NATIONAL RESEARCH COUNCIL OF THE PHILIPPINE ISLANDS

Created on December 8, 1933 by the Philippine Legislature under Act No. 4120 and organized with the cooperation of the Department of Agriculture and Commerce on March 23, 1934

February, 1935 Report No. 1

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FOREWORD

Section 9 of Act No. 4120 requires that "the National Research Council of the Philippine Islands shall submit regularly an annual report to the Philippine Legislature and to the Governor-General, containing an accurate account of its work and activities during the corresponding year."

Although the law creating the National Research Council of the Philippine Islands was approved on December 8, 1933, the Council started its organization on April 3, 1934, eleven days after the members were inducted into office by the Acting Secretary of Agriculture and Commerce, on March 23. Therefore the first report of the Council now being published in this bulletin only covers activities of eleven months, from April 1934 to February, 1935.

Attached to this report will be found a symposium of historical reviews on the status of the different branches of Philippine Science written by specialists in the different lines; biographical and bibliographical data on the life and works of members and associates of the National Research Council; a descriptive list of laboratories and some of the special equipment available for research work in the Philippines; and finally, a tentative program of activities adopted by the several divisions. There are also appended: List of charter members, Act 4120, address of President Manuel L. Quezon to the Members of the Second Philippine Science Convention, a memorial to Governor-General Frank Murphy regarding the creation of the National Research Council of the Philippine Islands, Bills proposed by the Philippine Scientific Society, and Constitution and By-Laws of the Council.

The Council started its first year in a humble way, but it is hoped that as the government and the business and industrial entities come to realize the importance of the work the Council has decided to undertake, greater support will be given, thus enabling the Council to carry out successfully its program of activities.

The first endowment received by the Council for the purpose of stimulating research was the amount of three hundred and sixty pesos (₱360.00) granted by Mr. Victoriano Elicaño of the Consolidated Mines, Inc., for a fellowship awarded to a research student in the Department of Chemistry of the University of the Philippines.

For 1935, the Legislature and the Governor-General have provided ₱20,000 for the general expenses of the Council, in Act No. 4190, passed by the Tenth Philippine Legislature at its last session.

MANUEL L. ROXAS
Chairman

Aims of the National Research Council of the Philippine Islands

The Philippine Government in creating the National Research Council of the Philippine Islands has recognized certain well defined cardinal principles.

1. The great importance of a properly conducted scientific research work to the life of the nation.

2. The benefits derived from the "exchange and correlation of ideas" by a persistent and intensive study of different scientific fields.

3. The laying down of an organizational basis of attack on such problems.

All these objectives are to be attained, as in the case of national research councils in other countries, through associated efforts, as follows:

1. *Aid to research through organization.*
2. *Advancing specific pieces of research.*
3. *Advanced training of talented personnel.*
4. *Giving selected projects support for laboratory equipment and technical assistance in field work through special grants.*
5. *Maintaining and improving relations with scientists of different countries.*

The National Research Council shall endeavor to secure, through relationships at its command, supporting funds to carry out the purposes for which it has been created. Until such times as private entities have fully realized the great value to their own enterprises of accurately obtained technical information to be more advantageously secured through the work of the Council, to the point of making grants of money and equipment to the Council, the latter must depend for its support on the Government. It is for this reason that the Executive Board in a resolution has ***requested the Government to set aside ₱2,000,000 as a trust fund, the interest of which is to be used to support specific researches.***

FUNDS RECEIVED BY THE NATIONAL RESEARCH COUNCILS OF DIFFERENT COUNTRIES *

UNITED STATES

From the Government and private foundations, during 1918 to 1932	₱8,924,464.74

GREAT BRITAIN

(Medical Research Council)

From the Government, in 1929-1930	₱1,480,000.00

CANADA

From the Government (annual appropriation)	₱240,000.00

AUSTRALIA

From Rockefeller Foundation, in 1932	₱135,476.46

* The data given were obtained from sources that are only available to the National Research Council of the Philippine Islands.

Report of the National Research Council of the Philippine Islands

(For the period from March 23, 1934, to February 28, 1935)

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PART I

ORGANIZATION

One hundred and fourteen scientists (Appendix A) *ad interim* charter members of the National Research Council of the Philippine Islands appointed by His Excellency Governor-General Frank Murphy were inducted into office by the Acting Secretary of Agriculture and Commerce, Honorable Jorge B. Vargas, on the morning of March 23, 1934, in the auditorium of the School of Hygiene and Public Health, University of the Philippines. On the same morning the first business meeting was held and Drs. Manuel L. Roxas and Patrocinio Valenzuela were unanimously elected acting chairman and secretary respectively, of the Council. On April 3, 1934, the second meeting was held in the same auditorium to adopt the constitution and by-laws (Appendix E). This was mainly evolved from a draft prepared by the members of the Philippine Scientific Society. The Committee on Constitution and By-Laws was composed of Rev. Miguel Selga as chairman, Dr. Leopoldo A. Faustino, Dr. Leoncio Lopez-Rizal, Professor Hermenegildo B. Reyes and Dr. Hilario A. Roxas as members.

At this second meeting of the Council the following members of the Executive Board were elected:

EXECUTIVE BOARD

Members-at-Large

Dr. Manuel L. Roxas
Dr. Bienvenido M. Gonzalez
Dr. Patrocinio Valenzuela

Chairmen of Divisions

Dr. Victor Buencamino, Chairman, Division of Government, Foreign and Educational Relations.

Rev. Miguel Selga, Chairman, Division of Physical and Mathematical Sciences.

Dr. Antonio G. Sison, Chairman, Division of Medical Sciences.

Dir. Angel S. Arguelles, Chairman, Division of Chemical and Pharmaceutical Sciences.

Dir. Arthur F. Fischer, Chairman, Division of Agriculture and Forestry.

Prof. Hermenegildo B. Reyes, Chairman, Division of Engineering and Industrial Research.

Dr. Eduardo Quisumbing and Dr. Leopoldo B. Uichanco received an equal number of votes in the election of the Chairman of the Division of Biological Sciences. At the first meeting, however, of the Executive Board held on April 6, 1934, Dr. Eduardo Quisumbing was unanimously elected Chairman of the Division of Biological Sciences as a result of the procedure agreed upon by the Board in electing the chairman referred to.

On April 13, 1934, the second meeting of the Executive Board was held for the purpose of electing the officers of the Council. The result follows:

EXECUTIVE BOARD

Members-at-Large

Chairman, Dr. Manuel L. Roxas, Under-Secretary of Agriculture and Commerce and Commissioner of Research, and President, Philippine Scientific Society, Science Building, Manila.

Vice-Chairman, Dr. Bienvenido M. Gonzalez, Dean, College of Agriculture, University of the Philippines, Agricultural College, Laguna.

Executive Secretary and Treasurer, Dr. Patrocinio Valenzuela, Associate Professor, School of Pharmacy, University of the Philippines, Secretary-Treasurer, Philippine Scientific Society, Science Building, Manila.

Chairmen of Divisions

I. Division of Government, Foreign and Educational Relations.
Chairman, Dr. Victor Buencamino, Under Secretary of Agriculture and Commerce.

II. Division of Physical and Mathematical Sciences.
Chairman, Rev. Miguel Selga, Director, Weather Bureau.

III. Division of Medical Sciences.
Chairman, Dr. Antonio G. Sison, Professor of Medicine, University of the Philippines.

IV. Division of Chemical and Pharmaceutical Sciences.
Chairman, Mr. Angel S. Argüelles, Director, Bureau of Science.

V. Division of Biological Sciences.
Chairman, Dr. Eduardo Quisumbing, Chief, National Museum, and Curator, Philippine National Herbarium, Bureau of Science.

VI. Division of Agriculture and Forestry.
Chairman, Mr. Arthur F. Fischer, Director, Bureau of Forestry.

VII. Division of Engineering and Industrial Research.
Chairman, Prof. Hermenegildo B. Reyes, Chief, Division of Industrial Engineering, Bureau of Science, and Professorial Lecturer in Electrical Engineering, University of the Philippines.

Ex-Officio Assistant Treasurer

Mr. Victor Pagulayan, Assistant Chief, Division of Accounts and Property, Department of Agriculture and Commerce.

With the cooperation offered by the Acting Secretary of Agriculture and Commerce, Honorable Jorge B. Vargas, to the National Research Council of the Philippine Islands in his communication to the Executive Board on May 5, 1934, the services of Mr. Victor Pagulayan, Assistant Chief of the Division of Accounts and Property of the Department of Agriculture and Commerce, as *ex-officio* assistant treasurer of the Council, have been engaged since the date of his appointment, May 18, 1934.

After several organization meetings of the Executive Board, the different divisions and the various sections of the Council, the following complete organization of the Council was approved:

I. DIVISION OF GOVERNMENT, FOREIGN AND EDUCATIONAL RELATIONS.

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Dr. Vidal A. Tan, *Secretary*

Executive Committee

Dr. Victor Buencamino, *Chairman*

Members

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Dr. Leoncio Lopez-Rizal
Dr. Vidal A. Tan

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Ylanan, Dr. Regino R.

Collaborators

Cruz, Dr. Cornelio C.
Fischer, Dir. Arthur F.
Gonzalez, Dr. Bienvenido M.
Paz, Dr. Daniel de la
Quisumbing, Dr. Eduardo
San Agustin, Dr. Gregorio
Velarde, Dr. Herminio

Associates

Albert, Hon. Alejandro
Bernardo, Prof. Gabriel A.
Kalaw, Hon. Teodoro
Perez, Mr. Cirilo B.
Rodriguez, Dir. Eulogio B.

B. Section of Government Relations ...... Dr. Leoncio Lopez-Rizal, *Chairman*

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McGregor, Mr. Richard
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Quisumbing, Dr. Eduardo
Reyes, Dr. Carmelo

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Roxas, Dr. Hilario A.
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Reyes, Prof. Hermenegildo B.
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(Under the Division of Biological Sciences)

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ACTIVITIES

Meetings of the Council

Two meetings of the National Research Council of the Philippine Islands were held in the Auditorium of the School of Hygiene and Public Health, University of the Philippines, during the period covered by this report—one in the morning of March 23, 1934, and the other in the morning of April 3, 1934. Matters considered in these two meetings are discussed under "Organization."

Meetings of the Executive Board

The Executive Board of the National Research Council of the Philippine Islands held sixteen meetings, from April 6, 1934, to December 31, 1934.

The meetings were held on the dates given below:

First meeting	April 6, 1934
Second meeting	April 13, 1934
Third meeting	April 20, 1934
Fourth meeting	April 27, 1934
Fifth meeting	May 4, 1934
Sixth meeting	May 18, 1934
Seventh meeting	June 8, 1934
Eighth meeting	June 22, 1934
Ninth meeting	July 6, 1934
Tenth meeting	July 13, 1934
Eleventh meeting	August 10, 1934
Twelfth meeting	August 17, 1934
Thirteenth meeting	September 7, 1934
Fourteenth meeting	October 5, 1934
Fifteenth meeting	October 26, 1934
Fifteenth meeting (continuation)	November 9, 1934
Sixteenth meeting	December 16, 1934

The first five meetings of the Executive Board were held in the Conference Room of the School of Hygiene and Public Health. All the subsequent meetings after the sixth, took place in the office of the National Research Council of the Philippine Islands.

The important matters considered at the different meetings of the Executive Board are embodied in the present report.

Divisional and Sectional Meetings

The different divisions and sections held several meetings. These meetings were mostly devoted to the organization of the divisions and to the consideration of research projects submitted by the different members of sections. Those finally acted upon are included in the list of research problems published elsewhere in this report.

CONTACTS WITH ORGANIZATIONS ABROAD

Pacific Science Association

Dr. Ernest A. Hodgson, Chairman of the Section of Seismology and Volcanology of the Fifth Pacific Science Congress, and Chairman of the Standing Committee on Seismology, has been in communication with the National Research Council of the Philippine Islands in connection with the work on seismological problems.

Dr. W. C. Lowdermilk, Vice-Director of the Soil Erosion Service, Department of the Interior, Washington, D. C., has communicated with the Council in connection with the work of the Standing Committee on Land Classification and Utilization of the Pacific Science Association.

In order to cooperate with the International Committee on the Oceanography of the Pacific, and upon the request of Dr. T. Wayland Vaughan, of the Scripps Institution of Oceanography of the University of California, La Jolla, California, the Executive Board at its meeting held on August 17, 1934, appointed the Chairman of the National Research Council of the Philippine Islands as Chairman of the Committee for this country and Dr. Leopoldo Faustino as Chairman of the Sub-Committee on Coral and Coral Reefs, and Dr. Hilario A. Roxas as Chairman of the Sub-Committee of Physical and Chemical Oceanography, Marine Biology, Fisheries and Fisheries Technology.

Far Eastern Association of Tropical Medicine

The National Research Council of the Philippine Islands was represented by Dr. Antonio G. Sison, Chairman of the Division of Medical Sciences, at the Ninth Congress of the Far Eastern Association of Tropical Medicine held at Nanking, China, from October 3 to 8, 1934, through the cooperation of the University of the Philippines. At this Congress, Dr. Sison was elected member of the Council of the Far Eastern Association of Tropical Medicine. Besides registering the name of the National Research Council of the Philippine Islands, Dr. Sison also filed the following two scientific papers that will be published in the Proceedings of the Congress:

1. Single Cell Transmission of Surra—By Dr. Teodulo Topacio of the Bureau of Animal Industry
2. Further Study of the Unidentified Organism of Solis Isolated from Culion Leper Colony—By Dr. Rogelio Relova of the Department of Laboratories, Philippine General Hospital.

A brief report on this attendance at the Congress by Dr. Sison is appended with the minutes of the fifteenth meeting of the Executive Board.

National Research Councils Abroad

The National Research Council of the Philippine Islands, through its chairman, has been in correspondence during the period covered by this report with the National Research Council of the United States through Dr. Isaiah Bowman, Chairman of the Council, and the Research Information Service of that institution; with Dr. H. M. Tory, President of the National Research Council of Canada and President of the Fifth Pacific Science Congress; with the National Research Council of Japan, through its Secretary, Dr. Y. Ishimaru. With all the national research councils referred to abroad and the Council for Scientific and Industrial Research in Australia, the National Research Council of the Philippine Islands has established an exchange of publications.

MEMORIAL TO THE MEMBERS OF THE CONSTITUTIONAL CONVENTION

Realizing the need of bringing to the attention of the members of the Constitutional Convention the importance of the inclusion of constitutional provisions establishing the National Research Council, the Executive Board at its sixth meeting held on May 18, 1934, considered the appointment of a committee to prepare the draft of a memorial to the members of the Constitutional Convention, urging the inclusion of provisions for scientific and research activities in the Constitution of the Commonwealth of the Philippine Islands.

The Committee appointed for this purpose was composed of:

Dr. Carmelo Reyes, *Chairman*
Dr. Leopoldo A. Faustino, *Member*
Prof. Hermenegildo B. Reyes, *Member*

The Office of the Council and the members of the Committee reviewed all the provisions of all known constitutions of the different nations of the world and considered those provisions bearing upon scientific and research activities.

As a result of the work of this Committee, the Council published in July, 1934, the brochure, entitled "A Memorial to the Members of the Constitutional Convention," copies of which were delivered to the Chief Executive, the legislative leaders, each and every member of the Constitutional Convention, the members of the Tenth Philippine Legislature, and other government officials. Proposed provisions supplementing those submitted in the memorial were also presented at different committee hearings of the Convention.

In this connection, some members of the Executive Board as well as other charter members of the Council appeared at the hearings of the Committee on Industry, Committee on National Defense, and Committee on Scientific Investigations of the Constitutional Convention, upon invitation of the respective chairmen of the committees.

That the Council helped the convention in the study of the provisions that will affect scientific, research and industrial undertakings of the Philippine Commonwealth is well shown by the inclusion of Section 4 of Article XII on Civil Service (page 41) and Sections 8, 9, 10 and 13 of Article XIII on the General Provisions of the draft (page 43) of the Constitution now under consideration by the Constitutional Assembly. The provisions referred to read as follows:

ART. XII.—CIVIL SERVICE

SEC. 4. No public officer shall be removed, suspended or transferred except for cause as provided by law.

ART. XIII.—GENERAL PROVISIONS

SEC. 8. It shall be the duty of the State through the organization of a National Research Council, or in other ways, to promote by legislation scientific research and invention. Arts and letters shall also be under the patronage of the State. The exclusive right to writings and discoveries shall be secured to authors and inventors for a limited period.

SEC. 9. It shall be the duty of the State to safeguard the social progress of its inhabitants, and to plan the national economy with the aid of a National Economic Council; it may establish and operate such industries and means of transportation and communication as may be considered important to national welfare and defense and, when necessary, upon payment of just compensation, may transfer to public ownership private enterprises suitable for nationalization.

SEC. 10. Railroads, telegraphs and other means of communication shall be subject to control and regulation of the State.

SEC. 13. All agricultural, timber and mineral lands of the public domain, waters, minerals, coal, petroleum and other mineral oils, game, fish or other aquatic products, and other natural resources of the Philippines, including the air and all forces of potential energy, belong to the Nation, and their disposition, exploitation, development, or utilization shall be limited to persons owing permanent allegiance to the sovereign authority thereof, or corporations, or associations, seventy-five per cent of the capital of which is owned by such persons, subject to any right, grant, lease, or concession existing in respect thereto on the date of the adoption of this Constitution: *Provided, however,* That in case a license, concession, or lease for the exploitation, development, or utilization of any of the natural resources be granted, the same shall not exceed a period of fifty years, except in case of water rights for irrigation, or water supply, or fisheries, or industrial uses other than the development of water power, for which beneficial use shall be the measure and the limit of the grant.

COOPERATION WITH THE DIFFERENT BRANCHES OF THE GOVERNMENT AND ORGANIZATIONS

Cooperation with the Department of Agriculture and Commerce

The appointment by His Excellency the Governor-General of the one hundred and fourteen charter members of the National Research Council of the Philippine Islands was made partly with the advice of the Department of Agriculture and Commerce. The first financial aid, consisting of ten thousand pesos (₱10,000), had come from it. In line with the cooperation offered by the Department, the services of Mr. Victor Pagulayan and the Division of Accounts and Property have been given so that proper accounting of all disbursements and expenditures could be had without the necessity of additional personnel and so that purchases could be made on the most economical basis. A number of pieces of furniture of the Office of the Council have been obtained by transfer without cost through the cooperation of the Department.

The Council helped the Department in the preparation of the sugar quota. Some queries sent to the Department have been referred to the Council for the necessary information.

Cooperation with the Bureau of Science

Ever since the Council started to function, the Director and members of the staff of the Bureau of Science have generously cooperated with the Council. A small space was first provided for the present quarters (Room No. 213) which were formerly occupied by the National Museum. Within a short period, the exhibits of the Museum were removed and the entire big rooms were given for the use of the office of the National Research Council of the Philippine Islands. The limited resources of the Council have been greatly helped by the Bureau of Science by the furnishing of some equipment and furniture. The Scientific Library which is now again a division of the Bureau of Science has also cooperated in many ways with the office of the Council. To mention a few of them, reference can be made to the furnishing of scientific information gathered from various sources, compilation of bibliographies, lending of sets and series of publications often consulted by the office and members of the Council, etc.

The Bureau of Science is the Government branch that has on its staff the second largest number of members of the Council.

Cooperation with the University of the Philippines

The University of the Philippines being the largest institution of the Government that can promote research activities because of the numerous research workers in its various scientific laboratories has constantly cooperated with the National Research Council of the Philippine Islands in several ways. The largest number of the charter and associate members of the Council are primarily connected with the University of the Philippines. When this highest institution of learning was being reorganized owing to the retrenchment policy that it has adopted to safeguard its finances, the Executive Board of the National Research Council of the Philippine Islands requested the President of the University and the members of the Board of Visitors and the Board of Regents that in the reorganization of the University of the Philippines every possible encouragement be given to all members of the faculty who are engaged in scientific research. Replies to this resolution from the President of the University as well as from the members of the Board of Visitors and the Board of Regents were received, giving assurance that they would do their best to afford all the facilities and encouragement to faculty members engaged in research compatible with the present retrenchment policy of the state university.

In line with the cooperation of the University of the Philippines, Dr. Antonio G. Sison, Chairman of the Division of Medical Sciences of the National Research Council of the Philippine Islands, and Professor of Medicine of the University of the Philippines, was sent to Nanking as the official delegate of the state university and the National Research Council of the Philippine Islands to the Ninth Congress of the Far Eastern Association of Tropical Medicine held during October 3 to 8, 1934, at the expense of the University of the Philippines. At the Congress referred to, Dr. Sison registered the name of the National Research Council of the Philippine Islands as one of the participants.

The Board of Regents at its meeting held on June 18, 1934, granted the request of the Executive Board of the Council that in so far as it is consistent with their regular duties, and through proper arrangement with their respective immediate chiefs, all members of the Council who are employed in the University of the Philippines be allowed to use official time in attending meetings of the Council or doing research work in behalf of the Council.

