It would launch a coordinated effort to close the present gap between the amount of rice produced and the amount needed for an adequate diet for the 1.4 billion people who now depend more heavily on rice than on any other food.

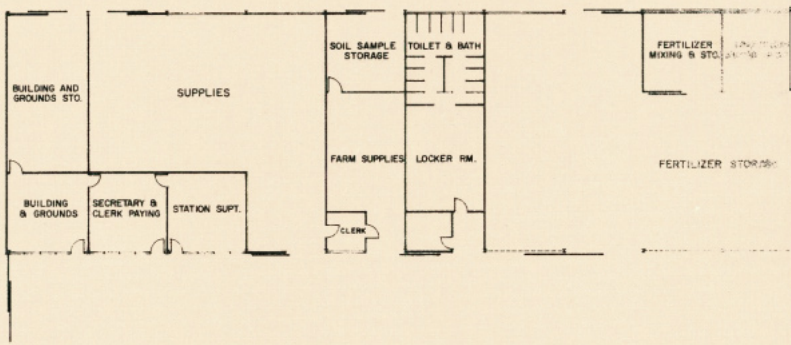
Because of the relative isolation of Los Baños (the College of Agriculture of the University of the Philippines being the only other facility in the area), it is necessary to provide housing for the staff and trainees and to supplement modestly the recreational facilities which are available at the College of Agriculture. It is proposed that houses be provided for twenty-three professional staff members and that a dormitory be built to accommodate thirty trainees.

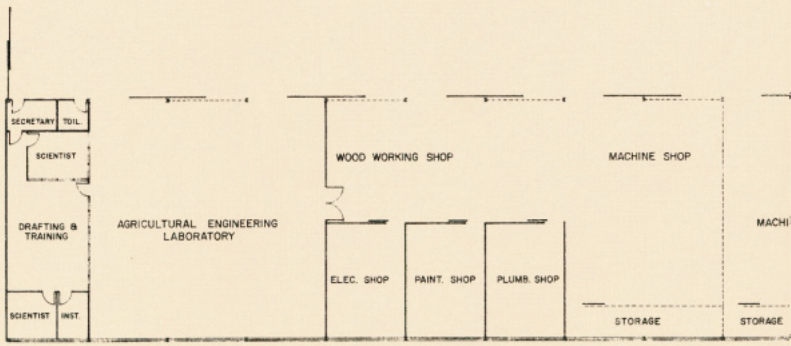
A capital expense budget based on estimated costs is given in Attachment A. Estimates for equipment are based on carefully prepared shopping lists at current prices. Construction costs were estimated on the basis of preliminary plans and current costs per square foot. While these estimates have been carefully prepared, it is emphasized that because of price changes or other factors, they may prove to be too low in some budget categories and too high in others. For this reason it is proposed that the Institute be free to make transfers between the categories shown in the attached budget. Furthermore, because construction costs in particular are preliminary and approximate, a contingency reserve of approximately 15 per cent has been provided. However, the terms of the grant would specify that only as much as necessary of the $6.9 million would be expended and that any balance would be returned to the Foundation.

ATTACHMENT A
The International Rice Research Institute
Capital Expense Budget

Construction		
Administration building	$330,000	
Central research laboratory	705,000	
Dormitory, cafeteria, and recreational center	785,000	
Service and shop building	480,000	
Guesthouse for visiting scientists	62,400	
Eight-family apartment house	172,400	
Director's house and fourteen staff houses	539,900	
Total		$3,074,700
Equipment and Furnishings		
Laboratory equipment, including benches and tables	579,000	
Household furnishing and equipment	171,300	
Dormitory, cafeteria, and recreation center equipment and furnishings	145,800	
Office furnishings and equipment for all professional buildings	165,700	
Equipment for service building	114,000	
Field and farm machinery	97,000	
Vehicles	64,400	
Total		1,337,200
Miscellaneous		
Electrical installations	91,000	
Landscaping, driveways, site preparation, parking areas, etc.	429,900	
Water supply system	128,800	
Fencing	76,300	
Sewage disposal system	84,400	
Storm drainage system	47,300	
Swimming pool and tennis courts	64,600	
Library material	100,000	
Special items for all buildings: air conditioning, internal telephone system, and fire extinguishers	194,000	
Experimental field preparation, including irrigation and drainage systems, roads, bridges, etc.	200,000	
Architects' fees	230,000	
Total		1,646,300
Contingency (approximately 15 per cent)		841,800
Grand Total		$6,900,000