The National Research Council of the Philippine Islands enjoys the cooperation of the staff of the School of Hygiene and Public Health. All the meetings of the entire Council are held in the Auditorium of the latter. The first five meetings of the Executive Board were held in the Conference Room of the same building. Equipment, such as the mimeographing machine, was always placed at the disposal of the office of the National Research Council of the Philippine Islands before the latter was able to purchase its own.

SCIENTIFIC CONVENTIONS

The National Research Council of the Philippine Islands, like other similar organizations abroad, sponsors scientific conventions. As part of this work the Council is publishing the proceedings of the Second Philippine Science Convention held in Manila under the auspices of the Philippine Scientific Society during Feburary 14-18, 1933. The Third Philippine Science Convention to be held from February 26 to March 2, 1935, is sponsored by the National Research Council of the Philippine Islands jointly with the Philippine Scientific Society. If conditions permit, the National Research Council of the Philippine Islands may consider seriously the extension of invitations to international organizations, such as the Pan-Pacific Science Association or the Far Eastern Association of Tropical Medicine and other similar organizations, to hold one of their congresses in Manila under the auspices of the National Research Council of the Philippine Islands.

The general program of the Third Philippine Science Convention approved by the Executive Committee follows:

Tuesday, February 26, to Saturday, March 2, 1935

TUESDAY—February 26

Third Philippine Science Convention

8:00 to 10:00 a. m.
Registration

10:00 to 12:00 noon
Opening Session
Dr. Manuel L. Roxas, *Presiding*

1:30 to 3:30 p. m.
General Meeting
Dr. Eduardo Quisumbing, *Presiding*

3:30 to 5:30 p. m.
Divisional Meetings
Chairman of Division, *Presiding*

National Research Council of the Philippine Islands

5:30 p. m. Election of Nominees for chairmen of divisions of the National Research Council of the Philippine Islands (Art. VI, Sec. 2, *Constitution and By-Laws of the National Research Council of the Philippine Islands*)

WEDNESDAY—February 27

Third Philippine Science Convention

8:00 to 10:00 a. m.
General Meeting
Dr. Leopoldo Uichanco, *Presiding*

10:00 to 12:00 noon
Divisional Meetings
Chairman of Division, *Presiding*

THURSDAY—February 28

National Research Council of the Philippine Islands

8:00 to 12:00 a. m.
Annual Meeting of the National Research Council of the Philippine Islands (Art. VII, Sec. 1, *Constitution and By-Laws of the National Research Council of the Philippine Islands*)

THURSDAY—February 28

Third Philippine Science Convention

1:30 to 3:30 p. m.
General Meeting
Dir. A. S. Arguelles, *Presiding*

3:30 to 5:30 p. m.
Divisional Meetings
Chairman of Division, *Presiding*

FRIDAY—March 1 (to be held in the College of Agriculture, Laguna)

Third Philippine Science Convention

9:00 to 12:00 a. m.
General Meeting
Dean B. M. Gonzalez, *Presiding*

SATURDAY—March 2

Third Philippine Science Convention

8:00 to 10:00 a. m.
Dr. Manuel L. Roxas, *Presiding*

Philippine Scientific Society

10:00 to 12.00 a. m.
Business Meeting
Dr. Manuel L. Roxas, *Presiding*

National Research Council of the Philippine Islands

3.00 p. m.
Election of officers of the National
Research Council of the Philippine Islands

Third Philippine Science Convention

7:00 p. m.
Banquet
Dr. Victor Buencamino, *Presiding*

Visit to Industrial Plants and Exhibits

WEDNESDAY—February 27

1:30 p. m.
Visit to an industrial plant.

3.00 p. m.
Visit to the Second Agricultural and Commercial Exposition, Philippine Carnival.

FRIDAY—March 1

From 1:30 p. m.
All laboratories in the College of Agriculture will be opened to delegates and visitors.

COMMITTEES

EXECUTIVE COMMITTEE

DR. EDUARDO QUISUMBING

Dr. Amando Clemente .... *Member*
Dr. Timoteo Dar Juan .... *Member*
Dr. Bienvenido M. Gonzalez .... *Member*
Dr. Hilario Lara .... *Member*
Prof. Hermenegildo B. Reyes .... *Member*
Dr. Manuel L. Roxas .... *Member*
Dr. Francisco O. Santos .... *Member*
Dr. Agerico B. M. Sison .... *Member*
Dr. Leopoldo B. Uichanco .... *Member*
Dr. Patrocinio Valenzuela .... *Member*

COMMITTEE ON ARRANGEMENTS AT LOS BAÑOS, LAGUNA

Dean Bienvenido M. Gonzalez .... *Chairman*
Dr. E. B. Copeland .... *Member*
Prof. Harold Cuzner .... *Member*
Prof. Placido Dacanay .... *Member*
Dr. Francisco O. Santos .... *Member*
Dr. Leopoldo B. Uichanco .... *Member*

FINANCE AND BANQUET

Dr. Patrocinio Valenzuela .... *Chairman*
Dr. Felipe T. Adriano .... *Member*
Dir. Angel S. Arguelles..................... *Member*
Dr. Victor Buencamino .... *Member*
Dir. Jose S. Camus .... *Member*
Dr. Cornelio C. Cruz .... *Member*
Prof. P. Dacanay .... *Member*
Mr. Victoriano Elicaño .... *Member*
Mr. Basilo Hernandez .... *Member*
Dr. Antonio I. de Leon .... *Member*
Mr. L. Miranda .... *Member*
Miss Maria Y. Orosa .... *Member*
Mr. Victor Pagulayan .... *Member*
Dr. Eugenio Quesada .... *Member*
Dir. Miguel Selga .... *Member*
Dir. Florencio Tamesis .... *Member*
Mr. Gregorio Velasquez .... *Member*

MUSIC

Dr. Arturo Garcia

RECEPTION, ENTERTAINMENT AND EXCURSION

Under-Sec. Victor Buencamino .... *Chairman*
Dr. Felipe T. Adriano .... *Member*
Dr. Feliciano M. Clara .... *Member*
Dr. Leopoldo A. Faustino .... *Member*
Dir. Arthur F. Fischer .... *Member*
Dr. Eduardo Quisumbing .... *Member*
Dr. Hilario A. Roxas .... *Member*
Mr. Hilarion S. Silayan .... *Member*
Prof. Valente Villegas .... *Member*

REFRESHMENTS

Miss Maria Y. Orosa .... *Chairman*
Dr. Felipe T. Adriano .... *Member*
Prof. Alejandro de Mesa .... *Member*
Dr. Josefina Ramos .... *Member*
Miss Feliciana Reyes .... *Member*
Dr. Santiago Y. Rotea .... *Member*
Dr. Francisco O. Santos .... *Member*

PUBLICITY

Dr. Amando Clemente	*Chairman*
Dr. Leopoldo B. Uichanco	*Member*
Dr. Patrocinio Valenzuela	*Member*

RESOLUTIONS

Dr. Arturo Garcia	*Chairman*
Dr. Victor Buencamino	*Member*
Mr. Victoriano Elicaño	*Member*
Dr. Leopoldo Faustino	*Member*
Dr. Bienvenido M. Gonzalez	*Member*
Dr. Carmelo Reyes	*Member*
Dr. Manuel L. Roxas	*Member*
Dr. Antonio G. Sison	*Member*
Dr. Leopoldo B. Uichanco	*Member*

Elicaño Fellowship

At the second meeting of the Executive Board, the Secretary-Treasurer reported the receipt of the amount of ₱360.00 to be paid in two semesters as a research endowment from Mr. Victoriano Elicaño of the Consolidated Mines to cover the stipend of ₱30.00 monthly for a period of one year for a research assistant who will work under Professor Luis Gonzaga of the Department of Chemistry of the University of the Philippines on the "Quantitative Determination of Gold in Ores by Spectroscopic Method."

In this connection, Miss Pilar Da Silva, a graduate student majoring in chemistry, was appointed Elicaño Fellow effective June 1, 1934, upon the recommendation of the authorities concerned of the University of the Philippines. In view of the fact that the term of the Elicaño Fellowship has not as yet expired, the following excerpts from the report of progress submitted by Prof. Luis Gonzaga is quoted:

> Miss Da Silva had to undergo considerable preliminary practice in the art of handling spectrographic equipment and in the art of photography because these are essential to the acquisition of technique in quantitative spectrography. The proper manipulation of instruments involving measurements to the order of one ten-millionth of a millimeter, require considerable preliminary practice for the production of accurate and reliable results. This task in a laboratory crowded with students and with meagre facilities must necessarily be long and tedious.
>
> In spite of handicaps, Miss Da Silva was able finally to handle the spectrograph with sufficient accuracy to make series photographs of different samples of previously assayed ores from the Balatoc Mines. These

photographs were made in juxtaposition and include spectra of the blank electrode and of pure gold chloride. Many series photographs of this type were made by her, each under different conditions of excitation, different electrodes and degrees of self inductance. The object was to study the different series of photographs to ascertain whether differences in gold content produce enough variation in the number or intensity of the gold lines under any set of conditions, to warrant their use in evaluating the gold content of unknown samples.

The above method originally developed by the Gramont of France, has been used with considerable success by some of the biggest metallurgical laboratories of the world in the determination of small percentages of vanadium and other metals in steel and other alloy. Besides being the cheapest and simplest method, it is the only photographic method that can be tested exhaustively with the existing equipment of the Department of Chemistry.

Unfortunately in none of the above series photographs taken could sufficient variation of gold lines be discerned to warrant the application of the method to the materials in question.

Miss Da Silva also tried the visual method of timing the rate of disappearance of some gold lines with the aid of the wavelength spectrometer. She used also Balatoc ores of known gold content, but the time of disappearance did not prove indicative of the gold content.

A great deal of Miss Da Silva's time was also occupied in compiling and abstracting the literature on the subject. The majority of the articles being in French and German, it is easy to see how tedious this task alone has been for her.

There are at present several other methods of quantitative spectrography, more or less successfully used in some metallurgical laboratories. Some of these are of complicated nature, involving expensive equipment and considerable experimental skill in their execution. They would therefore not constitute a distinct improvement over the assay method even if they were applicable to gold determination. There is however one simple and inexpensive method developed by Sheibe and Neuhausser which would be convenient to use in the mines, if found applicable to Philippine gold ores. This method makes use of a logarithmic sector before the spectrograph for varying the exposure along the length of the line, thus producing a wedge-like blackening whose length is proportional to the intensity of the line and hence to the metal content of the sample. The catalogue price of this instrument is only £21 or ₱210 (Adam Hilger, London) and it can also be used for quantitative estimation of small amounts of other metals in foodstuffs and other similar materials as shown by the most recent literature along this line.

VISITING SCIENTISTS

In order to promote cooperation in research abroad the National Research Council of the Philippine Islands is always ready to give help to research organizations abroad and to their representatives sent to the Philippine Islands in gathering any desired information. During the year Dr. Heinz Krause of the University of Jena who was working for the Rockefeller Foundation was the guest of the Council for a period of about three weeks. During Dr. Krause's stay in Manila, office accommodations were given him by the Office of the National Research Council of the Philippine Islands and the Division of Statistics of the Department of Agriculture and Commerce. He worked most of the time in the office of the Council. He was accompanied by the Chairman of the Division of Government, Foreign, and Educational Relations and the Secretary of the Council to various government offices and other places of interest to him in order to help him obtain the desired information. This facility is offered by the Council to any visiting scientist in Manila.

PUBLICATIONS

During the period covered by this report, the Council has issued Bulletin No. 1, a reprint from the Philippine Journal of Agriculture, volume 5, No. 2, second quarter, 1934, which gives an account of the organization of the Council, and includes the address of His Excellency Governor-General Frank Murphy delivered when the members were inducted into office; the constitution and by-laws and the list of officers and a list of the charter members of the Council. The other publication issued by the Council during the period was a brochure, entitled "A Memorial to the Members of the Constitutional Convention," consisting of twelve pages. The Council is also publishing the abstracts of the proceedings of the Second Philippine Science Convention held during February 14 to 18, 1933. The most important publication issued by the Council during the period is the present report.

RESEARCH INFORMATION SERVICE

Several queries regarding research information have been received by the Council from time to time. These queries were duly replied to by furnishing the information desired. Information about research work and biographies of scientists, bibliographical sources, queries about certain industries, and requests for methods and procedures, composed the main bulk of information service rendered by the Council. In this work, the Council has always obtained the indispensable help of the staff of the Scientific Library Division of the Bureau of Science.

In the questionnaire sent to every charter member and associate member of the council, biographical data and other information relative to the training and experience and the extent of research work engaged in by the members were obtained. An inventory of special research equipment and apparatus of the research workers in the Philippines was made for the information of research workers who are handicapped by the lack of adequate facilities. Some of the foregoing data are embodied in this special report, together with bibliographies of the scientific works and other contributions published by each charter and associate member.

SPECIAL REPORTS

The following special and progress reports have been submitted to the divisions of the Council concerned:

SECTION OF PLANT PHYSIOLOGY

RESEARCH ON FACTORS RESPONSIBLE FOR HIGHER RICE YIELDS IN TEMPERATE THAN IN TROPIC LANDS

By E. B. COPELAND

Rice yields heavier crops, as a general rule, in temperate zone lands than in the tropics. It seems improbable that any difference in cultural technique is responsible for the difference in yield. Factors responsible for the difference may be:

1. Length of day.
2. Genetic character of the rice, all temperate rices being perhaps a natural group distinct from all tropic rices.
3. Unknown, but of course knowable.

The problem is of great and obvious interest in a purely scientific sense. Its practical importance is equally great but not equally obvious. Its practical importance lies in the fact that in experimentation and in practice alike we require standards by which to judge results; which is equally true whether the result aimed at is maximum yield or most profitable yield. In all efforts to improve the field technique, we grope, until we know whether or not Spanish yields are possible of attainment in the tropics.

To illustrate the handicap due to uncertainty of standards, we can compare the experience of Java and Japan (not the Philippines and the United States or Spain, in which prejudice might influence us). Javan experimentation with rice breeding has been regarded as the most skillful and most extensive in the world; in studies of rice nutrition also Java has very high rank, and the Government's machinery for the translation of experimental findings to farm practice is very perfect in Java; and yet Japan is far ahead of Java in these respects of practice in which Javan study has seemed most perfect,—and it is in the almost mechanical field of irrigation that the Javan rice industry has profited most by governmental effort.

We cannot appraise experiments with rice until we fix standards of judgment. And until we know why yields in Spain and Japan are higher than in Java and the Philippines, we do not know whether or not the northern yields represent for us the approach to perfection.

The analysis of this problem and its solution will have value far beyond the field of rice. For instance, what proves true of rice will probably be applicable to maize and potato; also to short-lived crops of tropic or subtropic origin, which are likewise more productive now in temperate lands. As to long-lived crops, the forester's evidence is that the tropics outyield the temperate zones by a wide margin.

REPORT OF THE SECTION OF ANIMAL PRODUCTION

The Animal Production Section of the National Research Council of the Philippine Islands has the honor to submit herewith a report containing its recommendations.

The Animal Production Section views as the most immediate task in its field the stimulation of local production of animals and animal products at present imported into the Islands.

With every nation establishing tariff barriers against other nations, it would seem to be the safest move for the present to attempt to develop local animal industries to reduce importations. A casual perusal of the trade of the Philippine Islands with the United States and foreign countries indicates the following as very conspicuous animal products at present imported from other countries.

Animals and animal products imported from the United States and foreign countries

Articles	Calendar Year	
	1933	1932
Animals:	*pesos*	*pesos*
Cattle, other than carabaos	10,000	3,606
Other animals	31,163	22,676
Eggs, in natural form	831,114	1,538,319
Leather and manufactures of:		
Shoes, leather soles	300,903	351,319
Sandals and slippers	16,025	18,714
All others	1,452,678	1,440,541
Meat and dairy products:		
Meat products	2,636,654	2,925,234
Dairy products	4,985,813	5,203,020

The Animal Production Section recommends specific lines of action with a view to producing these materials locally as much as possible.

1. LIVE ANIMALS.—There is an apparent sufficiency of live animals in the Islands at present, as evidenced by the fact that in spite of curtailed importations the prevailing prices for animals and animal products have remained low. It is generally conceded, however, that the size and quality of Philippine animals leave much to be desired, and for this reason, efforts being made at present by government and private enterprises to improve them should be encouraged (a) by adequate government support of such projects, (b) by facilitating the transmission to the public of any results of such work, and (c) by sale of breeding stock to the public at reasonable prices. It is acknowledged that there is a fundamental difficulty encountered in the establishment of animal industries in the Islands in that local breeds are of inferior quality while improved breeds from foreign countries do not readily adapt themselves to the Philippine environment. Constant effort should, therefore, be exerted towards the development of improved breeds specifically adapted to the country.

No doubt, one of the biggest problems of the stockman in the Islands lies in the marketing of his animals. This is not only expensive but also difficult. Efforts should be made to remedy this situation (a) by reduction of freight rates and slaughterhouse fees and (b) by the construction of abattoirs in centralized ports of embarkation and transportation of meat to centers of consumption in vessels equipped with cold storage facilities.

2. EGGS.—Notable progress has already been accomplished in the diminution of egg importations from an average of ₱2,199,336 in 1928-30 to an average of ₱1,481,190 in 1931-33. While a great deal of this decrease may be attributed to the higher tariff on eggs, which has been in effect since 1932, which sustains a satisfactory price level, and to a certain extent to the prevailing economic depression which has limited the purchasing power of the population, it cannot be doubted that the campaign for greater poultry production undertaken by the government has also had its effect.

The increased production of eggs in the face of the general curtailment of production of most other agricultural products is an excellent demonstration of what protection can do for such industries as are possible in the Islands but which at present remain in a more or less dormant or stationary condition on account of heavy competition from abroad.

There is still room for stimulating further the production of eggs to offset entirely, if possible, all importations of this product, and the agencies which have operated to effect the results so far attained should be encouraged to continue further in their work.

3. MEAT PRODUCTS.—With an adequate supply of fresh meat products such as beef, pork, and poultry, and with the expected lower purchasing power of the population under the impending relationship with the United States, it would seem that the importation of meat products will be reduced automatically. On the other hand, it must be borne in mind that a considerable proportion of these products are in the form of refrigerated meats which are largely consumed by the non-native population. Packing house products from the point of view of the Filipino masses are not necessities but luxuries. Therefore, regardless of what animal products we may produce, there will always be a certain demand for foreign products from those who can afford to pay for them, in the same manner that there will always be

a demand for automobiles, silk goods, fancy toilet articles, perfumes, powders and the like. We should, nevertheless, attempt to gradually develop such industries although recognizing the limited market for such products, and the fact that progress will necessarily be slow as the specific characteristics which give such products their particular appeal are often closely guarded trade secrets.

4. DAIRY PRODUCTS.—In the interest of the welfare of our population, the consumption of dairy products should be stimulated. Small communities should be encouraged to raise milking animals. Select Native carabaos should be used to begin with and the government should sell Indian buffalo bulls to improve production by grading. This work should begin in communities close to large provincial centers. As the people gradually learn the problems of dairy management, then there will be created a demand for a better grade of dairy animal. When this time comes, the Indian buffalo may be replaced with higher producing animals such as the Scindi, or any improved breed that may have been acclimated or developed by the government agencies.

Inasmuch as it is generally claimed that love for animals is not natural among Filipinos, it may take some time to develop a dairy industry. For this reason, this program should be started in selected regions where people are already used to keeping animals, as in Batangas and in the Ilocos provinces. It may be expected that in time a dairy industry will develop in such regions that will ultimately give rise to centralized establishments, as condenseries, creameries, and cheese factories.

The organization of larger dairies should be encouraged in the larger provincial capitals. It is believed that the greater risk assumed in the establishment of such enterprises will be fully justified by the better opportunities for gain.

5. LEATHER AND LEATHER PRODUCTS.—We wish to commend to the Division of Engineering and Industrial Research a serious study of the possibilities of leather manufacturing in the Philippines. While large quantities of leather are at present being produced in the Islands, Philippine-made leather is notoriously inferior to imported leather. If we lack the technical

knowledge to undertake this line of work, it is suggested that the Division consider recommending the specialized training of capable personnel with basic training in chemistry.

Summarizing, the Animal Production Section recommends the following:

1. Efforts being made by government and private enterprises to improve Philippine animals should be encouraged (a) by adequate government support of such projects, (b) by facilitating the transmissions to the public of any results of such work, and (c) by sale of breeding stock to the public at reasonable prices.

2. Efforts should be exerted towards the development of breeds of animals specifically adapted to the country.

3. The stockman should be helped in the marketing of his animals (a) by reduction of freight rates and / or (b) by the construction of abattoirs in centralized ports of embarkation and transportation of meat to centers of consumption in vessels equipped with cold storage facilities.

4. Poultry production should be stimulated and the agencies concerned should be encouraged to continue further in their work.

5. The poultry industry should be protected by increasing the tariff on eggs and egg products.

6. Although packing house products have a rather limited market in the Islands, we should attempt to gradually develop packing industries.

7. Small communities should be encouraged to raise select Native carabaos for milking purposes, and the government should sell Indian buffalo bulls to improve production by grading.

8. The organization of large dairies should be encouraged in the larger provincial capitals.

9. The possibilities of leather manufacturing in the Philippines should be seriously studied by the Division of Engineering and Industrial Research. If technical knowledge is lacking in this line of work, it is suggested that they consider recommending the specialized training of capable personnel with basic training in chemistry.

PROGRESS REPORT OF THE SOILS AND FERTILIZERS SECTION

By ROBERT L. PENDLETON

In accordance with the letter dated June 12, 1934, of the Chairman of the Division, the undersigned as chairman of the Section of Soils and Fertilizers, has had several meetings with the members, Dr. M. M. Alicante and Director A. S. Arguelles.

The majority elected the undersigned permanent chairman. It was further decided that Dr. D. I. Aquino, Dr. Nicolas Galvez, and Mr. F. D. Reyes should be accepted as Associates for this section.

Encouragement of Research in Soils and Fertilizers

This Section has given much consideration to the main lines of research that should be encouraged in the field of soils and fertilizers. The members of this Section feel very strongly that this important field has not been given at all adequate encouragement in the study of the fundamental problems of Philippine agriculture. It is felt that until better support is given to the study of soils and fertilizers, much of the agricultural improvement being attempted along other lines will be built upon a very uncertain and inadequate foundation. This at once suggests that increased funds should be available for the study of the soil and fertilizer problems that are most pressing, and the attention of the several administrative officers is directed to these matters. However, provided that the internal and cooperating arrangements can be adjusted satisfactorily, much can at once be done with only modest amounts of money with the staffs and the facilities now available in the several bureaus and in the College of Agriculture.

The one inescapable added expense is that for travelling, as it is impossible to satisfactorily study the soil without much time being spent in the field. The mere laboratory study and "analysis" of "soil samples" is now known to be far from adequate for the serious study of the soil.

Before considering some of the possible cooperative arrangements by which the problems may be attacked, let us first state the more important soil and fertilizer problems which, if the Philippines is to compete with her neighbors in agricultural production, must be solved.

First: We need accurate knowledge of the nature and extent of the main kinds of soils of the Islands, that is to say, a soil survey is essential. We cannot intelligently study the soils with reference to their fertilizer needs or their crop responses, nor can we assist the Bureau of Forestry in its important and difficult land classification work until we have knowledge of the kind that can only be obtained from a soil survey. This soil survey must, of course, be supplemented and supported by laboratory analysis of the more important chemical, physical, and biological characteristics or "constants" of at least the more important soil types.

Second: We need to know the effects of the use of the principal plant nutrients as applied to the principal crops upon the more important soil types. Except for sugar cane fertilization responses (and this information has been obtained almost entirely at private expense and by private initiative), we are far behind most agricultural regions in our knowledge of the effects of the fertilizers upon the quantity and quality of our agricultural products. Suitable studies upon these lines will enable us to produce higher yields of better quality, and often at a lower cost per unit, of tobacco, rice, pineapples, bananas, abaca, coffee, cacao.... But even about sugar cane we as yet have learned only a small part of what we should know about the soils and their fertilization and management. Under suitable conditions of soil and culture significantly greater differences may be obtained with economically practicable applications of fertilizers. It is important, however, to lay out the experimental work in such a way as to obtain results in terms of quality and quantity of product, and not merely in terms of money values for the particular experimental season. Such results, particularly for the perennial crop, cannot be carried out on a high standard, and for many years continuously. In such experiments, the use of copra and other oil cakes and other fertilizing materials produced locally should be given adequate attention.

Third: Soil management experiments relative to the use of green manures, cover crops, and soil amendments are necessary. Similar high standards of plot experimental procedure must be maintained throughout the work. Organic matter relationships in the soil, including the maintenance of organic matter in the soil at desirable levels, and similar subjects would be covered by work under this head. A number of these studies might well be carried out in cooperation with certain other sections of this Division. Laboratory studies of the soils being experimented with, to assist in evaluating the effects, and interpreting them, would be carried out for these projects, as well as for those under the second head.

Fourth: Because it is annually carrying away to the sea enormous quantities of fertile Philippine soils, soil erosion is a continual menace. For the main types of our hill and mountain soils, measurement of the amount of erosion, the factors that affect it, and methods of management need to be devised, in order that the soils may continue to be utilized economically and profitably, and at the same time their permanent productiveness not be impaired or ruined. Tests need to be devised so that in advance, before the forests are destroyed and the land given over to agriculturists, a hill or mountain soil may be examined as to its erosiveness. This would prevent the clearing and planting of those soils more liable to erosion, whether or not according to other criteria, the land would seem to be "agricultural."

Fifth: A comprehensive study of the nitrogen economy of Philippine soils, from both the chemical and microbiological points of view, while not so imperative and not of such immediate economic importance as the four preceding lines of research, will facilitate a better general understanding of the soil fertility problems of our soils, and is closely connected with the questions of fertilization and soil management, with reforestation, and forestry practices in general.

The Need of Detailed, Accurate Topographic Maps in the Philippines

While the importance of accurate, relative large scale contour maps for the study and development of a region can hardly be overestimated, so many lines of activity in these Islands manage to get along with imperfect and laboriously constructed maps of their own, that it is too little appreciated what an adequate topographic survey could accomplish in supplying this need. Not only soil survey but many other lines of development and conservation of the natural resources of the Islands are greatly handicapped by inadequate base maps. The Bureau of Coast and Geodetic Survey, in the Insular branch, of course, does publish many maps of the Islands, but this office does not have any field staff, and can merely compile available data. The results, while better than nothing, are, for most purposes, distressingly inadequate.

This Soils and Fertilizers Section wishes to emphasize the great importance of detailed topographic maps, and hopes that the Council will lend its support to the encouragement of the activities of the Map Board, created some years ago by Executive Order, but unable to accomplish much because of a complete lack of financial support. It must be confessed that here is a case where adequate cooperation seemed to have been provided for, but, because of the lack of any funds, the machinery refused to operate with any good result. Modest financial encouragement for this Board would enable it to make real progress in providing the Philippines with better maps. There is little doubt but that money put into good map making, even at the expense of appropriations for almost any one of the already established governmental activities, would, in the long run, pay better dividends through the availability of good maps for so many lines of activity.

For soil survey and similar lines of field work the direct use of airplane photographs is of very great aid, particularly in the absence of other detailed maps. It is probable that if photographic materials were supplied the U. S. Army Air Service would be willing to renew its former offers of making aerial photographs of regions that the National Research Council or other Insular organizations desired to study. Such effective and relatively inexpensive types of cooperation should not be overlooked.

Possible Cooperating Agencies

Of course, ultimately all of the agricultural population of the Philippines will be benefited by the increased knowledge of the soil that will result from an adequate study of the soils of the Islands. With no increased funds in sight, the only possible way to increase and develop the soil research is to effect cooperative arrangements. There are two types of cooperation and cooperative agencies, first, those bureaus or other entities which are directly interested in applying the results of the research, and second, those organizations or offices which are serving merely as agencies for effecting certain results. These groups might be listed as follows:

1. Using results directly.
   A. Official organizations—
      Bureau of Plant Industry
      Bureau of Forestry
      Bureau of Public Works
      Fiber Board
      Tobacco Board
      College of Agriculture
      Bureau of Education
   B. Commercial organizations—
      Philippine Sugar Association
      Fertilizer importing and mixing firms
2. Organizations which in cooperative activity would serve as agencies for accomplishing results—
      Bureau of Science—Laboratory determinations
      Bureau of Public Works—Map drafting
      Bureau of Coast & Geodetic Survey—Map lithographing
      Division of Publications—Report publication.
      Bureau of Audits—Sympathetic understanding of the nature of cooperation and permitting Bureau expenditures for the several component features and portions of the entire work.
   U. S. Army—
      Air Service—Aerial photography and mapping.
      Engineers—Topographic mapping.

Relation of Soil Research to Geology and Geography

Particularly in connection with soil surveys, there is a general and indeed very old idea that the survey of soils and similar soil studies, should be closely correlated with, or should follow geological surveys. However, while most soils have been derived from geological formations, and some are still very closely related to the parent geological materials and while a good geological survey of a region is of very great interest and of distinct value in connection with the making of a soil survey, it is by no means necessary for the soil survey to wait upon or be directly correlated with the geological survey. Indeed, the experience of the writer in China, where he was in charge of soil survey work, as a branch of the National Geological Survey, demonstrated clearly the handicap that arises from too close association of a soil survey with geological work. It is particularly fortunate for us in the Philippines that the soil work does not have to be dependent upon or follow the geological work, for the geological work is necessarily limited for the most part to the mountainous regions of importance in mining or where economic mineral deposits are found or suspected, while the soil surveys must necessarily be carried out upon the lowland agricultural soils.

It is therefore felt that while geological surveys and soil surveys are and should be supplementary, there is nothing to be gained at this stage by suggesting the cooperation of the geological sciences in the soil survey and the other lines of activity that naturally come within the scope of the Section of Soils and Fertilizers. The National Research Council is for the purpose of encouraging cooperation between workers in related fields of activity, and it is an excellent policy, but effective cooperation should not include groups so large as to run the risk of becoming unwieldy and unnecessarily complicated. It is believed that the most effective results can be obtained by limiting the work of the section to the field of soils as such, and as applied to agriculture and forestry.

Limits beyond which Cooperation cannot Effectively be Carried

Cooperative effort must be, in these years of leanness of financial support, the main means by which progress can be effected. A reasonable degree of cooperation between the various entities mentioned above will be a long step in advance in soil research. It is necessary, however, particularly in connection with soil survey work, to prevent certain misconceptions from arising. Soil survey is an art, and a rather specialized art at that, and while it is desirable to develop an understanding of soil mapping methods and the utilization of the resulting soil maps and reports as generally as possible among the scientific personnel of the Government, it must not be supposed that it will be at all practicable to train any considerable number of members of the staffs of the several bureaus to make soil surveys. It is no more possible for one to satisfactorily map soils without adequate training and experience than it is to expect to make a good geological field man by giving some members of the staff of the College of Agriculture a short training course, nor to train foresters by having an assistant from the Bureau of Science, say, accompany a party of foresters for a few weeks. No one would suppose that a rice agronomist could rapidly be trained to do timber cruising; nor a veterinarian to do sugar cane breeding!

Effective accomplishment in soil survey work particularly will require certain members of the personnel to devote their whole time and attention to the work, so that there must be at least a few posts provided with salaries at modest rates for the soil surveyors who will be necessary. And there must be travelling expenses provided for, as a soil survey is necessarily a field procedure. For the necessary laboratory routine determinations, and there should be large numbers of them, in order to accumulate the very necessary mass of data for establishing the values of the "soil constants", a few relatively low-paid assistants can be trained.

This section therefore urges the Division, after it has given due consideration to the suggested lines of study and cooperation, and has made any constructive criticism or suggestions, to approve in principle the proposed policy of cooperative soil research, particularly for the soil survey and soil erosion studies, that the plan may be developed and presented by the Division, or the Council, to the several entities concerned, for the necessary favorable action.

Summary

The Section on Soils and Fertilizers calls attention to five important lines of soil research, viz. soil survey; kinds and quantities of fertilizers for our soils and crops; green manuring, cover crops, and other soil management practices; control of soil erosion; and nitrogen economy of Philippine soils.

While the administrative officers concerned have it now within their power to see that greater attention is paid to these vitally important questions facing our main industry, additional means of solving these problems may be found in cooperative arrangements, and thus men and equipment may be used most effectively.

The Section wishes to emphasize the great importance of giving more encouragement to the preparation of suitable topographic maps of the Philippines, for use as base maps for all lines of research upon forestry and agricultural subjects, and particularly for the soil survey. The Insular Map Board should have its powers implemented by a modest appropriation, as it is well fitted to serve as the coordinating agency in supervising the preparation of contour maps.

For the carrying out of the soil survey a certain amount of money is necessary for a permanent field staff, and for the travelling expenses. It is not possible to successfully carry on survey work with superficial training of specialists already in the employ of the various Bureaus.

The Soils and Fertilizers Section urges the active support of the Division of Agriculture and Forestry to obtain adequate attention for these important soil problems, and the necessary cooperation in order that results of value may be attained.

RESEARCH PROJECTS

The research projects submitted by the different divisions of the Council are enumerated in this section of the report. The list of problems therein given is partly a recapitulation and extension of the work which members of the different sections of the division have already been working on in a more or less discontinuous manner, depending on the availability of time, equipment, materials and supplies. While many of the research projects included are actually in progress, however, a great number of them have not yet been started but will be undertaken from time to time as the Council succeeds in obtaining the necessary funds for their promotion.

II. DIVISION OF PHYSICAL AND MATHEMATICAL SCIENCES

SECTION OF ASTRONOMY

1. Development of new methods for the more accurate transmission of time signals.
2. Study of variable stars.
3. Study of the trembling and oscillations of the stars due to bad seeing, and the possible use of same to get direction of upper air currents.

4. Spectroscopic study of telluric lines in the solar spectrum as an aid to information on upper air structure.
5. Determination of the value of gravity at selected points in the Islands.

SECTION OF SEISMOLOGY

1. Accurate study of the seismicity of the different parts of the Islands.
2. Study of possible methods of prediction of earthquakes, e.g. through earth tilting, etc.
3. Study of building types adapted to the P. I. most suited to withstand quakes.
4. Source of microseisms.
5. The establishment of a first-class seismic observatory in a region of igneous rock.
6. Seismic folklore of the Islands.
7. Petrographic study of the rocks associated with each volcano of the Islands.
8. Systematic study of the hot-springs of the Islands.
9. Precise levelling in seismic areas.
10. Geophysical prospecting.

SECTION OF METEOROLOGY

1. Study of air streams in the P. I., their origin, their characteristics as to temperature, humidity, etc.
2. The relation between the air streams of the Far East and depressions, typhoons, etc.
3. The relation of the different types of clouds to air masses and weather forecasting.
4. The intimate nature of typhoons.
5. The possibility of long range forecasting of typhoons and the relation, if any, with solar activity.
6. The possibility of the *mathematical* calculation of the paths of depressions and typhoons in the Far East along the lines set down by Patterssen of Norway.
7. The upper air in the P. I.
   (a) Its direction of motion at various heights, temperature, humidity, etc.
   (b) The correlation of upper air in the P. I. with that of Indo-China, India, China, the Carolines, etc.
8. The upper air and its relation to aviation in the Far East.
9. Scientific study of the possibility of the improvement of meteorological instruments to suit the peculiar conditions of the tropics.
10. Ultra-violet radiation in the P. I. and its relation to health, etc.
11. The ozone content of the air in the P. I. and its variation, if any, near typhoons, etc.

12. The influence of the various air masses of the P. I. and the topography of the country upon the distribution of the country's rainfall.
13. Effect of climate upon man, man's activities, animals, plants, and micro-organisms.
14. The correlation of the various weather elements such as temperature, humidity, barometric pressure, with the various seasons of the year.
15. The correlation, if any, between the various weather elements and atmospherical electricity.
16. Static and its relation to typhoon position.
17. Meteorological folklore of the Philippines.
18. Study of evaporation.
19. Study of the droughts in the Philippines.
20. Katathermometric observations.
21. Study of floods in the Philippines.
22. Action of precipitation in relation to erosion.
23. Climatic classification of the P. I.
24. Study of air conditioning in the Philippines.

III. DIVISION OF MEDICAL SCIENCES

SECTION OF ANATOMY AND PHYSIOLOGY

1. Studies on the Anatomo-Physiological Standards of Filipinos:
   - (a) Anatomical Standards—
     1. On the internal secreting glands.
     2. On the cranial indices.
     3. On the brain and spinal cord.
   - (b) Physiological Standards—
     1. On blood gases.
     2. On blood chemistry.
     3. On functional efficiency tests.
2. Studies on Comparative Anatomy:
   - (a) Studies on the regeneration of peripheral nerves in horses.
   - (b) Histological studies of the muscle fibers in different domestic animals.
   - (c) Studies on the morphogenesis of the compound stomach in ruminants.
   - (d) Studies on the reticulo-endothelial system.
   - (e) Study of peripheral nerves in beriberi and other types of polyneuritis.
   - (f) Comparative study of the anatomy of the skin among Filipinos.
3. Studies in Experimental Physiology:
   - (a) Preservation of semen of domestic animals for purposes of artificial insemination.
   - (b) Studies on the normal and applied chemical physiology of the blood and other body fluids of domesticated animals.

SECTION OF BACTERIOLOGY AND IMMUNOLOGY

1. Investigation on the newer strains of dysentery organisms.
2. The length of immunity conferred by inoculation against dysentery.
3. Vaccination against tuberculosis.
4. The use of bacteriophage in disease.
5. Survey and classification of animal diseases transmissible to man and vice versa.
6. Type culture of collection.

SECTION OF CLINICAL AND EXPERIMENTAL MEDICINE

1. Studies on the anthelmintic properties of betel nut, papaya latex and other Philippine products.
2. Experiments on the purgative effects of coconut milk and coconut oil in combination with anthelmintics.
3. Studies on the treatment and control of surra.
4. Study of the basilar artery in hypertension due to arteriosclerosis.
5. Study of the volatile oil and other constituents obtained from *Premna odorata* (Tag. alagao).
6. Effects of garlic (*Allium sativum*, Tag. bawang) on the blood pressure.
7. Neurological aspect of leprosy.
8. Incidence of paragonimiasis in tuberculosis.
9. Incidence of intestinal parasites in malignant tumors of the liver.
10. Study of gastric juice in normal individuals.
11. Blood sugar in beriberi and allergy.
12. Galactose tolerance test in diseases of the liver.

SECTION OF HYGIENE AND PREVENTIVE MEDICINE

1. Convenient and safe purification of water in country homes.
2. More practical, efficient and economical method of disposal of human wastes in rural districts.
3. Studies on the heat conserving power of different textiles used for clothing purposes in the Philippines.
4. The influence of the methods for the control of one disease upon the prevalance of others.
5. Study of the known influences affecting the prevalence of certain diseases.
6. Factors affecting immunity and susceptibility in certain diseases.
7. Factors influencing duration of protective power of small-pox vaccination, typhoid fever inoculation, etc.
8. Influence of heredity upon susceptibility and resistance to infection and upon longevity.
9. The influence of physical disabilities upon school attendance and scholarship.
10. Relative predisposing influences of different diseases upon the development of tuberculosis.
11. Nation-wide survey to determine the geographical distribution of the molluskan host of *Schistosoma japonicum*.

12. Studies on trachoma with special reference to its etiology and manner of transmission, etc.
13. Inquiries into the causes of food poisoning in the Philippines.
14. Eradication of rabies in the Philippines.
15. Incidence of rabies among stray dogs killed in the City Pound.
16. Further epidemiological study of the prevalence of typhoid fever and dysentery in Manila and other cities of the Philippines.
17. Preparation of a national vocabulary of terms used in hygiene and preventive medicine for general use of the masses in the Philippines.

SECTION OF PATHOLOGY

1. Experimental work on cancer with special emphasis on the determination of the effect of radium and other substances that may inhibit or stimulate growth of cancer cells as observed in laboratory animals with the end in view of its application to the problem in human pathology.
2. Investigation regarding the pathology of tuberculosis among Filipinos.
3. Determination of tumors in domestic animals.
4. Research on pathology of insanity.
5. Research on trypanosomiasis in animals.

SECTION OF SURGERY, GYNECOLOGY, OBSTETRICS AND EYE, EAR, NOSE AND THROAT

1. *Surgery*
    1. Bacteriology and minerology of urolithiasis.
    2. Incidence of carcinoma in the gastro-intestinal apparatus in the Philippines.
    3. Tumor transplantation.
    4. Traumatic injuries of radial nerve.
    5. Local antiseptic anaesthesia.
2. *Gynecology*
    1. Carcinoma of the uterus.
3. *Obstetrics*
    1. Pathology of toxemia of pregnancy.
    2. Pathology of the formation and clinical causes of normal and abnormal dilatation of the cervix and lower segment of the uterus.
4. *Eye, Ear, Nose and Throat*
    1. Incidence of maxillary suppuration of dental origin.
    2. Statistics of blindness in the Philippine Islands.
5. *Veterinary*
    1. Transplantation of testicular tissue from young to old animals with a view of causing rejuvenation.
    2. Surgical treatment of bone diseases, such as spavin, splint, ringbone, etc.
    3. Surgical treatment of periodic moonblindness and other diseases of the eye.