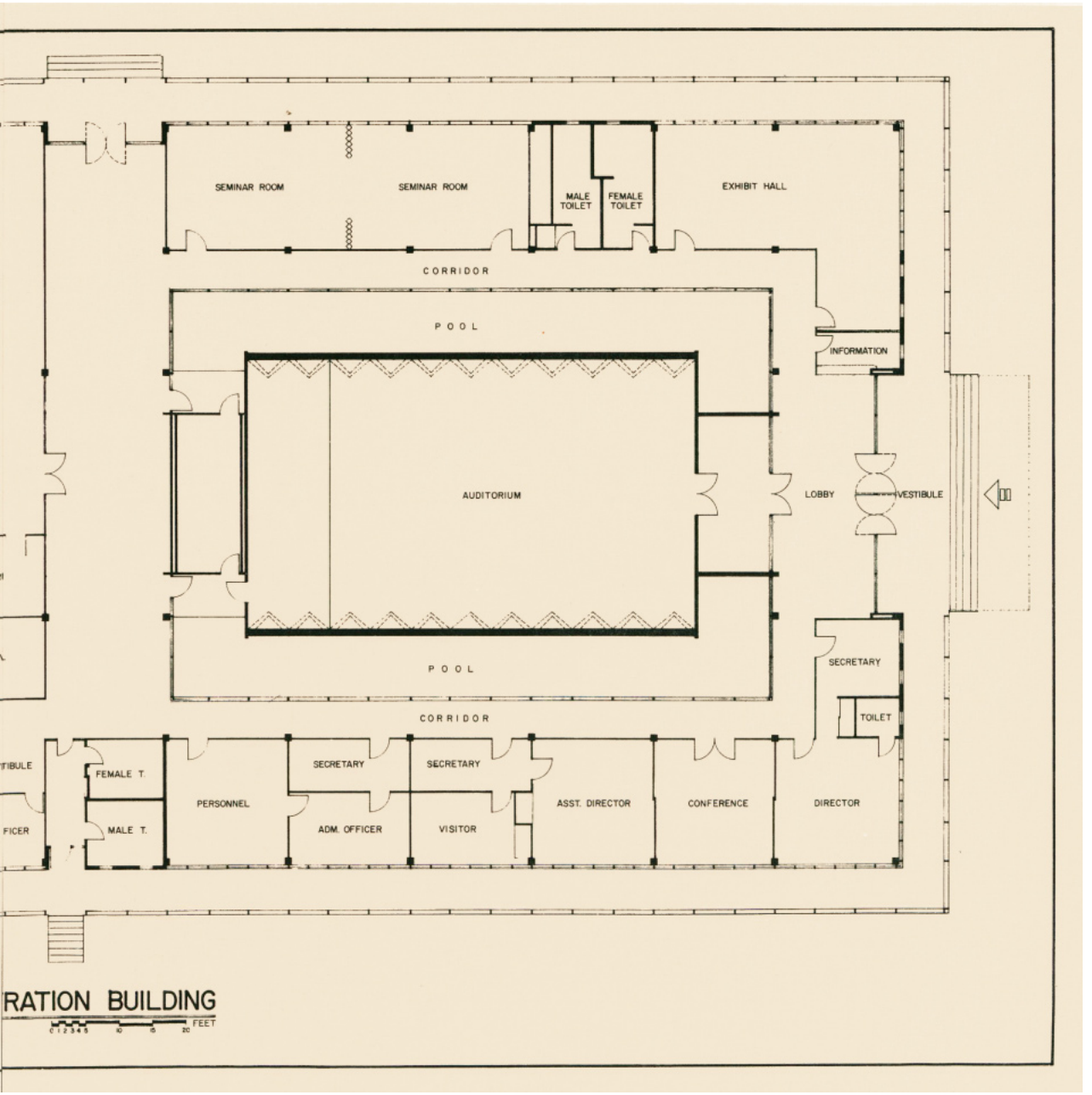
Appendix 9



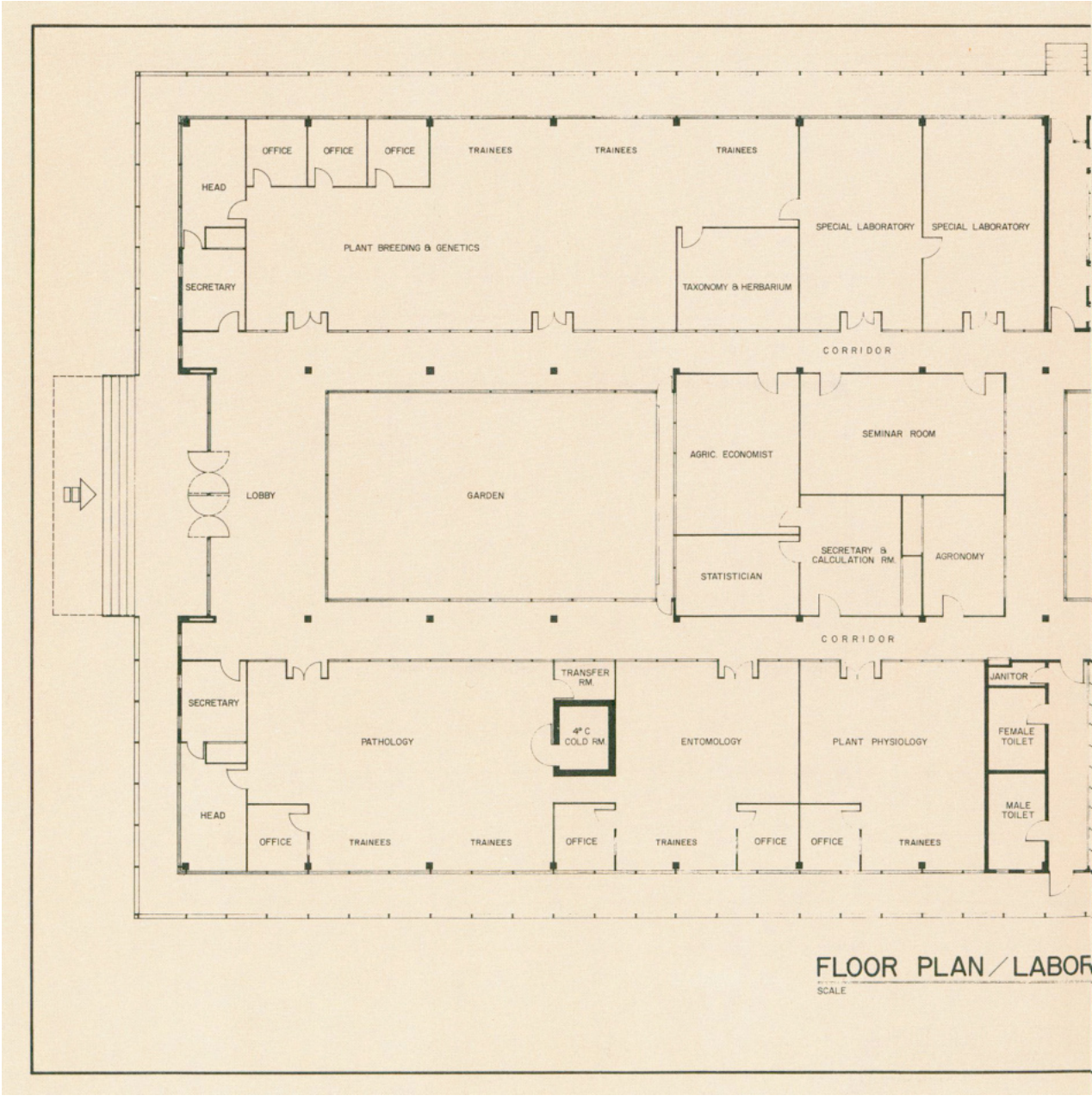


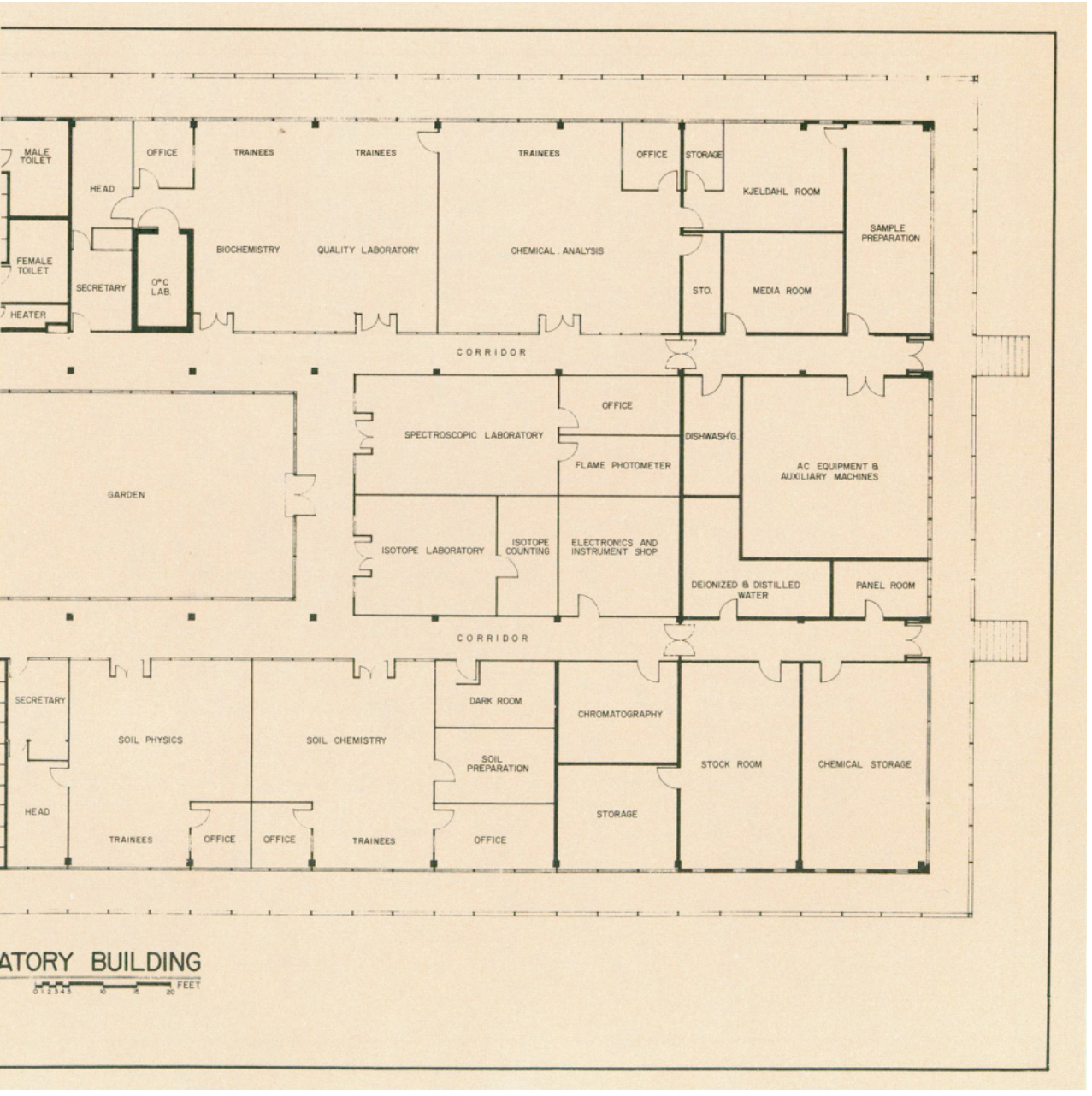