4. Investigation on method of relieving the animals from stones and other concrements from the bile duct, gall bladder, renal pelvis, ureter, urinary bladder and urethra.
5. Investigation on the relief of animals from enterolith, intussuception, volvulus.
6. Investigation on the diseases of hoof, such as corns, canker, quitter.
7. Investigation on different methods of aesophagostomy.

6. *Dental*

1. The relation of Filipino diet in the development of teeth of Filipino children.
2. Oral septic foci and their systemic effects.
3. Surgical treatment of pyorrhea.
4. Incidence of dental caries in different sections of the Philippines.
5. The effects of ultra-violet rays in the treatment of pyorrhea with Vincents Infection (Ready to start).
6. The relation of impacted teeth to the systemic condition.
7. Application of Philippine medicinal plants in dental surgery.
8. Incidence of dental caries during pregnancy.
9. The effects of chemicals upon the teeth of laborers in industries, especially in chemical industries.

SECTION OF BIOLOGICAL PRODUCTS

1. Efficacy of bilivaccines and similar tablets (medical).
2. Perfection of a vaccine or serum against measles and varicella.
3. Detoxication of the present typhoid vaccine to remove the often severe reaction that follows inoculation (medical).
4. A vaccine against foot-and-mouth disease of cattle (veterinary).
5. Verification of the present standards used on biologic products.
6. To establish collection of bacterial types.
7. Purification and concentration of immune sera.

IV. DIVISION OF CHEMICAL AND PHARMACEUTICAL SCIENCES

SECTION OF GENERAL AND PHYSICAL CHEMISTRY

1. Further study on the preparation, activation and adsorptive power of charcoals made from agricultural waste products.
2. Physico-chemical studies of some Philippine starches.
3. Survey of Philippine clays and their suitability for ceramics.
4. Phase rule study of some Philippine minerals for possible utilization.
5. The best and most economical method to break the emulsion, and separate the oil, if possible, without the use of costly machinery.
6. Iodine in Philippine waters.

SECTION OF ORGANIC CHEMISTRY

1. The chemistry of economic plants such as tobacco, etc.
2. Studies on Philippine oils.
3. The improvement of the tanning and leather industry of the Islands.
4. To experiment on the possibilities of utilizing old rubber trees that go to waste.
5. The use of low grade hemp and hemp waste for making cellulose.

SECTION OF PHYTOCHEMISTRY

1. The influence of external and internal factors on the chemical composition of some medicinal and other economic plants.
2. Separation of natural flavors from Philippine fruits.
3. A survey of the plants containing alkaloids, glucosides, oils, and other therapeutically or economically important plant constituents.
4. Isolation and determination of the chemical nature and properties of the active constituents of the plant.
5. Iodine in Philippine aquatic plants.

SECTION OF AGRICULTURAL CHEMISTRY

1. Standardization of method or methods for determination of available phosphorus and potassium adapted under Philippine soil conditions.
2. To develop certain chemical method which will replace the present platinic chloride method for determination of potassium.
3. To develop certain chemical and biological methods which can be used as indexes of soil fertility.
4. To investigate certain chemical tests that can be used in the field to determine the soil requirement for a maximum crop production.

SECTION OF BIOLOGICAL CHEMISTRY

1. Determination of inorganic constituents of food plants.
2. Metabolism Studies.
   a. Basal
   b. Nitrogen
   c. Carbohydrates—with special reference to beriberi
   d. Minerals—Calcium and phosphorus
3. Organic acids in fruits.
4. The hydrogen-ion concentration of fruit juices.
5. Nitrogen partition in foods.
6. Proteins in Philippine food materials.
7. The effect of the period of cooking on the chemical constituents of foodstuffs.
8. Urine and blood chemistry.

SECTION OF INDUSTRIAL CHEMISTRY

1. Stabilization of alcohol-gasoline blend containing not over 20% of 95% alcohol.
2. Agricultural sources of alcohol.
3. Utilization of the by-products of coconut oil in the manufacture of plastic articles like Bakelite.
4. Investigation of other motor fuels.
5. Study of the possibility of manufacturing from local raw materials:
   a. Sodium hydroxide
   b. Sulfuric acid
   c. Hydrochloric acid

SECTION OF CHEMICAL DEFENSE

1. Study of the possibilities of establishing metallurgical industries in reference to copper, iron, chromium, manganese, etc.
2. Pyrolysis of oils.
3. The protection of the civil population against chemical and bacterial raids.
   a. Methods of alarm
   b. Places of refuge
   c. Individual protective measures
   d. Methods of eliminating or neutralizing poisonous gases.
4. The protection of city and municipal water supplies, survey and location of possible water sources to be made available in case of destruction or contamination of the existing city and municipal water supplies.
5. The encouragement of the manufacture and utilization in commercial quantity, during peace time, of materials which are essential for an effective chemical defense.
   1. Coconut shell charcoal and its by-products.
   2. The comparative study of the properties and suitabilities of other similar materials, produced locally, in commercial quantities as a substitute for coconut shell.
6. The feasibility of manufacturing and storage of important chemicals and materials used in chemical defense.
7. Survey of Philippine materials suitable for the preparation of pure cellulose and its derivatives.

SECTION OF PHARMACY AND PHARMACEUTICAL CHEMISTRY

1. Preparation of galenicals and chemicals from Philippine drugs or minerals.
2. Possible utilization of coconut and other fixed oils in pharmaceutical preparations.
3. Preparation of tikitiki in powder form.

SECTION OF PHARMACOPOEIA

1. Continuation of the chemical investigation of the plants found in our flora which are reputed to possess medicinal and poisonous properties.
2. To obtain as many as possible formulas of household remedies for comparative study of their respective merits.
3. To select from among the different formulas of galenical and chemical preparations those which by their nature should not be included in our Pharmacopoeia.
4. To examine the recipes for medicinal preparations in accordance with the foreign formularies used by our pharmacists during the past Spanish regime.

SECTION OF PHARMACOLOGY

1. Study of the Philippine medicinal and poisonous plants commencing with those that appear to have promise from the therapeutic, economic and commercial point of view.
2. To work out biochemic methods of assay useful in the Philippines.

V. DIVISION OF BIOLOGICAL SCIENCES

SECTION OF SYSTEMATIC BOTANY

1. Flora of the Philippines.
2. National Botanic Garden.
3. Flora of Mt. Makiling.

SECTION OF FISHERY

A. *Systematic Work*

1. Checklist of Philippine Fishes
2. Systematic studies of Philippine Fishes
3. Handbooks of food and game fishes
4. Systematic studies on aquatic animals

B. *Fish and Fisheries Biology*

1. Life history and development of fishes
   a. Embryology
   b. Development
      (1) Age and rate of growth
      (2) Sexual maturity
      (3) Spawning habits
      (4) Breeding habits
      (5) Feeding habits
   c. Migration during different states of development
      (1) Drift of the spawn
      (2) Larval migration
      (3) Migration during breeding, brooding and feeding periods
   d. Sex ratio
      (1) During breeding, brooding and feeding periods

2. Composition of catch.
    a. Statistics of catch per unit of effort or gear.
    b. Statistics as to percentage of young in the catch.
    c. Composition of catch of gear as to species.
    d. Composition of catch of gear as to size-groups.
3. Fishing Banks (Marine)
    a. Survey of fishing banks in Philippine waters
        (1) As to nature of bottom
        (2) As to depths
        (3) As to currents
        (4) As to temperature
        (5) As to plankton distribution
    b. Survey of pelagic fishing areas
4. Fresh-water fisheries
    a. Lakes
    b. Rivers
    c. Natural ponds
5. Water pollution

C. *Aquiculture*

1. Cultivation of introduced aquatic animals
2. Improvement of Bañgos cultivation
3. Experiments of Banak pond-raising
4. Cultivation of economic crustaceans
5. Mollusk and brachiopod industry
6. Miscellaneous aquatic products

D. *Preservation of fish and fishery products and their proper utilization*

1. Improved methods of preservation by
    a. Freezing
    b. Smoking
    c. Drying
    d. Fermentation
    e. Salting
    f. Canning
2. Manufacture of fishery products
    a. Fish meals
    b. Fish fertilizers
    c. Oils
    d. Pearl essence
    e. Leather
    f. Buttons
    g. Kinglass
    h. By-products

SECTION OF GENETICS

1. Improvement of Philippine crops, particularly those that are important cash and food crops.
2. Development of improved types of farm animals suited to the Philippines, such as milch carabaos, native cattle, dual-purpose Nellores and the Philamin breed of beef cattle.
3. Production on a large scale of horses suitable for use by the Philippine Army, extension to other parts of the Islands of the raising of the Berkjala breed of swine.
4. Further improvement of the breeds of chickens that have become adapted to the Philippines.

SECTION OF BIOLOGICAL SURVEY

1. Studies of plant succession in reforested areas.
2. Encyclopedia of Philippine useful plants.
3. Asthma or hay-fever producing plants in the Philippines.
4. Effect of climate on lenses.
5. Survey of wild useful plants in the Philippines.

SECTION OF ENTOMOLOGY

1. To make the Philippine entomological literature on Philippine insects up-to-date.
2. To carry on extensive taxonomic work on Philippine insects.
3. To carry on faunistic work on insects.
4. To carry on an ecological survey on Philippine insects with the object of applying the results to the control measures.
5. To make survey of the food and feeding habits of insects with a view of utilizing these in the methods of control.
6. To make a study of the anatomy, embryology, histology and physiology of insects.

SECTION OF PARASITOLOGY

1. Further observations on the local distribution of and institution of control measures against schistosomiasis japonica.
2. Investigations on human filariasis—geographical distribution, incidence, periodicity, mosquito vector.
3. Determination of the distribution of hookworm disease in the Philippines.
4. Determination of the molluscan intermediate host of the liver fluke of ruminants.
5. Investigation on sera of horses with special reference to the biology of its causative agent.
6. Practical methods of control against the ascaris, stomach worms, kidney worms and nodular worms of livestock and coccidiosis of poultry.

SECTION OF PLANT PATHOLOGY AND MYCOLOGY

1. Extensive survey of plant diseases affecting major, minor and miscellaneous crops.
2. Investigations on wood-destroying fungi.
3. Studies on fungicides and bactericides.
4. Studies on the poisonous and edible mushrooms of the Philippines.
5. Indexing of literature on plant pathology and mycology.

SECTION OF NUTRITION

1. Food chemistry—determination of the nutritive value of foods (minerals, vitamins, fats, carbohydrates, proteins, etc.)
2. Studies on metabolism in Filipinos—determination or investigation of the calcium, phosphorus, nitrogen and the coefficients of digestibility of our common foodstuffs.

3. Biological investigations of the nutritive values of foods by experimentation in animals.
4. Investigations into the new sources of foods not yet utilized at present for lack of definite information.
5. Family surveys to find out what is actually eaten by the common people in different regions of the country, together with the study of the present status of food eaten by the people and the kind of food available in the different localities at different seasons of the year. This will include a research in infant nutrition in welfare institution and children's institutions or hospitals and puericulture centers.
6. Investigations of the dietary habits of the different groups of population, especially the laboring class, farmers, etc.
7. Research on the determination of the fat content of the milk sold or sterilized in the Health Stations of the Bureau of Health in Manila, which are daily sold to the public.
8. Research on the chemical analyses of the different constituents of the milk of Filipino mothers during different periods of lactation.
9. Chemical analyses of foods served in "fiambreras" prepared and sold by the different food contractors in the City of Manila.
10. The influence of nutrition on endocrine organs and the influence of hormones on effective nutrition.
11. Nutrition as preventive measure against parasites.
12. The influence of nutrition on reproduction, longevity and learning capacity.
13. The manufacture of vitamins B, C and D.
14. Food in relation to dental caries.

A plan for the investigation of a blue-green alga, Clathrocystia aeruginosa Monfrey, with the view of eradicating its periodic infestation of Laguna de Bay and Pasig River

I. Biochemical study of the alga.
   a. Structure, growth and reproduction.
   b. Ecological and physiological relation.
   c. Organic and inorganic composition.
   d. Source and distribution of the alga in Laguna de Bay.
   e. Products of decomposition

II. Chemical and physical studies of the water in the Laguna de Bay and Pasig River.
   a. Oxygen concentration.
   b. Alkalinity and acidity.
   c. Ph concentration.
   d. Organic matter.
   e. Turbidity.
   f. Salinity.

III. Physiographic study of the Lake.

IV. Hydrology of the Lake.
  a. Rate of evaporation.
  b. Amount of river discharge.
  c. Suspended matter carried by the rivers. Their nature and properties.
  d. Fluctuation of the water surface level.

V. Relation of the growth of alga to other living organisms in the lake.
  a. The plankton vegetation of the lake.
  b. The effect of the living and decaying alga on other aquatic organisms found in the lake.

VI. Suggested control measures.
  A. Emergency:
    1. Destruction of the algae by suitable algicides.
    2. Flooding the decaying algae and the fly larvae, stranded on the shores.
    3. Destruction of decaying alga stranded along the shore line.
  B. Permanent:
    1. Changing the composition of the water of the lake to make it inhibitory to algal growth.
    2. Filling up of lowlands along the lake and reclaiming these lands for agricultural and other purposes.
    3. Improvement of the Manila esteros to prevent stagnation of algae and all sorts of filth.
    4. Proposed opening of an Outlet Channel from Laguna de Bay to Manila Bay.
    5. Other means of biological control based on an extensive study of the properties and characteristics of the alga.

VI. DIVISION OF AGRICULTURE AND FORESTRY

SECTION OF AGRICULTURAL EDUCATION AND EXTENSION

1. Research in agricultural extension and education.
2. Agricultural extension for out-of-school groups, both young and adult.

SECTION OF AGRONOMY

1. Investigations on forage, cereals, sugar cane, tobacco and fiber.
2. Horticultural research on citrus, coffee, avocado, bananas, mango, papaya, rimas and root crops.
3. Agronomic studies on rubber and semi-temperate crops.

SECTION OF ECONOMICS

1. Studies on agricultural economics.
2. Studies on forest economics.

SECTION OF FORESTRY

1. Silviculture (Site Classification; Tree Association; Forest Succession; Reproduction; Seeds; Nursery Practice; Forest Planting and Forest Reproduction).

2. Forest Management (Forest Mensuration; Regulation).
3. Forest Protection (Injurious Forest Insects; Beneficial and Injurious Animals and Forests Insects).
4. Forest Utilization (Minor Wood Industries; Minor Forest Products; Studies of Wood; Durability of Wood; Mechanical Properties of Wood and Wood Preservation).
5. Wood Technology (Wood Structure).
6. Grazing (Study of native and introduced forage plants).

SECTION OF HORTICULTURE

1. The study of the ways of improving the mango industry.
2. The improvement of the citrus fruit particularly through finding and selecting the most promising varieties adapted to different localities in the Philippine Islands.
3. The improvement of the lanzon particularly in connection with the cause or causes of the irregular fruiting and the isolation of sweet strain.
4. The study of the extent of Loranthus and other allied plant parasites as affecting the horticultural crops of the Philippine Islands.

SECTION OF PLANT PESTS AND DISEASES CONTROL

1. *Locust*
   (a) Biometrical and climatological studies of the pest with reference to the development of the locust from one phase to another.
   (b) A study of the aestivation of eggs of locust.
   (c) Further tests with sodium fluosilicate and cryolites as baits.
   (d) Study of micro-organism that might parasitize locusts especially the eggs along with the other natural enemies.
2. *Leaf Miner of Coconut*
   (a) The possibilities of using sinamay instead of wire screen in connection with mass liberation of parasites.
   (b) Studies on the liberation of parasites, the effects of freezing the parasites in order to retard metabolism so that their liberation can be done at the right time for the next main brood and to synchronize with the larva of the incoming main brood.
   (c) Further investigations of the biology and life histories of the different natural enemies.
   (d) The use of cryolite dust as sprays against the leaf miner.
   (e) Further study of the biology of the leaf miner.
3. *Mango Leaf Hoppers and Other Important Pests*
   (a) Studies of the control of the mango leaf hopper.
   (b) Investigation of the possibilities of new local materials for insecticides like derris of different species, etc.

4. *Mango Scales, Mealy Bugs and Soft Shell Scales*
   (a) Studies on the adaptability of sprays both standard and sprays and dust.
5. *Vertebrate Pests, Particularly Rats and Mice*
   (a) Introduction of the bulbs of red squill from the Mediterranean regions for poisoning rats and mice.
   (b) Adoption of the Hawaiian method of poisoning field rats and mice, and the study of the food preference of rats and mice to be used as baits.
6. *Rice Pests*
   Control measures against atañgia, rice stem borer, cut worms and army worms, and cotton pest (Philippine boll weevil).

VII. DIVISION OF ENGINEERING AND INDUSTRIAL RESEARCH

SECTION OF HYDRO-ELECTRIC POWER

1. Possibilities of hydro-electric power development in the Philippine Islands. (In conjunction with the investigation and study of proposed power sites by the Section of Hydraulic Engineering).

SECTION OF MECHANICAL AND ELECTRICAL APPLIANCES

1. Development, design, and construction of various appliances for industries and other research investigations.

SECTION OF FARM MACHINERY

1. Adaptability of the use of modern farm machinery to Philippine conditions.
2. Conditions of farm mechanization in the Philippines.

SECTION OF FUELS AND LUBRICANTS

A. Present status of activity.
   1. Service test and laboratory control of fuels.
      (a) Coal (local andn foreign).
      (b) Comparative service tests of coal and fuel oil in locomotives.
      (c) Fuel value of coconut shell and coconut shell charcoal.
      (d) Comparative service tests of gasoline, alcohol and alcohol blends.
   2. Service tests and laboratory control of various kinds of lubricants.

B. Future program of activity.
   1. Investigation into the proper working conditions of native fuels so that they may compare favorably with the imported ones.
   2. The possibilities of some Philippine vegetable oils as lubricating materials.

SECTION OF HYDRAULIC ENGINEERING

Research Problems in Progress:

1. Irrigation water requirements of rice.
2. Design of sluiceways for Philippine rivers.
3. Determination of coefficients of percolation under dams.
4. Evaporation on water surfaces in the P. I. for storage purposes.
5. Prevention of floods and drainage of the city of Manila and neighboring towns.

Research Problems to be undertaken:

1. Investigation and study of proposed power sites.
2. Study of hydrographs of rivers for power development.
3. Study of hydrological data for power and irrigation, river control, etc.
4. Yield of ground water and its relation to forests and soils.
5. Chemical character of the water of rivers and other water sources.
6. Study of the hydrology of Laguna de Bay in relation to flood prevention and drainage of the city of Manila.

SECTION OF CERAMICS AND OTHER SILICATE INDUSTRIES

1. Investigation of Philippine kaolins for chinaware.
2. Philippine feldspars and pegmatites for ceramic uses.
3. The manufacture of clay roofing material as a substitute for galvanized iron and nipa.
4. Baggase ash as a glass-making material.
5. Baguio and Siruma siliceous sinter for glass making.
6. An investigation of clays and earths for adsorptive capacity.
7. Sand from San Fernando, La Union, for cement and glass making.
8. The manufacture of enamels for metals from Philippine materials.

SECTION OF PAPER AND ALLIED PRODUCTS

Work in Progress:

1. Determination of the pulp raw material ration of local raw materials.
2. Determination of the relative amount of chemicals required.
3. Converting waste paper and cardboard into usable cardboards and wall boards, black boards.
4. Alkali-chlorine miniature plant.

Future Program of Work:

1. Acquisition of a ₱200,000 semi-commercial mill.
2. Making different grades of paper in the mill.
3. Bleaching qualities of the raw material.
4. Manufacture of rayon pulp materials.

SECTION OF ANIMAL PRODUCTS

1. General study on the preservation of meat products.
2. Experiments on the production of inedible animal by-products such as glue, guts, bone meal, meat crop, fertilizer, etc.

3. Experiments on the improvement in the native process of curing and preservation of fishes, like tinapa, toyo, bagoong, patis, etc.
4. Study on the manufacture of fish meal in conjunction with fish canning.
5. Study on the canning of natural, evaporated and sweetened condensed milk.
6. The study of the nutritive value of different native cheeses.
7. Study on the improvement of native hides.
8. Comparative study of hides of different animals both macroscopic and microscopic.
9. The survey of the tanning properties of native plants.
10. The study of chemical properties of native raw materials used in the preservation of animal products.

SECTION OF COCONUT PRODUCTS

1. Extraction of coconut oil from fresh coconuts.
2. Utilization of coconut oil.
3. Utilization of by-products from the coconut industry.
4. Activation of coconut charcoal.

SECTION OF PLANT PRODUCTS

1. Studies on proteins of different Philippine food materials.
2. Studies on the mineral content of different kinds of commercial sugar and candies.
3. Further studies on quick freezing and refrigeration of Philippine fruits and other plant products.
4. Alcoholic fermentation.
5. Methods of preserving various fruits and vegetables and some of their by-products.
6. Chemical studies on tobacco:
   (a) Fire-holding capacity and burning quality of wrappers, cigars and cigarettes.
   (b) Chemical changes in tobacco.
      (1) During stages in sun and flue curing.
      (2) Subjected to different climatic, soil sharing, fertilizing, etc., treatments.
   (c) Absorption and residual quantities of fumigants or sprays.
   (d) Nutrient transfer in the tobacco plant.
   (e) Quantitative indices for tobacco quality.
   (f) Flavoring and blending of tobacco.
7. Insecticides:
   (a) Chemical studies on rotenone as an insecticide.
      (1) Solvents, laboratory and commercial.
   (b) Studies on derris as a source of rotenone.
      (2) Age relationships with rotenone content.
      (3) Assay methods for rotenone content.

(4) Rotenone distribution in the root.
(5) Storage qualities of derris roots.

(c) Chemical studies of other insecticidal plants.
(d) Assay of promising Philippine medicinal plants.

8. Plant utilization work.
(a) Methods of control in certain agricultural industries.
(b) Improvement of and new uses for present agricultural products.
(1) Water-white, odorless coconut oil.
(2) Flours from Philippine grains and flour blends.
(3) Cottonization and softening of abaca fiber.
(4) Investigations on coconut oil soaps.
(5) Fermentation products, like wines, vinegars, pickles, sauerkraut, glycerine, lactic acid, butyl alcohol, etc.
(6) Storage and preserving qualities of Philippine fruits, vegetables and root crops.

9. Studies on agricultural wastes.
(a) Commercial products from agricultural wastes, like furfural from coconut husks, cellulose from copra meal, etc.
(b) Destructive distillation of coconut shell.
(c) Studies on some methods of waste disposal.
(d) Utilization of excess or culled farm products.

10. Other agricultural chemistry work.
(a) Chemistry of mango smudging.
(b) Chemical tests in connection with other agricultural projects.

SECTION OF TESTS AND STANDARDS

Work in progress:

1. Closely identified with the Division of Tests and Standards, Bureau of Science, performing tests on foods and drugs, construction materials, articles of commerce, such as textiles, shoes, paper, fuels, lubricating oils, galvanized iron, fertilizers, paints and so forth.
2. The preparation of specifications adaptable to local conditions of the above-mentioned goods.

Future program of work:

1. Research work on the methods of testing such materials as rubber, certain textiles, plastic materials, etc.
2. Preparation of specifications for certain classes of materials which are still unincluded in the government specifications.

SECTION OF SANITARY ENGINEERING

1. Sewage disposal in unsewered areas.
2. Cross connections.
3. Pollution and contamination of Manila Bay.
4. Refuse disposal of Manila.
5. Housing conditions of the poor in Manila.

6. Study of septic tanks with emphasis on the design of a more modern septic tank.
7. Connection of midden sheds to sewers.
8. Additional outfall sewer for the city of Manila.
9. Improvement of water works in the provinces especially with regard to their purification. (Other research problems were submitted to Section of Biological Survey).
10. Improvement of shallow wells.
11. Improvement of automatic paris green distributors for malaria control.
12. Zoning plan for the city of Manila.
13. Improvement of storm drains of the city of Manila.
14. Studies on more efficient and reliable method of detecting leaks in water pipes and sewers and their location in a distribution system.
15. Studies on earthquake-proof distributing system for water supply.
16. Studies on method of preventing the creation of negative pressure in a distributing system during emergency times as in case of fire.
17. Survey of towns with a view to possible institution of an adequate town-planning system.
18. Studies on a method of preventing or minimizing dust in streets. Aside from concreting, asphalting, watering and oiling what other convenient and less expensive methods can be adopted to remedy the dust problem?
19. Studies on method of solving the dust excreta problem in trains.

FINANCES

In accordance with Sec. 8 of Act No. 4120, creating the National Research Council of the Philippine Islands, the Acting Secretary of Agriculture and Commerce, Hon. Jorge B. Vargas, authorized on May 5, 1934, the release of ten thousand pesos (₱10,000.00) under General Memorandum Order No. 54 for the necessary expenses of the National Research Council of the Philippine Islands. This amount, together with the three hundred sixty pesos (₱360) received as the Elicaño grant, has been the only source of income of the Council.

The total expenses incurred by the Council during the year are given in the financial statement and report submitted by the ex-officio assistant treasurer, Mr. Victor Pagulayan, herewith appended. As shown in the statement the Council has been very economical in its expenditures.

On October 12, 1934, a request was made by the Executive Board to the Secretary of Agriculture and Commerce, Hon. Eulogio Rodriguez, for the release of the additional amount of ten thousand pesos (₱10,000.00) in order to enable the Council to grant contributions for research, but owing to the retrenchment policy of the Department the amount referred to was not released.

With the help of the legislative leaders, Representative Eulogio Rodriguez, and Acting Under-Secretary of Agriculture and Commerce, Victor Buencamino, and the support given the Council by His Excellency Governor-General Frank Murphy, H. B. No. 1670 introduced by Representative Fernando Duran in the last session of the Tenth Philippine Legislature, appropriating the sum of twenty thousand pesos for the use of the National Research Council of the Philippine Islands has been enacted into a law (Act No. 4190).

This amount will help the Council to carry out some of the purposes for which it was established by Act No. 4120.

On October 12, 1934, communications were forwarded by the Chairman of the Council to His Excellency the Governor-General, the President and the Speaker of the House of Representatives, informing them of the activities already undertaken by the Council and of the comprehensive projects of research that the different divisions of the Council have formulated. In this connection, the Chairman of the Council brought it to their attention that an undertaking such as the one contemplated by the National Research Council of the Philippine Islands would necessarily require funds to carry it out. For this reason the Chairman submitted the request of the Executive Board of the National Research Council of the Philippine Islands that the amount of two million pesos (₱2,000,000) out of the amount of forty-seven million pesos (₱47,000,000) that the Philippine Government will receive from the United States as a result of the gold devaluation, be given to the National Research Council of the Philippine Islands as a trust fund, in order to enable the latter to use the accrued interest of the fund in carrying out its research program. Replies to the communication regarding the foregoing state that a sympathetic hearing will be given the matter.

At the sixteenth meeting of the Executive Board held on December 14, 1934, the Board resolved that the necessary steps be taken in order to obtain the funds needed by the Council to enable the latter to help the nation in its program of economic planning and development. It was resolved further that if the amount of two million pesos (₱2,000,000.00) could not be obtained from the forty-seven million pesos (₱47,000,000.00), efforts be exerted to obtain that amount from the coconut excise tax as permanent endowment of the Council.

A perusal of the reports of the National Academy of Sciences, the National Research Council of the United States and the research councils of other nations shows that hundreds of thousands, and not infrequently millions of dollars, are received by those councils as endowments for their research programs. In the United States, the National Research Council not only receives research grants in huge amounts from the Carnegie Corporation of New York, Rockefeller Foundation, Engineering Foundation, and from a number of other research foundations, commercial and industrial firms, and numerous philanthropists; but appropriations in great amounts are also made by different government agencies, such as the General Education Board, the President's fund, Commonwealth fund, and Council of National Defense, to mention only a few.

In the Philippines where wealthy research foundations are not in existence, the aid from the Government to carry out the purposes for which the National Research Council of the Philippine Islands has been established, is indispensable.

FINANCIAL STATEMENT OF THE NATIONAL RESEARCH COUNCIL OF THE PHILIPPINE ISLANDS AS OF DECEMBER 31, 1934.

Nature of Account	1934 Appropriation as Adjusted	Actual Expenses to Dec. 31, 1934	Amounts Obligated to Dec. 31, 1934	Total Expenses to Dec. 31, 1934	Unexpended Balance on Dec. 31, 1934
1. *Salaries and Wages:*					
Salaries and wages	4,925.00	4,773.79	36.67	4,810.46	114.54
2. *Sundry Expenses:*					
Traveling expenses of personnel	50.00	5.10	40.00	45.10	4.90
Freight, express and delivery service	5.00	—	5.00	5.00	—
Postal, telegraph, telephone and cable service	285.00	284.63	.37	285.00	—
Consumption of supplies and materials	800.00	666.99	130.00	796.99	3.01
Printing and binding reports, documents and publications	3,097.10	78.61	3,015.00	3,093.61	3.49
Other services	50.00	4.00	46.00	50.00	—
Total Sundry Expenses	4,287.10	1,039.33	3,236.37	4,275.70	11.40
3. *Furniture and Equipment:*					
For furniture and equipment	745.00	489.98	250.00	739.98	5.02
4. *Contributions and Gratuities:*					
For contributions and gratuities	42.90	—	42.90	42.90	—
GRAND TOTAL	10,000.00	6,303.10	3,565.94	9,869.04	130.96
5. *Fiduciary Fund:*					
Elicaño fund	360.00	210.00	—	210.00	150.00

Manila, January 10, 1935

Certified correct:
(Sgd.) PATROCINIO VALENZUELA
Secretary-Treasurer

(Sgd.) VICTOR PAGULAYAN
Ex-Officio Assistant Treasurer

FUNDS RECEIVED BY THE NATIONAL RESEARCH COUNCILS OF DIFFERENT COUNTRIES *

Donor	Purpose	Endowment	Year
	UNITED STATES	*pesos*	
President's Fund	For general expenses	240,000.00	1918–19
Commonwealth Fund	For general maintenance expenses	24,000.00	1920
Carnegie Corporation of New York	For general maintenance expenses and research undertakings	1,669,732.10	1916–32
Rockefeller Foundation	For fellowships, publications, and research undertakings	3,804,811.16	1916–32
Engineering Foundation	For general expenses and special investigations	18,072.18	1916–18
General Education Board	For fellowships and committee work	139,914.66	1925–32
Council of National Defense	For committee and research information work	92,800.00	1916–18
International Education Board	For research work and fellowships	501,708.90	1926–31
Other sources	For miscellaneous purposes including fellowships, and special investigations	2,433,425.74	1920–32
	GREAT BRITAIN (MEDICAL RESEARCH COUNCIL)		
Parliament	For general expenses	1,480,000.00	1929–30
	CANADA		
Government	For general maintenance ...	240,000.00	Annual appropriation
	AUSTRALIA		
Rockefeller Foundation	For research work and fellowships	135,476.46	1932

* The data given were obtained from sources that are only available to the Council.

RECOMMENDATIONS

DIVISION I

Educational Section

That the Educational Section should encourage members to prepare textbooks for the high schools but due precautions should be taken whenever the author or authors desire to have the publications of the books sponsored by the National Research Council of the Philippine Islands.

In this connection reference may be made to the activity that the Division of the National Research Council of the United States undertook from 1920 to 1922 when the sum of ₱3,000 was appropriated to initiate a revolving fund for the publication of mathematical books. According to the History of the National Research Council of the United States (Reprint and circular, series No. 106, 1933, page 14), the Division has published three such books.

DIVISION II

Section of Geology

That steps be taken so that 25% of the revenues derived from the mining industry be set aside for the promotion of geologic and topographic surveys and investigations.

That investigations in pure and applied physics be promoted and encouraged, especially in scientific institutions, like the Bureau of Science and the Departments of Physics in the various universities of the Philippines.

DIVISION III

That the morbidity and mortality statistics of tuberculosis, malaria and beriberi in the Philippine Islands, the three diseases topping the list of deaths in this country, be verified. It is believed that although these three diseases actually cause the greatest number of deaths, the figures, however, were exaggerated due to poor and unreliable diagnosis, particularly in the case of beriberi in infants. In this connection a recommendation is made that a committee of the Division of Medical Sciences be appointed to formulate:

(a) In pamphlet form standard methods for the Philippine Islands to be followed in the examination of sputum for tuberculosis, blood in malaria, and feces in dysentery.

(b) A syllabus containing certain questions to be answered by the municipal secretary in connection with every death brought to his attention in order to enable the nearest available physician to make a more accurate although delayed diagnosis.

Section of Anatomy

That the Executive Board of the National Research Council should give direct financial aid towards the accomplishment of researches, not only for materials and equipment, but also for services of technical assistants to relieve the research workers of a good part of the routine work, which is one of the greatest deterrents to research.

To publish monographs which collect, correlate and review all the work done on the subjects not only by themselves but by others as well.

Section of Surgery

That two physician-pensionados be sent by the Philippine Government abroad to Europe and America to study and specialize in radium application and Roentgen administration to carcinoma.

Section of Clinical and Experimental Medicine

That the authorities concerned be requested to place at the disposal of the members of the National Research Council of the Philippine Islands not less than ten beds in each one of the different government hospitals for purposes of research.

DIVISION IV

Section of Pharmacopoeia

The Section recommends that a list be prepared of crude drugs official in the United States Pharmacopoeia and other pharmacopoeias and that ways and means of stimulating the local production of these drugs be studied with the cooperation of other sections of the Council; that a list of unofficial vegetable drugs locally obtained and of established therapeutic value be compiled; that a list of galenical preparations widely used in the Philippines be submitted; that suggestions be made to all schools and colleges of pharmacy that the preparation of galenical products from indigenous drugs of established therapeutic value be made a feature of laboratory study in their institutions, and that pharmacopoeial monographs of drugs and galenical preparations of known therapeutical value be submitted and studied for adoption in the future Philippine Pharmacopeia.

DIVISION V

Section of Genetics

Owing to the fact that an adequate number of men to do genetics work are lacking in the Philippines, it is recommended that men be trained in genetics, both here and abroad.

Biological Survey Section

The section recommends strongly the establishment of gauging stations in Laguna de Bay at the following points on the lake: (a) *Wawang Napindan;* (b) *Los Baños;* (c) *Santa Cruz;* and (d) *Binañgonan.* In conjunction with the proposed establishment of gauging stations in Laguna de Bay, the Section recommends the purchase of the necessary equipment and apparatus to consist of: Piche tube, evaporating floating tank, fluviometer thermometer, and anemometer. It was further recommended that studies be undertaken with the end in view of determining the amount of water discharged into the lake. The following rivers flowing into Laguna de Bay are recommended to be the seat of such studies: In the province of Laguna (*Sorosoro, San Cristobal, Calo, Gating-gating, Calauan, Masapang, Santa Cruz, Lumbang, and Mabitac*); in the province of Rizal (*Tanay,* and *Morong*).

Section of Medicinal Plants

Owing to the fact that therapeutic possibilities of Philippine medicinal plants can only be ascertained through systematic inquiry along modern scientific lines with the aim of determining their varied properties, a recommendation is strongly made to the effect that the efforts of research workers engaged in the study of medicinal plants from different view points be effectively promoted and coordinated.

DIVISION VI

Section of Forestry

The trend of forest research must be "toward those fundamental problems which underlie all knowledge of forest growth and of forest products and hence all forestry practice and timber utilization. Forest research must bring many sciences to its aid, which cross and recross each other inextricably and which are exclusively subdivisions of biology, chemistry, physics, and economics." Research problems that should be given preference are: (a) those of immediate need for the proper management of the forests and (b) those that will develop the country economically and which will also give revenue to the government.

In order that the work already started may be developed and fundamental forest research problems solved, a Forest Products Laboratory and Forest Experiment Stations should be established in various parts of the Islands. The establishment of these is essential, urgent and fundamental.

DIVISION VII

Hydraulic Engineering

For the purpose of securing data at the earliest possible date on the flow of certain streams, it is recommended that the cooperation of the provincial governors concerned be requested in order that appropriation may be made from provincial funds for the preliminary survey of proposed power sites, and the establishment, operation, and maintenance of gauging stations, which are necessary in the development of electric power. Such power can be used to advantage not only to supply electric light to the people but also for the development of certain basic industries which will undoubtedly benefit both the people of the provinces concerned and the provincial governments by the revenues that may be derived from the power plants as well as from some of the industries that the availability of cheap electric power will make possible.

Pursuant to the foregoing recommendations, the Chairman communicated with the provincial governors of Camarines Norte, Camarines Sur, Laguna, Tarlac, Samar, and the Director of the Bureau of Non-Christian Tribes, in order to place at the disposal of the Bureau of Public Works the following necessary appropriations needed for the rivers indicated hereinbelow:

1.	Labor River, Camarines Norte	₱500.00
2.	Lagonoy River, Camarines Sur	500.00
3.	Libmanan River, Camarines Sur	500.00

4. Caliraya River, Laguna 500.00
5. Moriones River, Tarlac 450.00
6. Lokolokon waterfall, near the municipality of Gandara, Samar 500.00
7. Mataling waterfall near the main road of Dasalang and Malabang, province of Lanao . 500.00

It is believed that the installation, operation and maintenance of self-recording gauging stations in Rizal and Laguna will also help the Section of Hydraulic Engineering in the investigation and study that it is undertaking regarding the proposed project of opening a channel connecting Laguna de Bay with Manila Bay for the purpose of preventing inundations not only of the towns bordering the lake but also of the City of Manila and neighboring towns along the Pasig River of Rizal province.

SUGGESTIONS FROM MEMBERS OF THE COUNCIL AS TO GENERAL POLICIES.

OTANES, FAUSTINO Q. To support a plan whereby research workers in the bureaus can spend a sort of sabbatical leave abroad in connection with their special lines of work.

MENDIOLA, NEMESIO BLANCO. To compile the research work being undertaken by members and to furnish each member of the Council with a copy of such compilation.

CLARA, FELICIANO M. To find ways and means of obtaining or establishing funds which will aid and encourage Filipino scientists to spend their accrued leave abroad for further studies along their lines.

TOPACIO, TEODULO. In view of the depressed financial condition of the country arrangements with the proper authorities should be made so that space and equipment may be made available to an investigator at any existing laboratories. This would economize the expense of acquiring facilities that necessarily have to be purchased. The Council should be an agency to advise and encourage research workers as much as humanly possible in procuring available facilities when they apply for help.

PENDLETON, ROBERT L. It is believed that one of the most important functions of the Council is to place the inventory of scientific resources of these Islands before the scientists of the world, with the invitation to come here on sabbatical or other leave, and work with us, so that we may have the benefit of their research. A unified presentation of the scientific resources of the Islands by an authoritative body will do much to attract here men of ability. This is particularly important as our ability to employ specialists fails because of decreasing revenues. It is also believed that the secretariat of the Council could do much to exchange with similar organizations information about scientific progress and resources in nearby countries, with a view to placing at the disposal of our own members as well as before our visiting scientists, an adequate idea of the work in progress as well as published, of the Netherlands Indies, Indo-China, Formosa, South China, Federated Malay States, British India and Ceylon, Burma, etc. We are all working too much in isolation. Too much our technical men have been trained in the United States where the degrees have been awarded, and not in the adjacent tropical countries where the actual research and information of value to us is being obtained.

Report of the National Research Council of the Philippine Islands

(For the period from March 23, 1934, to February 28, 1935)

PART II

HISTORICAL REVIEW OF PAST RESEARCH ACTIVITIES IN THE PHILIPPINES ALONG SCIENTIFIC AND TECHNICAL LINES

A HISTORICAL REVIEW OF MOVEMENTS TO ESTABLISH A RESEARCH COUNCIL FOR THE PHILIPPINES

By PATROCINIO VALENZUELA
Executive Secretary and Treasurer, National Research Council of the Philippine Islands

The realization of the need of a country for organized research work to promote industrial and agricultural development as well as the health of the people through the study of fundamental scientific principles was evident even during the Spanish time. A historical review of movements to establish coordinated scientific research and investigation would prove undoubtedly of great interest not only to members of the National Research Council but also to all those who should be concerned with this activity of the nation.

REAL SOCIEDAD ECONOMICA DE LOS AMIGOS DEL PAIS *

The Royal Economic Society of Friends of the Country was a society founded by Governor Don José Basco y Vargas by virtue of a royal decree dated August 27, 1780. The Society was formally inaugurated on May 6, 1781, with Governor Basco presiding. Its first president was the quartermaster-general of the Islands, Ciriaco Gonzalez Carvajal. In 1817 it suspended its meetings but it resumed its functions in 1819.

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* Sometimes referred to as "*Real Sociedad Economica de Filipina,*" "*Real Sociedad Economica Filipina de Amigos del Pais.*"

BLAIR and ROBERTSON. 1907. *The Philippine Islands* v. 50, 1764-1800. The Arthur H. Clark Co., 51-52, Cleveland, Ohio.

The promotion of the cultivation of indigo, cotton, cinnamon and pepper and the silk industry were among the activities the Society undertook. It was endowed with a permanent fund of nine hundred sixty pesos a year, the value of two tons which were assigned to it in the lading of the Acapulco galleon in order to help it carry out its ordinary expenses.

According to its first regulations, it included sections of natural history, agriculture and rural economy, factories and manufactures, industries and popular education.

Although the purposes and aims of this Society were not exactly identical with those of a national research council, yet some of the activities it undertook as related in a memoir published by the society in 1855 [1] reveal several works it has in common with that of the National Research Council of the Philippine Islands.

Such activities as the offering of a prize for the most successful experiments in dyes (1824), publication of memoirs on technical matters (coffee, 1827, clays, 1851, and others), the awarding of five hundred pesos to Father Blanco for the cost of printing and publishing the "Flora Filipina" which bears his name (1840), and other works for the improvement of agriculture and industry are undertakings similar to those fostered by research councils.