FLOOR PLAN

SCALE

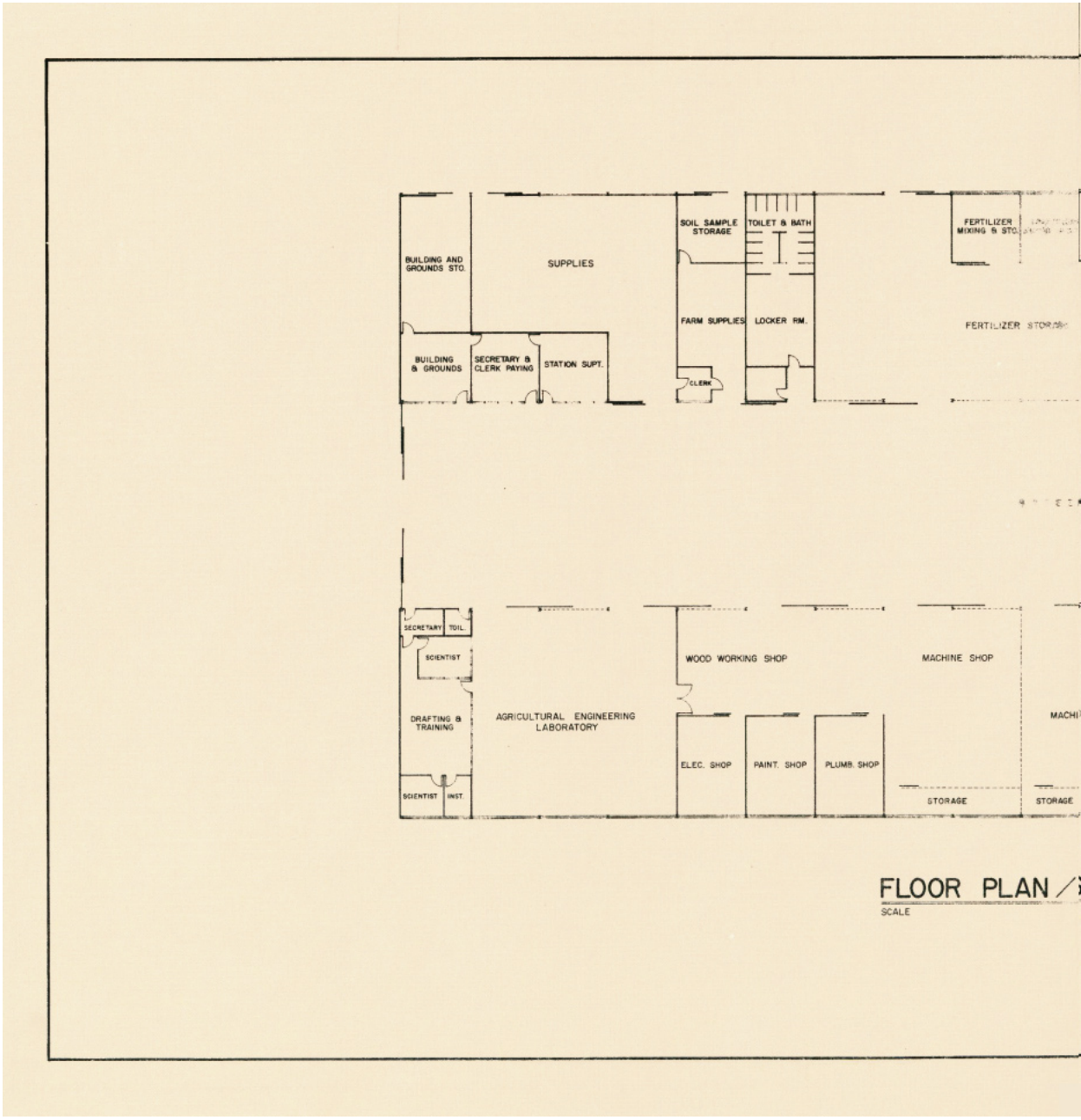

SEMINAR ROOM
SEMINAR ROOM
MALE TOILET
FEMALE TOILET
EXHIBIT HALL
CORRIDOR
POOL
INFORMATION
AUDITORIUM
LOBBY
VESTIBULE
POOL
SECRETARY
TOILET
CORRIDOR
FEMALE T.
MALE T.
PERSONNEL
SECRETARY
ADM. OFFICER
SECRETARY
VISITOR
ASST. DIRECTOR
CONFERENCE
DIRECTOR
RATION BUILDING
FEET