Jagor in his "Reisen in den Philippinen" [2] mentioned the existence of the Society, although he believed that it did not quite succeed in its program of activities owing to the lack of public spirit. As regards the same society, Alexander S. Webb, former American Consul at Manila, said: "It is claimed on its behalf that it has accomplished a vast amount of good, but there is not that degree of energy and activity manifested in its work to be seen in similar organizations in some other countries." [3]

The history of the Royal Economic Society of Friends of the Country speaks for itself and the comments of its critics, Jagor and Webb, who referred to the lack of public appreciation

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[1] *Noticia del Origen y Hechos Notables de la Real Sociedad Economica de Filipinas según sus actas y documentos oficiales escrita para la dirección general de ultramar á consecuencia de la Real orden de 2 de Mayo de 1885.* Imprenta del Boletin Oficial de Manila, año de 1855.

[2] JAGOR, F. 1873. *Reisen in den Philippinen,* Berlin, Weidmannsche Buchhandlung, 307-308.

[3] Footnote in BLAIR and ROBERTSON, etc. v. 45 (1736). The Arthur H. Clark Co., 1906, p. 282. *Comp.* Report of Commissioner of Education, 1897-98, 980.

and to the energy and activity that were wanting in its work as its serious handicaps, are significant pointers to those of the present generation who are called upon to do their duty so that they may serve as warnings against the repetition of history without the correction of all its attending defects.

CLUB INTERNACIONAL

The "Club Internacional" was the precursor of the present "Club Filipino." It was an organization that purported, among other things, to contribute to the moral and material prosperity of the country. One of the aims [1] was to send promising Filipino students to Europe and America to pursue special professional studies. These apparently referred to those courses that were not offered then in the Philippines, as can be discerned from the fact that the fellows that were sent by the "Club Internacional" studied courses in engineering. It was also one of its objects to create chairs in the different branches of human knowledge. In connection with the former aim, the names of Engineers Santiago Artiaga, Juan Tecson, and Antonio Tayzon, may be mentioned as those who were recipients of the fellowship of the "Club Internacional". Artiaga and Tecson studied and completed courses in civil engineering in the University of Michigan whereas Tayzon obtained his degree from the University of California. Miguel Lukban and Lorenzo Onrubia who were sent to the University of California and the University of Illinois respectively by the Club as its pensionados, were unable to continue their studies in engineering and were forced to return to the Philippines owing to illness.

The intention of creating chairs was not carried out.

As for the policy of sending out pensionados or fellows which was adopted later by the Government and the University of the Philippines and which is one of the activities fostered by a national research council, credit may be given to the "Club Internacional" for having pioneered in that commendable work that has largely contributed to the promotion of research in the Philippines.

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[1] Club Internacional, Reglamento. *Manila:* Imprenta de El Liberal, 1900, 4.

Estatuto y Reglamento del Club Internacional. *Manila:* Estab. Tipografico de M. Paterno y Ca. S. Sebastian, 162, 1902, p. 5.

PHILIPPINE RESEARCH INSTITUTE

The organization of the Philippine Research Institute in June, 1929 [1] for the encouragement of research in pure science in the Philippine Islands was one of the attempts made toward the establishment of a research council. The idea of the organizers of the Institute was to carry on research of benefit to the Philippine Islands and to make use of the favorable situation of the Philippine Archipelago as a center of tropical research.

It was intended to be a private corporation but it was designed to work in a very close harmony with the Philippine Government as shown by the composition of its board of directors.

A detailed research program with an estimated expenditure of one hundred thousand dollars ($100,000) covering medicine, medical zoology, physiological chemistry, archaeology and botany was laid out. Other problems were also indicated.

The Philippine Research Institute has remained a mere plan.

PREVIOUS ATTEMPTS TOWARD THE ENACTMENT OF A LAW CREATING THE NATIONAL RESEARCH COUNCIL OF THE PHILIPPINE ISLANDS

At the meeting of the Philippine Islands Medical Association on December 17, 1927, a resolution urging the creation of a Medical Research Council of the Philippine Islands was approved.[2] The Colegio Medico-Farmaceutico de Filipinas at its meeting held on December 22, 1927, adopted a similar resolution.

In pursuance of the resolution adopted by the Colegio Medico-Farmaceutico de Filipinas, a special committee to study ways and means of carrying out the purposes of the resolution was appointed. This committee submitted its report published in the *Revista Filipina de Medicina y Farmacia*, April, 1931 [3] under the title of "Foreign Research Organization." The members of the committee approached informally some officials of the Philippine government but were informed that the organiza-

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[1] Philippine Research Institute. Organization and Program, Manila; Philippine Islands, 1929. On October 9, 1929, the Philippine Research Institute unanimously adopted a statement of its organization, purposes and program.

[2] *Jour. Philip. Is. Med. Assoc.*, v. 8: 38, 1928.

[3] *Rev. Filip. Med. Farm.*, v. 22: 121, 1931.

tion of a National Medical Research Council in the Philippine Islands was not then timely.

In 1931, the activities towards the creation of a research council were renewed in view of the existence of a favorable attitude among the legislators and the national leaders towards promoting research.

A growing interest in the establishment of a National Research Council of the Philippine Islands has been noticed since 1927, especially when the idea was emphasized that in the solution of our agricultural and other technical problems, research is indispensable.

The Colegio Medico-Farmaceutico de Filipinas, in continuing its efforts to realize the creation of a National Research Council of the Philippine Islands, issued an invitation to the different scientific and technical institutions, both within and outside of the Philippine Government, to send in their representatives in a meeting called for October 10, 1931, at the Colegio Medico-Farmaceutico de Filipinas for the purpose of discussing House Bill Number 876 introduced by Honorable Manuel Gallego of the province of Nueva Ecija.[1] Several representatives of the institutions invited attended the meeting.

PRESIDENT MANUEL L. QUEZON AND THE NATIONAL RESEARCH COUNCIL OF THE PHILIPPINE ISLANDS

It was on February 17, 1933, when on the occasion of the Second Philippine Science Convention held under the auspices of the Philippine Scientific Society, President Manuel L. Quezon expressed in unequivocal terms his favorable endorsement of the creation of a National Research Council similar to the ones existing in the United States, Australia, Japan and other countries, as given in the following quotation from the address of the Senate President, delivered before the Convention of the Philippine Scientific Society on that date:[2]

> In this connection, leaders of the Legislature are seriously considering the suggestion made by one of the Department Secretaries some years ago regarding the creation of a National Research Council similar to the ones they have in the United States, Australia, Japan and other countries. We feel that the time has come for the government to utilize to full advantage our scientific men and women, make them come out of their shell, so to speak, and advise us on matters pertaining to their respective fields.

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[1] Records of the Colegio Medico-Farmaceutico de Filipinas.

[2] Appendix B to this report.

When the Council and past presidents of the Philippine Scientific Society unanimously approved the draft of the bill creating the National Research Council of the Philippine Islands, a committee headed by Under-Secretary Manuel L. Roxas called on President Quezon to request his opinion on, and his support for, the approval of the bill. Some amendments were introduced in the original bill upon the suggestion of President Quezon, who later expressed on more than one occasion his approval of the bill and his desire to help the Council in order to enable it to carry on its work with success.

GOVERNOR-GENERAL FRANK MURPHY AND THE COUNCIL

For the purpose of enlisting the support of His Exellency, Governor-General Frank Murphy, which has been generously given, the Council of the Philippine Scientific Society submitted on September 12, 1933, the memorial which appears in Appendix C.

Similar memorials were forwarded to legislative leaders and the Honorable, the Secretary of Agriculture and Commerce.

ENACTMENT OF ACT NUMBERED 4120

After enlisting the support of President Quezon and Governor-General Murphy, former Representatives Manuel Gallego from the Province of Nueva Ecija, and Leonardo Farol from the Province of Batangas, introduced in the House of Representatives House Bill No. 3276,* incorporated in this report as Appendix G.

Recognizing the importance of the creation of the National Research Council, Honorable Quintin Paredes, Speaker of the House of Representatives, gave encouraging support for its approval. The history of the National Research Council of the Philippine Islands will be incomplete if mention is not made of the interest taken in it by former Secretary of Agriculture and Commerce, Honorable Vicente Singson Encarnacion, Under-Secretary of Agriculture and Commerce Jorge B. Vargas, Mr. Wenceslao Trinidad, Manager of the Pampanga Sugar Development Company, Representative Ramon Diokno of the Committee

* This bill was prepared with the cooperation of members of the Council and past presidents of the Philippine Scientific Society who held several weekly meetings in order to help in perfecting the draft.

on Rules of the House of Representatives, Representative Eulogio Rodriguez, Representative Mariano Alisangco of the first District of La Union, Chairman of the Committee on Library and Museum, and the Members of his committee, Representative Jose Ozamis who sponsored the bill on the floor of the House of Representatives, Senator Claro M. Recto, who spoke for it on the floor of the Senate the other members of the Ninth Philippine Legislature whose names are too many to be enumerated, and a number of Filipino scientists who worked for the cause of science and their country.

BRIEF OBSERVATIONS ON SCIENCE IN THE PHILIPPINES IN THE PRE-AMERICAN ERA

By EULOGIO B. RODRIGUEZ
Assistant Director, National Library
Associate Member, Section of Educational Relations

"And step by step since time began
I see the steady gain of man."
—WHITTIER.

In order to have a general appraisal of science in the Philippines during the Pre-American era it is fundamentally essential to know the spirit of the time and the sense of value of the epoch. In that era spiritual matters were given more emphasis than things material. Hence the study of the Humanities, Philosophy and Theology had prominence over scientific studies. And as Dr. David P. Barrows aptly said, "The Filipino has been affected by these centuries of Spanish sovereignty far less on his material side than he has on his spiritual, and it is mainly in the deepening and elevating of his emotional and mental life and not in the bettering of his material condition that advance has been made."

The study, however, with the investigations, and researches made on pure and applied sciences, which I shall later enumerate, was not entirely overlooked and there were no few pioneering studies. How much they helped the people and the country and how effective they were as well as the extent to, and thoroughness with which they were pursued is a point which is not easy to determine. I shall not attempt to go to that extent. Nor shall I attempt to treat the subject of *Science* in its complete groups and classifications as was done in the Century of Progress Exhibition at Chicago where the basic sciences were grouped under seven headings, namely; mathematics, astronomy, physics, chemistry, biology, geology, and medicine. I shall deal only with some of the pure and applied sciences developed in those days of which we have knowledge and records. I would ask the reader, likewise, to bear in mind that these observations are from the pen of a mere layman and not of a scientist—of one merely a student of the history of the progress of the Philippines and of its people.

During the past régime original research and investigations were made on the elements and epidemics, including plant diseases, that fundamentally affect the country, in order to gain some definite knowledge of their causes as well as their effects. And these elements and epidemics visit the country frequently enough to attract attention and destructively enough to arouse interest. The historical bases, forces, circumstances, or objectives that obliged the country or some of its citizens to pursue scientific investigations and research, give the necessary basic facts for my present observations.

As illustrations I may state that the study of metallurgy and the manufacture of gunpowder, crude or elementary as they might have been forced by the necessity of casting cannon and making gunpowder for the necessary fortification and protection of the country. Frequent destruction by earthquakes compelled the scientifically minded men to make a study of seismic causes, hence the study of seismography. Earthquakes had made disastrous visits to the Philippines. The most fatal of which we have a record occurred in 1601, 1610, 1645, 1658, 1675, 1699, 1796, 1824, 1852, and 1863. The first in Spanish times took place during the administration of Governor Francisco Tello de Guzman. Possibly the most destructive one was on November 30, 1645, better known as the Earthquake of San Andres, on account of its having occurred on the feast of this Patron of the city. Earthquake shocks followed one another at intervals of five days, which caused Manila to be depopulated, and there were over 600 victims. The rebuilt city ceased building lofty buildings and settled down to the simple safety construction that has only recently been changed by the use of concrete and structural steel. Then in 1863, an earthquake almost reduced Manila to a mountain of ruins with 400 people killed and 2,000 injured. One of the highest dignitaries of the Archdiocese, Reverend Father Pedro Peleaz, was a victim of this earthquake while he was attending Matins at the Cathedral on the eve of Corpus Christi. Again Manila was visited, in 1880, during the administration of Governor Fernando Primo de Rivera. Because of this calamity, together with that strong typhoon (1882) whose vortex passed over Manila and the epidemic of cholera (1882) that claimed many lives, Governor Primo de Rivera was regarded as the most unlucky Governor the Philippines had during the whole Spanish régime.

The frequent eruptions of active volcanoes in the Philippines that were so calamitous to those who lived in their vicinity, forced a few men to make a scientific study of their causes. Our early record of volcanic eruptions during the Spanish régime took place in 1641, during the time of Sebastian Hurtado de Corcuera, when three volcanoes were supposed to have burst forth, one in Jolo, another in Sanguil, in the southern part of Mindanao, and a third in Aringay in the north of Luzon. A terrible eruption of Taal volcano took place in 1754 which resulted in a plague caused by the multitude of fishes, killed by the eruption, which floated upon Lake Taal. The beautiful Mayon Volcano of Albay erupted twice in 1765. Again it erupted terribly in 1814, then in 1853. The Macaturan volcano in Mindanao erupted in 1855. In 1871 the volcanoes of Cawiguiu of Mayon erupted. The last eruption was of Taal volcano, in 1911.

The existence of destructive cyclones, typhoons and storms in the Philippines and this part of the Orient gave rise to the scientific study of meteorology or weather forecasts. Destructive visits of these elements to the Philippines took place during the Spanish régime in 1599, 1611, 1658, 1711, 1742, 1768, 1782, 1797, 1821, 1831, 1843, 1855, and 1882. In 1865 the Jesuit Fathers founded the Manila Observatory for weather forecasts which was declared official in 1884. Typhoons or baguios were classified in the following forms: Cyclones formed in the Pacific, including cyclones of the Marianas Islands, of Japan, of Formosa, and of the Philippines, and cyclones formed in the China Sea, including Jolo Sea, and the interisland waters south of Luzon. The knowledge of forecasting the path of the cyclones is of tremendous importance for the protection of lives and property, especially to navigation, the study of which brought the well-merited fame to the Jesuits of being the best meteorologists in the Fart East.

In the desire of the Government to make the Philippines not only agriculturally self-sufficient but to produce on a grand scale for purposes of export, scientific investigations were made along agricultural lines.

Scientific investigations on thé cause and origin of cholera that wrought havoc in the Philippines at different periods of its history were made. But as to the results of these studies and investigations it must be admitted that they were not much of a success, as the appearance of this epidemic in the Philippines was never checked and prevented up to the advent of the new régime.

There were several factors that may be regarded as responsible for stimulating scientific study in those days. Among these factors were: first, the University of Sto. Tomas, the colleges of the Jesuits, the San Juan de Letran College and other colleges established before the coming of the Americans, giving courses in mathematics, physics, chemistry, biology (in the University of Sto. Tomas and the College of San Jose, courses in medicine and pharmacy were given); second, hospitals, the Jesuit Observatory, and the Government, in opening laboratories and weather bureaus, agricultural schools, experiment stations, a health service, mining office, forestry office, and promulgating royal decrees giving prizes to those who made scientific discoveries; third, academies, societies or corporations such as the *Real Sociedad Economica Filipina del Amigos del Pais*, a semi-government institution, the *Compañia de Filipinas*, and private factories such as the *Ayala Destileria* and similar entities that established chemical laboratories to advance their industry, where chemists such as Anacleto del Rosario and others were employed. The National and International Expositions in which the Philippines took part were, in a measure, manifestations of scientific achievements. The natural history museums of Sto. Tomas University and that of the Ateneo de Manila were an index of scientific persistent study of natural sciences.

On the other hand there were several factors during that epoch that caused the slow development of scientific studies. First, the absence of well equipped laboratories or facilities, not in the modern sense, but even according to the standard of the times, especially the absence of the modern microscope which was only introduced here at about the end of the Spanish régime (in 1895 the first compound microscope was sold by Boíe); second, the comparatively slow trade movements of those days, due to the difficulty in shipping and transportation especially when the Philippines were not open to world trade; third, the spirit of the times, when the study of speculative science was given preference over the study of pure and applied sciences. It was essentially a spiritual era in which the development of material matters was subsidiary to that of the former.

MEDICINAL BOTANY—PRE-EUROPEAN[1]

Medicinal botany is possibly the oldest branch of science in the Philippines. It was practiced by the ancient Filipino priests and priestesses in pre-Spanish times. In medicinal matters the Filipinos were herbalists as distinguished from the Europeans who were practicing the use of minerals. The ancient Filipinos had a scientific knowledge of Philippine medicinal plants that could be used for curing specific sicknesses. As illustrations, we may mention that *tañgan-tañgan* was used principally to alleviate headaches by applying its leaves to the forehead, causing sweating and consequently bringing relief. The seeds of *balocanag* were ground into oil and rubbed into the scalp to kill vermin. The boiled root of *pandakaki* when given as a drink improved the stomach and eased pain caused by cold or indigestion. The leaves of *taguypasin* were of value in any chronic stomach disease due to inflammation, overloading or cold. The boiled bark of *bakao* furnished a remedy which killed all kinds of intestinal parasites. The *sibukao* plant was used for absorbing coagulated blood and it was applied in cases where blows on the body had caused the extravasation of blood into the tissues. The ground root of *cumalikib* made into an infusion cleaned and cured ulcers or wounds. The pounded leaves of a climbing plant known as *balabgon* were used in the cure of wounds. The raisin of *culasi* cured stab wounds and itches. All kinds of spots on the skin were cured by means of roots of a tree known as *salak.* The leaves of the little tree called *alaklak* when crushed and applied to boils, quickly brought them to a head and then removed the content.

There were plants used as antidotes. The *manungal* was boiled and given to anyone who had eaten poisonous substances such as fish or herbs. The infusion of the bark of *palagnigon* was both an antidote and a febrifuge. The bark of the root of the *bagosabak* tree was curative of the bite of any kind of poisonous animal or snake. The most popular medicinal plant possibly is *igasud* which the Spanish missionaries re-named the *pepita of San Ignacio.* It abounds in the mountain regions of the Visayas. The seed is highly esteemed in all parts of the world and is used if a person has eaten something poisonous, in which case a little piece is chewed and followed by a drink

[1] For historical sketch of Philippine Botany, see Merrill's Enumeration.

of cold water. In this manner it cures many disturbances of the stomach and intestine. It is also used as an emetic. And held in the mouth, and sucked, it is effective for rheumatism. It also relieves indigestion.

The ancient Filipinos possessed a good practical knowledge of the various plants and herbs their country produced. It is said they could change the natural form of the carabao's horns by the application of chemical materials without hurting the carabao. They used the bark of trees or seeds for dyeing. By the application of poisonous substances to the points of arrows they made them deadly. For pep, vim, and vigor *takip-kohol* was used.

The crude principle of signaling was practiced by the ancient Filipinos. The trunks of trees that were hollowed out either purposely or became so on account of old age, were struck at certain intervals to produce a sound in accordance with a code of their own that could be understood in the neighborhood, and the sound was relayed and broadcast to other places by the same method of consecutive repetition from hill to hill throughout the land. This latter system may very well be considered the prototype of the modern signaling.

The manufacture of gun-powder was practiced in the Philippines, and the making of cannon and metallurgy were known long before Spain ever came to the Philippines. In 1587, during the régime of Governor Santiago de Vera, an artillery foundry was reopened under Panday Pira, a Pampangan, who cast cannon "as large as those of Malaga" (Spain), before the Spaniards came. This was followed by the construction of the walls of Manila, of Fort Santiago and the reorganization of the navy in the Philippines. The ancient Filipino was one who learned from direct and close observation of his surroundings. He learned from his actual contact with men and nature. Without the help of the watch, as no watch then existed, he could read the time by the position of the sun. Without the aid of the compass he was able to know his direction and guide his vessel in the high seas. Without the barometer, he was able, through weather signs, to predict the approach of storms. From this natural training his powers of observation were surprisingly developed and he acquired the habit of careful reflection and measured reasoning. Most of his learning may be considered scientific. These were experiences of our race that were transmitted to us and of which we made great use on the advent of the new science.

FLORA AND FAUNA

The fauna and flora of the Philippines were studied by Fathers Blanco, Mercado, Llanos, Naves, Celestino Garcia, O. S. A., Barranco, Cuartero, José Ma. Gonzalez Tuñon, brother of Cardinal Zeferino Gonzalez, Martinez Vigil, Casto de Elera, O. P., Blas de la Madre de Dios, José de Valencia, O. F., in accordance with the scientific classification which then controlled in natural sciences, bringing these studies up to the technical perfection which they had in that epoch.

Fathers Klein, (called here Clain) Blanco and Fernando de Santamaria applied themselves to the study of plants and their medicinal values. Through their study they saved innumerable Filipinos from death, restored others to health, freeing them from grievous infirmities, making a gloomy future disappear from many homes.

It should be remembered in this connection that the "Flora de Filipinas" of Fr. Manuel Blanco (in four volumes) with illustrations in natural colors was printed in Manila in 1887-1880 and is worthy to be compared with the better works of the kind printed elsewhere in the world. It is undoubtedly a monumental piece of work on Philippine botany. One of the earliest and perhaps most valuable works was on medicinal botany by a Filipino mestizo of the Augustinian order, Fr. Ignacio de Mercado of Parañaque, Rizal. This was the basis of Dr. Trinidad Pardo de Tavera's work entitled "Plantas Medicinales de Filipinas" (1893) which was translated into English by a United States Army surgeon, Dr. Thomas, and printed for the use of the American army in the Philippines.

The Jesuit botanist George Kamel, a German for whom the camelia was named, was the author of the description of tropical plants sent from Manila to Europe about 1703. His work was published in London in the "Philosophical Transactions", in volumes 21 and 22. Other Philippine botanical works are: *"Estudios Sobre Plantas de Filipinas"* (1851) by Antonio Llanos; *"Revisión de Plantas vasculares Filipinas"* (1886) by Sebastian Vidal y Soler; *"Catalogo sistematico de toda la Fauna de Filipinas conocida hasta el presente, ya a la vez el de la colección Zoologica del Museo del Colegio, Universidad de Manila"* *por Castro de Elera,* (1895); "Herbarium; *Apuntes sobre plantas medicinales y Flora de Filipinas*" (1895) by Dr. Leon Ma. Guerrero. Other treatises on medicinal plants were written by Paul Klein, called here Pablo Clain, S. J., entitled "*Remedios Faciles Para Diferentes Enfermedades*" (1857); Fr. Manuel Vilches "*Manual del Medicillo Visayo*" (1877).

In about 1623 Fr. Blas de la Madre de Dios of the Franciscan Order, wrote "Flora de Filipinas" one of the earliest works that was written on this subject in the Philippines. He also wrote treatises on domestic medicine (*Tratados de medicina domestica*). He came to Manila in 1585, and immediately mastered the native dialect. He founded the town of Morong, was parish priest of the town of Pila and in 1660 founded the town of Giling-giling and later transferred to Pililla, Meycauayan and Paete. He died September 7, 1686.

Fr. José de Valencia, of the Franciscan Order, came to the Philippines in 1654. He was an excellent physician and dedicated himself with the utmost charity to curing the sick, and wrote a "Flora de Filipinas" in which with minuteness he described the roots and herbs, their forms, the locations where they grew and their curative powers. He died in the Pila convent in 1669.

The flora of the Philippines in general naturally is tropical. There are, however, some notable differences between the vegetation on the Pacific coasts and that of the China Sea coasts, as in the former region the rains are more copious, while in the latter there are magnificent virgin forests containing an abundance of orchids, palms, aroids, and the like.

Don Sebastian Vidal y Soler grouped Philippine flora into two classes; forest flora and agricultural flora. The first is divided as follows: (a) mangrove swamp; (b) vegetation along the seashore; (c) vegetation in the lowlands of less than 200 meters altitude; (d) vegetation of the zone between 200 and 1,000 meters of elevation; (e) vegetation of the mountain zone between 1,800 and 3,000 meters. The second class is made up of various cultivated plants of commercial or other uses.

Vidal was one of the greatest botanists we have had in the Philippines. A study of his "Flora Forestal" and his scientific monographs on this archipelago makes evident his greatness.

Fr. Rodrigo de San Miguel of the Recollect Order wrote between 1610 and 1620 "*Manual de medicina caseras para con-*

suelo de los indios". He founded the towns of Bagak, Mariveles, Bataan; and Subic, Zambales in 1605. He died in 1626 at the age of forty-six.

Philippine fauna was studied with the same deep interest as its flora during the Spanish régime. Nevertheless work along this line may be considered merely to have been fairly started. Zoologically speaking, it may be stated that the Philippine Islands are not uniform areas. For instance, numerous Bornean forms are present in the Islands of Balabac, Palawan and the Calamianes Islands, which are conspicuously absent throughout the remaining islands of the archipelago. In general it may likewise be said that this archipelago is characterized by a scarcity of mammals but has a rich bird fauna and a high class of species peculiar to the group of molusca.

GEOLOGY

Enrique Abella y Casariego and Jose Centeno, Spaniards—very friendly to the Filipinos, made a profound geological study of the Philippines, of the structure of its mountains, its iron mines, its mineral springs and its earthquakes and volcanoes.

Warren D. Smith, an American, in his "Geology and Mineral Resources in the Philippine Islands", states:

> Of the workers who antedated the coming of the Americans to this land, many were merely passing travelers, and these contributed only fragmentary and cursory notes, but the following must be particularly mentioned:
>
> Richard von Drasche, a German geologist, who traveled extensively in Luzon in the decade 1870 to 1880.
>
> Karl Oebbeke, a German petrographer, who was never in the Archipelago, but who worked on von Drasche's collections.
>
> Karl Martin, a Dutch paleontologist of note and the authority on the paleontology of Java, who studied collections of Philippine fossils, but never visited the Islands.
>
> B. Koto, dean of Japanese geologists, who has never been here, but whose discussion of Malaysian tectonics is suggestive and helpful.
>
> Jose Centeno, chief of the Spanish mining bureau from 1876 to 1886, contributed much to the geologic literature of the Islands. His chief work was on Taal Volcano.
>
> Enrique Abella y Casariego, the last chief of the Spanish mining bureau, 1889 to 1897, was by far the ablest of the earlier investigators. It is a great pleasure to pay this tribute to our late colleague of another nationality. I have only words of commendation for his untiring efforts in the solution of the geologic and mining problems of the Philippines.

It is of interest to quote herewith the tribute paid by Mr. Frank de Thoma to Don Jose Centeno y Garcia, engineer and general inspector of mines in the Philippines, in the translation made by the former of the latter's monograph entitled "A brief sketch of the Geology and Mineralogy of the Philippine Islands." This translation was made in 1906, and is still in manuscript form, 93 pages, preserved in the Scientific Library, Department of Agriculture and Commerce. It states:

> Concise works on the geology and mineralogy of the Philippine Islands are few, if any. The material is scattered through a great number of monographs; the writings of Mr. Abella y Casariego; Caveda y Mendez de Vigo; Drasche, Wartenberg, Jagor and others.
>
> The best and most concise of all, covering the entire Archipelago, is the work of Don Jose Centeno y Garcia, published by Royal order in 1876. Although very nearly thirty years have passed since then, it is still the standard work on the subjects it treats of and for this reason the translation will, it is hoped, be of some service to persons interested in these studies and to the practical miner.

Doctor Pardo de Tavera in his 'Biblioteca Filipina' (Washington, 1903) comments on it as follows:

> The essay contains a large number of highly interesting notices and data, many completely new, others little known and a great number of them due to observations made by the author in the Archipelago. Considering the lack of roads, the climatological conditions of the country and the almost impenetrable forests covering a large part of its area, an idea may be formed of the hardships which it was necessary to undergo for collecting the geological data contained in this work, and the zeal and the industry and assiduity required.

MALACOLOGIST

Gonzalez Hidalgo, famous malacologist, represents possibly the greatest and most notable contributor to the study of Conchology in the Philippines. Fr. Gregorio Sanz, Augustinian Recollect, in his *"Embrologia Sagrada"* gives us a work on this important subject, so beneficial to many families, at the height of the epoch of 1856.

SEISMOLOGY

Seismology and the study of typhoons have ever been the specialties of the famous Directors of the Jesuit Observatory in Manila. Zuñiga, Fr. Ceferino Gonzalez, and Abella Casariego, noted Spanish engineer, (Philippine born but retaining Spanish nationality after the Treaty of Paris) examined likewise with great care the causes of the earth's trembling and the earthquakes which with frequency afflict the Archipelago and breed fear and cause death in many localities of these beautiful islands. In 1865 the Jesuit Fathers founded the Manila Observatory for weather forecasts and the institution was declared official in 1884. The departments of Magnetism and Astronomy were created many years later. As early as 1822 records were obtained at the Manila Observatory with crude seismographs showing the complicated movements of the earth in the famous earthquakes of Nueva Vizcaya and Pangasinan. In 1880, a weather forecast in the Orient was sent to Hongkong by cable. In 1886 a barometer, intended to forecast weather in the Philippines was invented by Father Faura. In 1890 at the request of the Minister of foreign affairs of the Japanese Empire, a mutual exchange of observations was established between the Manila Observatory and the Central Observatory of Tokyo.

GOLD DISCOVERY

Fr. José Torres, in 1829-31, in his immortal expeditions to Benguet and Bontoc, was the first European who penetrated and traversed the Luzon mountain regions, making known to the world the gold deposits which were hidden there that today are bringing great returns to companies mining their metal.

WATERWORKS

Fr. Juan Peguero, Dominican, gave Manila potable water before the Carriedo water system, by means of a canal which he opened in the neighborhood of the San Juan del Monte Church, by means of a system of conduits of water, modeled upon the systems then used by the capital, Madrid, and London.

SOME OF THE FAMOUS CONTRIBUTORS TO SCIENCE

Of all the scientists of the nineteenth century among the Religious Orders, and there were not a few of them, the one that most appealed to the Filipinos was the illustrious bishop of Nueva Caceres, who was a friend and admirer of the notable Filipino educator and ecónomist Father Pedro Peleaz, one time administrator of the Archdiocese of Manila, *Sede Vacante*. Francisco Gaînza was active along many lines of science. Student of geography, geology, ethnography, and a linguist, he supplied data of great value for the study of the customs and religions of the non-Christian tribes of Luzon. He was also practical in his ideas, developing the work of dyeing and making available for the lowlanders some of the more useful plants that the hill people were cultivating.

For the rest, the interior of Luzon was made known by such explorers as the Dominican Father Pedro Jimenez, who wrote the first report on the inhabitants of Isabela, and also P. Juan Prieto, who described the Ifugaos, Calingas and Yrrayas from knowledge gained during long years as a missionary among them.

The study of races, especially here in the Philippines where man presents himself with all kinds of characteristics conceivable, from those of the Negrito to those of the Chinese and European mestizos, is, evidently, always of profound interest. Fathers Pedro Chirino, S. J., Juan J. Delgado, S. J., Francisco Combes, S. J., Joaquin Martinez de Zuñiga, O. A., Don Joaquin Rijal, Dr. José de Lacalle, Don W. E. Retana, Dr. T. Montano, have written books and treatises on the people of the Philippines

One of these writers maintains that three trunks or three race stocks have given origin to the inhabitants that people the Oceanic Islands—the Malayans, Melanesians and Polynesians. Another maintains that the Filipino people must be divided into two groups, conveniently known as "pagan-mestizo" tribes and "Christianized" peoples. Still others maintain that the native inhabitants of the Philippines should be divided into two branches—the Negrito and the Malay. Others further divide them into three groups: Malay race, Negrito or Aeta race and mixed tribes of Malayan-Negrito origin.

Dr. Montano, after having made a thorough study of the subject during his trip to the different islands of the Orient, says:

> The peninsula of Malacca and the whole of the great Asiatic archipelago to the east of Flores, Cerám, Gilolo, or, if you please, the limit of the Papuan race, seems to be populated by three distinct races, namely, the Negrito, the Indonesian, and the Malay. At all events, this is the conclusion which I have reached from my observations of the human beings inhabiting this region to-day, and from my conclusions which have been gathered in all of the regions that I have traveled through.

Fathers Alamo, Malumbres, Campa, Villaverde and Zubieta likewise made studies which were profitably used by the Bohemian Blumentritt, and the American Worcester.

Fr. Francisco Roxano, another Dominican, was a pioneer in the Cagayan valley, teaching the people better methods of weaving and plowing after the European fashion, as well as of making hats, in which he was most expert. Fr. Francisco de Vega developed the agriculture in the valley and caused the setting out of fiber plants in order to develop the economic wealth of the country.

Fr. Francisco de Borja introduced the mulberry tree and silk worms as well as indigo. Fr. Miguel Vazquez introduced in Nueva Vizcaya and the mountains of Cagayan the planting of potatoes and beans. These good fathers combined the practical and the scientific, in their moments of leisure writing the results of their experiments.

Fr. Rosa made a reputation in mathematics with his "*Las integrales Eulerianas.*" It should also be mentioned that the Department of Mathematics of the University of the Philippines and the University of Sto. Tomas are doing research work in advanced mathematics most of which have been printed in the "University of the Philippines Natural and Applied Science Bulletin" and the "Unitas" respectively.

Lay Bro. Fr. Juan del Pilar was a bricklayer by profession, for which reason he had been sent to execute some masonry construction work in Spain as well as in the Philippines. In Manila be devoted himself with great tenacity to the study of mathematics and of architecture, wherein he excelled, and various imporant works within the church as well as in the public service of the government, were entrusted to his direction. In 1765 the Governor and Captain General, who was also President of the Real Audiencia, appeared before the Provincial Head of the Recollects to request him to authorize Fray Juan del Pilar to take charge of the reparation of the big Fortin bridge, an authority which was granted by this prelate, as may be gathered from one of his communications (May, 1765) to the Superior Head of the Archipelago (P. Marin, in his work" "*Ensayo de una sintesis etc.*")

It is interesting to note that Governor Pedro Manuel de Arandia enthusiastically encouraged the study of mathematics. From Fernando de Araya's dedication of his "*Conclusiones* *matematicas practicas, y especulativas defendidas en el principio del segundo año"* (*1758*), we gather that as a result of the progressive spirit shown by the king of Spain, Governor Manuel de Arandia introduced the study of mathematics in this country, a study that was bound to produce untold benefits for the Philippine Islands. Such was the enthusiastic appreciation it gave rise to that the author, Araya, could very eloquently say:

> From now on the commerce of the country will not have to resort to foreign lands for men who might ably guide and sail its trade galleons on the seas, nor for persons who would repair its forts, for cultured men who would know how to manage its artillery with intelligence and precision in case of invasion, or who would improve and beautify its military and civil establishments, and finally, for men who would benefit her with thousands of important inventions and services which for the good of the community are afforded wherever this noble faculty descended from the gods is not unknown.

CARTOGRAPHERS

The two Spanish officers Francisco Diaz Romero and Antonio de Chandia are the joint authors of a Philippine map, published in 1727 which, in the opinon of Mr. John Bach, "is distinguished for its painstaking draftsmanship of intrinsic features boldly pictured, its new and extensive geographical data proclaimed by a noteworthy multiplication of names and its descriptive notes of a maritime and political nature which testify to an unusual advance in this respect."

Complying with orders received from Madrid and with instructions issued by the Governor of the Philippine Islands, Rev. Pedro Murillo Velarde, S. J., prepared and published, in 1734, a map of the Philippine Islands, "That won widespread admiration and which for more than a century served as the basis for subsequent maps by European geographers." The chart may be rightly entitled hydrographic, (1) because it shows various sailing routes, as from Manila to New Spain via the San Bernardino Strait and via Cape Bojeador and from Manila to Spain in a south-westerly direction; (2) because it points out a number of anchorages and various outlying shoals with a remarkable completeness and accuracy in the names of coastal towns. Beautiful compass-roses symmetrically arranged in a large circle help to determine the direction or azimuth of the towns or places; the picture of the triumphant ship *Victoria*, the drawing of Saint Francis Xavier and of a crab in the act of bringing up from the briny deep the holy cross that the Saint had dropped overboard, the variety of pictures of Spanish galleons, Chinese junks, and Moro vintas, give to the map an aspect of prosperous commerce and intelligent navigation.

In the "*Chronicas de la Apostolica Provincia de San Gregorio, por Juan Francisco de San Antonio*", says Mr. Bach, "we find Velarde's own account of his preparation of this map, from which the following is quoted:

> And in the year 1733 an order came from Our Catholic Monarch that a map be made of these Islands, and the same having been entrusted to my care, it saw the light of publicity in the year '34. In it I put all the pueblos, points, inlets, ports, shoals, reefs, courses, sailing directions, rivers, forts, and distances, as far as was possible in so difficult a matter and within the scale. And in a description of a few lines, and in the figures in the margin, as in Egyptian hieroglyphics, I relate the most memorable things therein contained, as extensively as can be done in such few words and figures, and if anyone deems this boasting, let him undertake the work himself and he will see that it is more difficult to handle the pen and do this work, than to stand by and criticize it.

SCIENTIFIC EXPEDITION

The Malaspina expedition under the leadership of Captain Alejandro Malaspina, on a five year cruise of the world with the scientific purpose of collecting specimens of botany and zoology and studying the navigation, meteorology and hydrography of the various oceans is one of the outstanding scientific achievements of the pre-American régime. Dr. Elmer D. Merrill, former Director of the Bureau of Science, states that "the expedition was the most thoroughly equipped one of its kind up to that date" and that "it is doubtful if any similar expedition had previously been dispatched by any nation, with the same objects in view." In their scientific circumnavigation of the world, the corvettes *Atrevida* and *Descubierta* called at the Marianas and Philippines in the beginning of 1792. Astronomical, meteorological, magnetic, hydrographic and gravity observations were made in several places to fix the position of points and improve the hydrographic charts. This expedition left Cadiz, Spain, on July 30, 1789. "The result of the Malaspina Exploration", states Mr. John Bach," was a general chart of the Archipelago, published by the "*Dirección Hidrographia en Madrid, 1808,*" which constitutes the first nautical chart of the Philippine Islands based on modern survey methods and equipment. This chart superseded that of Murillo Velarde."

The Jesuits developed the cultivation of sugar and in 1786 there were exported 860 arobas of sugar from the lands that had been cultivated under their supervision before their suppression. In 1789 there were exported to India and China some forty or fifty thousand picos.

MEDICAL SCIENCE IN STO. TOMAS UNIVERSITY

There was a plan to introduce the teaching of medicine in 1682 and afterwards in 1785 in the University of Sto. Tomas, but it was not realized until 1872 after the efforts of Moret to secularize the teaching in the Islands. The ecclesiastical authorities transferred to the Dominicans for the establishment of classes of Medicine and Pharmacy the administration and income of the Colegio de San Jose, which had been founded by Esteban Rodriguez de Figueroa and had been administered by the Society of Jesus up to the time of the expulsion of the Jesuits from the Archipelago. From the time of the suppression of the Jesuits until the opening of the College of Medicine and Pharmacy, the College of San Jose was administered by secular priests. It was decided by the Holy See in 1911 that the Colegio de San Jose should be administered again by the Jesuits in compliance with the will of the founder, as a national seminary of the Philippines.

The study of medicine was very ancient in the Islands, but its teaching was deficient in its late start. There were few laboratories and very little apparatus for the use of the students. Microscopes were not employed but instead drawings were used. Students gained practical experience by diagnosing the patients in their beds in the hospital wards in the presence of their professors. Operations were performed by professors in the view of students but they rarely gave importance to operations. The examination for the degree was as thorough and as difficult as in the branch of law and, like this, was composed of exercises, one in theory and the other in practice.

But in about the last decade of the Spanish régime improvements in the study of medicine and pharmacy had been made. *The Memoria del Profesorado de Medicina y Farmacia, 1889,* prepared by the professors of medicine and pharmacy of this university explains that the faculty of medicine and pharmacy founded in 1870 literally copied the plan of study of the different universities of the Spanish peninsula from which they have not swerved a bit and whatever improvements were introduced in Spain had been immediately transmitted to this institution. The plan of study and the laboratories palpably demonstrate the truth of this statement. Its rich library of medicine and pharmacy had been placed at the disposal of the public where one could find materials on various subjects, such as the *Atlas of Bourgery in Anatomy*, the elegant editions of *Flora of the Philippines*, the *Clinica iconografica de las enfermedades of Olavide*, and all scientific monographs published during the last years which have been placed on its shelves.

In the year 1895 a college of sciences (*Facultad de Ciencias*) was established in this university. The course was introduced from Madrid after the necessary modifications had been made to meet local conditions, and was limited to the exact sciences or mathematics with some of their applications to special sciences. It was gradually expanded until it became in 1907 its college of Civil Engineering.

On April 7, 1875 when the "El Museo Ultramarino" was organized in Spain by the government with a collection of museum specimens coming from Cuba, Puerto Rico, and the Philippines, the professor of chemistry of this university, Don Ramon Botet, was designated by the Rector of this famous institution to be in charge of the vast collection.

HOSPITALS, CENTER OF MEDICAL SCIENCE

The hospitals in the Philippines naturally had to become the center of medical science especially at the time when the College of Medicine was not yet established in this archipelago. The first *general hospital* in the Far East was founded in Manila in 1596 by the sisterhood of Sta. Misericordia or Holy Mercy and it is now known as the Hospital of San Juan de Dios.