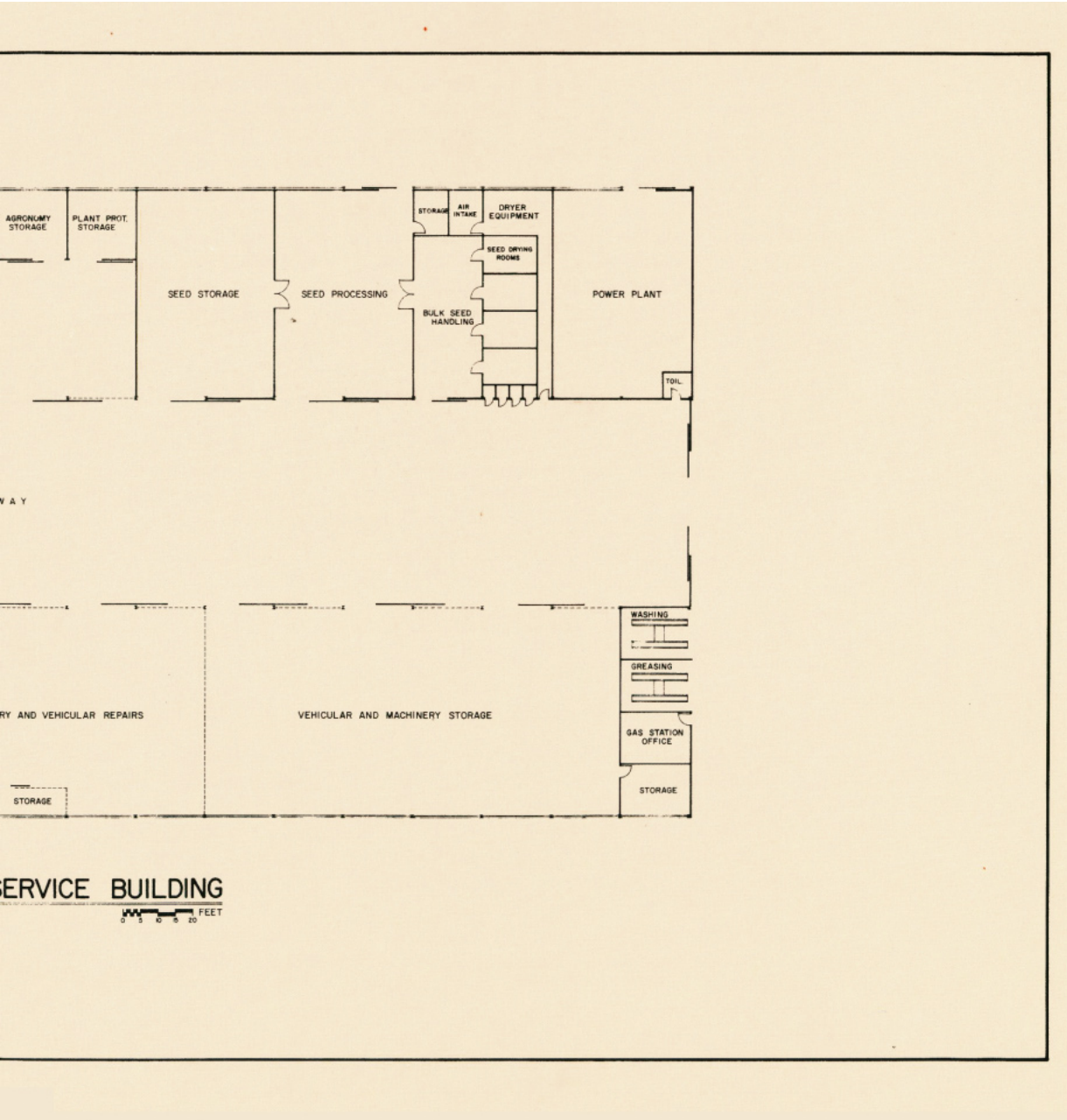
Appendix 9 continued




MALE TOILET
FEMALE TOILET
HEATER
HEAD
SECRETARY
OFFICE
O°C LAB.
TRAINEES
BIOCHEMISTRY
TRAINEES
QUALITY LABORATORY
TRAINEES
CHEMICAL ANALYSIS
OFFICE
STORAGE
KJELDAHL ROOM
STO.
MEDIA ROOM
SAMPLE PREPARATION
CORRIDOR
GARDEN
SPECTROSCOPIC LABORATORY
OFFICE
FLAME PHOTOMETER
DISHWASH'G.
AC EQUIPMENT & AUXILIARY MACHINES
ISOTOPE LABORATORY
ISOTOPE COUNTING
ELECTRONICS AND INSTRUMENT SHOP
DEIONIZED & DISTILLED WATER
PANEL ROOM
CORRIDOR
SECRETARY
HEAD
SOIL PHYSICS
TRAINEES
OFFICE
OFFICE
SOIL CHEMISTRY
TRAINEES
DARK ROOM
SOIL PREPARATION
OFFICE
CHROMATOGRAPHY
STORAGE
STOCK ROOM
CHEMICAL STORAGE
ATORY BUILDING
0 1 2 3 4 5 10 15 20 FEET

Appendix 9 continued




AGRONOMY STORAGE
PLANT PROT. STORAGE
SEED STORAGE
SEED PROCESSING
STORAGE
AIR INTAKE
DRYER EQUIPMENT
SEED DRYING ROOMS
BULK SEED HANDLING
POWER PLANT
TOIL.
W A Y
WASHING
GREASING
RY AND VEHICULAR REPAIRS
VEHICULAR AND MACHINERY STORAGE
GAS STATION OFFICE
STORAGE
STORAGE
SERVICE BUILDING
FEET
0 5 10 15 20

Appendix 10

EDUCATIONAL BENEFITS FOR IRRI STAFF FAMILIES

a. The Institute will reimburse the staff member for half of the educational costs of all his children from kindergarten through 12th grade (the 4th year of high school). Educational costs include the tuition and fees and the cost of textbooks required by the school. In case a staff member sends his children to a school not easily accessible from Los Baños, educational costs will, in addition, include the cost of room and board.

b. If a staff member wishes to send his children to school in the Manila area, the Institute will provide daily transportation, but only for children attending grades 6 through 12 and provided that two or more children will attend the same school or will attend schools where class hours begin and end at approximately the same time. Staff members wishing to avail themselves of this provision should make their wishes known at least six months ahead of the date transportation will be required.

   If a staff member wishes to send his children to a school in any other place in the Philippines not easily accessible from Los Baños, the Institute will pay only the cost of one round trip each semester.

c. If the staff member chooses to send any of his children to universities and colleges in countries other than where he is assigned or is residing, the Institute will pay the cost of travel between the school and his residence on the basis of one round trip economy jet per year, plus a total flat allowance for stopovers and incidental travel expenses.

Appendix 11

BELLAGIO II PARTICIPANTS

Those participating were: Dr. Felix Albani, Director, Plant Production and Protection, Food and Agriculture Organization of the United Nations; Dr. C.F. Bentley, Agricultural Consultant, Canadian International Development Agency; Dr. Joel Bernstein, Assistant Administrator for Technical Assistance, USAID; Dr. Milo L. Cox, Special Assistant for Agriculture, USAID; Sir John Crawford, Consultant to the World Bank; Dr. Joseph Edwards, Agriculture Projects Department, World Bank; Mr. Gösta Ericsson, Head, Division for Agricultural Development, Swedish International Development Agency; Dr. L.J.C. Evans, Director, Agriculture Projects Department, World Bank; Mr. F. Fournier, International Relations Service and Head of Agronomy, Office de la Recherche Scientifique et Technique Outre-Mer, France; Mr. Arthur Goldschmidt, Senior Consultant to the Director, United Nations Development Programme; Dr. Lowell S. Hardin, Program Officer for Agriculture, Ford Foundation; Dr. W. David Hopper, Associate Field Director, Indian Agricultural Program, The Rockefeller Foundation; Dr. S.C. Hsieh, Director of Projects Development, Asian Development Bank; and Dr. Leobardo Jimenez, Professor and Head, Agricultural Communications Branch, Graduate College, National School of Agriculture, Chapingo, Mexico.

Appendix 12

IRRI RESEARCH PAPER SERIES

Ser. No.	Title	Author(s)
1	Recent studies on rice tungro disease at IRRI. 1976	Ling, K.C.
2	Specific soil chemical characteristics for rice production in Asia. 1976	Ponnamperuma, F.N.
3	Biological nitrogen fixation in paddy field studied by in situ acetylene reduction assays. 1977	Watanabe, I., K.K. Lee, B.V. Alimagno, M. Sato, D.C. del Rosario, and M.R. de Guzman
4	Transmission of rice tungro virus at various temperatures: a transitory virus-vector interaction. 1977	Ling, K.C., and E.R. Tiongco
5	Physicochemical properties of submerged soils in relation to fertility. 1977	Ponnamperuma, F.N.
6	Screening rice for tolerance to mineral stresses. 1977	Ponnamperuma, F.N.
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