The earliest hospital, however, established in Manila was founded in 1575 by Governor Francisco de Sande for the Spanish soldiers. Among the others that were later founded are: Hospital of Naga, 1586; San Lazaro Hospital, 1587; the Hospital for the Natives and the Hospital for the Spaniards, 1588; Hospital of Los Baños, Laguna, 1590; Hospital of Cavite or the Holy Ghost Hospital, 1591; Hospital of Antipolo, 1602; Hospital of Sangleys or Chinese, 1630; Hospital of San Gabriel, Binondo, 1724;

Hospital of Zamboanga, 1742; Hospital of Cebu for lepers, 1850; Hospital of Nueva Caceres, 1872. To this the Hospicio de San Jose although primarily an asylum should be added because it served as a sort of psychopathic hospital.

PHARMACEUTICAL SCIENCE

Pharmacy was taught along with medicine in the old College of San Jose. It was likewise taught along with medicine in the University of Sto. Tomas in 1872. But it was a branch in which the Filipinos had made great advance even before the coming of the Spaniards for in this the native priests and priestesses were able and skilled. The mestizo priests of Parañaque, Rizal, Fr. Ignacio de Mercado, an Augustinian of the latter half of the 17th century, was the first to show interest in medicinal botany and his studies of medicinal plants are still useful and used. At that time the Filipinos were herbalists while the Europeans, in an age of alchemy, were using minerals. The chief development in instructions in pharmacy has come through the still-living, eminent scientist Dr. Leon Ma. Guerrero, whose honorary degree from the University of the Philippines honored that Filipino institution. In chemistry, the foremost name is of Anacleto del Rosario who paid great attention to mineral springs, sulphur and other products characteristic of a volcanic land such as the Philippines.

The Historical Research and Markers Committee created by the Governor-General in his Executive Order No. 451, dated October 23, 1933, made the following inscription on the oldest European drug Store established in this archipelago, in the City of Manila:

BOTICA BOIE
DR. LORENZO NEGRAO
SPANISH PHYSICIAN AND
PHARMACIST ESTABLISHED IN
MANILA IN 1830 A COMMERCIAL
PHARMACY LATER KNOWN AS BOIE
& SCHADENBERG AND CONTINUED
INTO MODERN TIMES AS THE BOTICA
BOIE PHILIPPINE-AMERICAN
DRUG COMPANY
1934

This is the forerunner of the many drug stores that are now found in all regions and towns of this archipelago.

DENTISTRY

One of the pioneer Filipinos in dentistry, long before the Americans came, was the patriot Dr. Bonifacio Arevalo of Quiapo, who seemed to have learned his profession mostly from the Americans from Hongkong who visited Manila. He succeeded so well that he became the private physician of Governor Blanco, who saved his life in 1896. He was also a sculptor. He was a patriot and before the first American Commission vindicated the cause of the Philippines in their tribulations and sufferings.

"Dentistry",* to quote from Mr. Amado R. Dizon, "was, however, practiced in the Philippines in the same manner as in other parts of the globe during the medieval ages. According to reliable sources and data I obtained from several authorities, the earliest practice in the science of dentistry began way back in the year 1870. In or about that year two French dentists found their way to Manila, where they immediately engaged in the profession of dentistry. Their work consisted mainly in making artificial dentures and extraction of wobbling teeth of badly broken down roots with crude pincers and trunkeys, the same instruments which have evolved into the forceps used nowadays in the practice. But the use of dental vulcanite for artificial denture which was discovered in 1851 was already known.

"About the middle of 1840 Harris, Halden and others organized and conducted the first Dental College in Baltimore, Maryland. They started to invest in the line with a personality distinctly of their own and making it a liberal and organized profession. It was then generally practiced as a mere craft, the practitioner being very careful to keep his knowledge to himself, passing it only to such persons as suited his fancy or convenience. It was, therefore, very lucky that one of the two Frenchmen who practiced in Manila, by the name of Fertri, admitted Juan Arevalo, better known as Captain Chengcheng, who was a sculptor by profession and an artist of some renown. After a short period Captain Chengcheng acquitted himself in his new trade with satisfactory ability and eventually became the first Filipino dental practitioner. He then attracted a great deal of attention on account of a full set of upper and lower dentures which he carved out of ivory.

"However, Captain Chengcheng passed his craft or the new trade on to his nephew, the late Bonifacio Arevalo and to his daughter Catalina Arevalo, the first lady dentist, who is still in practice in the province of Pangasinan. The Arevalos practiced contemporaneously with three Spaniards, namely, Mr. and Mrs. Farines and Mr. Martinez. But during that time, the extraction of the teeth was so severe and radical that it made the patient see the whole constellation of the stars in broad daylight. Aside from extraction, they constructed artificial dentures such as those for reparative or restorative dental operations, as gold crown, bridgework and filling of gold, cement and silver. These dental pioneers did not follow the famous Black's technique for cavity preparations or the Johnson method of making gold filling, but depended solely on their natural skill and artistic instinct. It is very remarkable however, that though handicapped by the lack or absence of modern knowledge, handy and refined instruments and electrical apparatus, the first dental practitioners in the Philippines, could have performed such marvelous, and incredible exhibits that could be favorably compared with modern achievements." The Bulletin of San Juan de Dios Hospital, May 1933, p. 152.

VETERINARY SCIENCE

Veterinary science has been but recently introduced in the Philippines. According to prevalent ideas, in comparison with humans, animals were not important and were not likely to receive much attention. There were, however, a few Spanish veterinarians who came to the Philippines to serve the Spanish army during the early days of the Spanish régime. They were the ones that introduced veterinary science here.

DEVELOPMENT OF SCIENTIFIC AGRICULTURE

Governor-General José Basco y Vargas (1778-1787) showed a decided desire to develop agriculture on a large scale. He granted rewards to those who were conspicuous for their success in agriculture. He obtained seeds from other countries and caused more than 4,000 mulberry trees to be planted in Camarines Sur for feeding silkworms. He realized even then that science must lend its aid in agricultural undertaking if agriculture is to succeed.

In 1785 the *"Compañia de Filipinas"* obtained a monopoly of the trade between Spain and her colonies. Its principal object was to acquire control of the produce of the colony on a grand scale. Attempts were then made to develop the cultivation of cotton, indigo, coffee, cacao, cinnamon, peppers, cloves, pigments and the mulbery tree for the growing of the silkworms, and other products of the soil. For various reasons this company failed.

In 1781 the *"Sociedad Económica de Amigos del País"* was established. Dean Conrado Benitez in his "Philippine Progress Prior to 1898" says, "Basco's idea was to make the Philippines economically self-sufficing, and not dependent on Mexico. For this reason, he encouraged the development of agriculture by offering prizes to those who should excell in the cultivation of cotton, spices, sugar and silk; those who should open up the various kinds of mines; for those who invented useful things, and those who excelled in the arts and sciences. Likewise, he issued circulars and pamphlets explaining the method of cultivating the different Philippine crops. In order to get the community's cooperation in carrying out his economic plan, he induced the King to issue a decree establishing the Economic Society. In spite of serious opposition on the part of many, the society was auspiciously inaugurated in 1782. It seemed, however, as if Basco's ideas were too advanced for his time, for the society was feeble. A memoir published by the Society, and containing a list of its achievements, shows its activity to have consisted of discussions of economic subjects; the publication of pamphlets dealing with the cultivation of coffee, sugar, indigo, silk, gutta-percha, hemp, cacao, and other plants; with making cloths and dyes, inventing hemp-stripping machines, and contributing other useful things to agriculture; and the introduction of agricultural implements of various kinds from the United States. The Society lived for over a century, till 1890. Another means resorted to by Basco to free the Philippines from its dependence on Mexico was the establishment of the tobacco monopoly by the Government. This proved to be a good source of revenue, and, at the same time, was instrumental in bringing into cultivation large tracts of land. However, the evils attending it were many; the abuses of the Government officials in enforcing the regulations, and in trying to make profits for themselves; the lack of incentive on the part of the producer to improve the quality of his tobacco; the existence of smuggling and bribery, and the poverty of the farmer; all these were attributed to the tobacco monopoly."

Several royal decrees were issued and promulgated by the Spanish Government relative to the development of agriculture in the Philippines. On July 2, 1899, the School of Agriculture in Manila which was created by royal decree of November 29, 1887, was opened. Its objects were as follows: "The theoretical and practical education of skilled farmers, the education of overseers, the promotion of agricultural development in the Philippines by means of observation, experiment, and investigation."

Modern farms were established in the town of La Carlota and in the town of San Pedro de Magalang, Pampanga. Agricultural stations were established in Albay, Isabela, Iloilo, Ilocos Sur, Cebu, Leyte, Mindanao and Sulu. Owing to various causes these agricultural stations, however, have not been a great success. In 1892, there was ordered the publication of a periodical entitled *"Boletin oficial agricola de Filipinas"* (1894) to contain a record of the work accomplished in these agricultural stations and establishments. This publication, together with the other publication entitled *"Boletin de la Real Sociedad Economica Filipina de Amigos del País"* (1882) contained many scientific treatises on Philippine agriculture which our present college-trained agriculturists should not fail to read.

ELEMENTARY SCIENCE STUDIED

The following colleges and secondary schools during the Spanish régime gave courses in elementary science, embracing the principles of physics, natural history (biology) and higher mathematics: University of Sto. Tomas, San Juan de Letran College, Ateneo Municipal de Manila, private colleges in Dagupan (San Alberto Magno), Vigan, under the Dominican friars; private colleges in Jaro and Nueva Caceres, under the Paulist; private colleges in Bacolod, under the Recollects. Chemistry was given in the University of Sto. Tomas and other scientific subjects like advanced physics, zoology and botany. There were forty-four private Latin colleges in the provinces and twenty-five in the City of Manila under secular priests. The following theological seminaries and other schools must likewise be added: Seminary of the Jesuit Fathers in Manila, San Vicente de Paul in Manila, Cebu, Nueva Caceres and Jaro; Seminary of the Augustinians in Vigan; Artillery School, Naval Academy, Nautical School, School of Commercial Accounting, and School of Practical Telegraphy. "The Filipinos, as students of science", a famous Spanish author says, "have shown good ability as chemists and at least one was in a fair way to become distinguished as a botanist when his career was cut short by death."

MUNICIPAL LABORATORY

By a Government decree of September 13, 1887, which was subsequently published in the Gazette and in "La Opinion", a Municipal Laboratory was created under the supervision and vigilance of the government of the province of Manila and of the "*Inspección de la Dirección general*" of the Civil Administration of these Islands.

Article 12 of this decree provided that the staff or personnel of this office should consist of a Chief or Director of the Laboratory and two employees charged with the duty of helping the Director in his work or functions, and besides one was to serve as janitor and the other as messenger. In 1888, Anacleto del Rosario became, by competitive examination, Director of this Laboratory. In this Laboratory many analytical works were done by him such as the analysis of food, drugs, etc. This laboratory mainly dedicated its resources to chemical and bacteriological analysis in connection with the office of the health service.

INTRODUCTION OF SMALLPOX VACCINATION

Smallpox vaccination was introduced into the Philippines on April 15, 1805, by order of King Charles IV of Bourbon. In the Monthly Bulletin of the Philippine Health Service of April 1927, Dr. José P. Bantug states that the "Story of its introduction in the Philippines reads like an epic poem worthy of the proudest years of Spain when the scepter of Castille held sway over a vast colonial empire, where it was truly said the sun never set." Dr. Bantug further states:

> With wisdom and foresight and moved undoubtedly by the tales of suffering that the disease was causing in the American continent as well as in the far off Philippines, Charles IV (influenced by Amar and Balmis, royal household physicians) was led to secure for his subjects overseas the inestimable blessings of vaccination, while the rest of Europe was still wrangling about the merits of the new discovery. Under the leadership of Dr. Francisco Xavier de Balmis, an elaborate expedition was fitted out to introduce vaccination into the Colonies. Commanded by Frigate Lieutenant D. Pedro del Basco, the corvette *Maria Pita* set sail from the port of La Coruña in Northern Spain, on November 30, 1803, in compliance with a Royal

Decree of September 1st of the same year. There were seven physicians on board besides the necessary number of nurses and attendants, under the direction of Balmis, and 27 children, with their mothers or nurses, two of whom were inoculated shortly before, and the rest at stated regular intervals, in the course of the navigation, the only means then known to preserve the virus in the freshest state possible and spread it everywhere. Each of these children, says Repiede, and others who were utilized for this purpose were adopted by Charles IV as particular children of the fatherland, and the Government took charge of their maintenance and education until they were able to take care of themselves.

On this errand of mercy, Balmis and his companions tarried in the Americas for nearly two years, arriving in Manila on board the frigate *Magallanes* on April 15, 1805, and had the glory of depositing in these Islands that inexhaustible source of health, prosperity, and increase of population.

The Filipinos, not unmindful of the benefits received, erected a life-sized statue of Charles IV on the Plaza del Palacio, now Plaza McKinley, Manila, on which may be read the following inscriptions:

> To King Charles IV of Bourbon, out of gratitude for the beneficent gift of vaccination. The inhabitants of the Philippine Islands. The Filipinos erected the statue in the year MDCCCXIV.
>
> The Ayuntamiento of Manila built this fountain in the year MDCCCLXXXVI.

This statue was ordered made in Mexico by Governor-General Rafael Maria Aguilar, late in 1805, but it was decided to make the bronze cast here as the ₱6,000 needed to cover the expenses could not be advanced by the City of Manila. It was, therefore, made in the Ordinance Department of Fort Santiago, under the technical direction of Colonel Ambrosio Casas of the Royal Prince Battalion, a native of Binondo. The statue was finished in 1808, two years after the work was commenced. The goldsmiths of Sta. Cruz and Ermita gilded it at a cost of ₱3,000. It appears, however, that the statue was not formally dedicated until 1824.

The following day, after the arrival of the expedition, the Commission commenced work. The first to be inoculated were the Governor-General's own children, in order to dispel any misconception that the people might entertain against this newly introduced measure. Within a few days a large number of children in the city and environs were vaccinated.

As a direct offshoot of this royal gift, the Central Institute of Vaccination was created with headquarters in Manila, the specific duty of which was to preserve and propagate the virus. The virus was passed from arm to arm every nine days among susceptible children, later in young calves, and then preserved in a more or less natural state between two pieces of thick smooth glass, 1 inch square, sealed with paraffin or wax or kept in capillary tubes and in this way was transported to the provinces.

The Central Institute of Vaccination was composed of:

H. E. the Governor-General, as Chairman
E. E. The Archbishop of Manila
The Lord Mayor of the City
The City Attorney
The Provincial of the Augustinian Order
The Provincial of the Franciscan Order
The Provincial of the Dominican Order
The Provincial of the Recollect Order
The Chief Physician of the Institute
The Assistant Chief Physician of the Institute, and
The Physician Secretary.

District Health Officers (medicos titulares) were entrusted with the general sanitation in the provinces, but there were *vacunadores titulares* in every provincial capital, numbering 122 in all at the end of 1897, with salaries ranging from 75 to 100 pesetas per month in the provinces of the third class and 150 pesetas in the first class, and as many private ones as desired to practice it, besides the *vacunadorcillos*, who were stationed one in each municipality.

The 27 children who made the heroic sacrifice on behalf of science were rewarded with a liberal education at the king's charge, a duty King Charles' decree laid upon his various governors. To convey the vaccine to the various islands of the archipelago, other children were used as had been those on the ship from Spain. At the end of 1897 there were 122 vaccinators scattered over the Philippines under the central vaccination office in Manila in charge of a first medical director, a second physician, a temporary one and three orderlies.

In speaking on the subject, Mr. Walter Robb, Chairman of the Committee on Historical Research and Markers Committee says:

It will be recalled that at that time, medical science was very young. Rush Medical, at Philadelphia, founded by Franklin, was, unless memory is at fault, the only medical college in the United States. The Quaker Johns Hopkins, who at his death was to found the great school bearing his name, was yet a lad; his family, and other Quakers of the South who stood with them in the schism that broke their ranks, were just manumitting their black slaves. 'The Ship of the Children strikes me as a capital yarn, doubly so because it is true. Without doubt they were orphans. Nurses, Sisters of Mercy, were aboard to care for them, and doctors, to keep up the inoculations.

CHOLERA

Scientific investigations were likewise made to determine the cause and origin of cholera, which decimated the population at different periods of its history. Possibly some of the oldest treatises on the subject were: Fernandez's (Gines) *Colera* *morbo* (1821); Keraudren (P. F.) *Memoria de la colera morbo de la Yndia y su metodo curativo* (1831); Benoit (Carlos Luis) *Observaciones sobre el colera morbo espasmodico* (1832); *Cartilla Higienica y de disenfección; con los precausiones que deben tomarse en el caso de una invasión colerica,"* (Manila, Cofre y Comp. 1888).

It can be said that the periodic appearance of this epidemic in the Philippines was never checked or prevented up to the advent of the new régime. The first occurrence of this epidemic of which we have a record, took place in 1820 when all authorities of Manila and the religious orders had to pray to heaven to combat the epidemic. It was the belief of some of the natives that the foreigners had poisoned the water that caused this scourge. Consequently, the unruly mob assassinated the French and English residents of Manila to the number of twenty-eight, attacking the Chinese afterwards. Upon investigation, it was discovered that several foreigners had collected biological specimens preserved in glasses with alcohol which was considered to be the cause of cholera. The Filipino lawyer, D. Jose M. Jugo, investigated and reported on the massacre which was made the subject of complaint to Spain by Russia and other European powers.

This epidemic reappeared in 1862 together with flood, cyclones, fire and locusts, during the régime of Governor Rafael Echague. In 1882 it again took possession of Manila and Zamboanga where the people were nearly exterminated. Ghastly are the descriptions given by those who are still living today and who witnessed the number of people that died every day. People died in such a number that they had to be carried by the *carreton* to the cemetery like banana trunks, one heaped above the other.

LEPROSY

The scientific treatment of leprosy during the Spanish régime was also taken care of. As to the origin of the disease in this country, Dr. Luis E. Guerrero explains:

> Leprosy is said to have been imported into the Philippines by the Japanese in 1633 but it is very probable that such importation must have occurred at a much earlier date if we take into account that these islands were already engaged in active commercial relations with China and Japan even before the arrival of the Spaniards. The possibility of its introduction from Spain during the period of

Spanish occupation must also be considered, for in those days leprosy in Spain and Europe was still in its stage of greatest development. or at least only in its early decline.

During the last years of the Spanish Government, Dr. Rogel, a district health officer of the islands of Cebu and Bohol in 1892 and 1893, estimated the total number of lepers in all the Visayan Islands to be about 10,000.

In 1902, four years after the beginning of American occupation, the health authorities compiled a census of all lepers found all over the Islands and arrived at the conclusion that their total number did not exceed 10,000, and that perhaps the total of 30,000 claimed by the Franciscan Fathers who from time immemorial had charge of all the leprosaria in the Islands, was unfounded and far from the truth." (F. E. A. of Tropical Medicine transactions of the Fifth Biennial Congress held at Singapore, 1923, pp. 392-3.)

In his other treatise entitled "Topographical Distribution of Leprosy in the Philippines", Dr. Guerrero explains:

Whatever the case, the fact remains that leprosy had existed in the Philippines long before the coming of the Spaniards. Legaspi arrived at Cebu in the year 1565 and he established and founded the City of Manila in 1570, which place was taken over by Martin de Goiti the year before. Eight years afterwards, or in 1578, a Franciscan lay brother by the name of Fr. Juan Clemente founded in the City of Manila the first Leper Hospital for the purpose of confining in an asylum the large number of lepers that usually came to the doors of the San Franciscan Church, seeking alms and relief for their ailments.

This hospital was first known as the Hospital of Santa Ana, and was really established not only for lepers alone, but for general cases as well. Later, the name of this hospital was changed to Hospital for Natives to distinguish it from another recently opened Hospital for the Spaniards. In 1632, owing to the arrival of 130 Christian Japanese lepers deported to this country by the Emperor of Japan, supposedly for refusing to be renegade to their faith, and who were confined to the Hospital for Natives, this institution was named the Hospital de San Lazaro, which name it has retained to the present date.

Leprosy in the Philippines, therefore, cannot be said to have originated from these 150 Japanese lepers, as some historians like Foreman would have us believe; for those unfortunate victims immediately upon their arrival were assigned to the Hospital de San Lazaro, and remained in it for the rest of their lives.

In 1586, another leper hospital was established, this one in Nueva Caceres, 13 years after Juan de Salcedo first explored Camarines Sur and founded the Villa de Santiago de Libon. During the time of Governor de Sande, Captain Pedro Chavez founded the City of Nueva Caceres, at present known as Naga. Historians tell us that "the idea of a hospital in Nueva Caceres antedated even the establishment of the city. Even before the village of Naga was converted into an actual city and ecclesiastical diocese, the Franciscan missionary fathers, who had been responsible for the foundation of the native and Spanish Hospitals in Manila, had extended their Christian charity to that part of the country and established another similar hospital in Naga, which was then the residence of many Spaniards and was a central town much visited by the natives of the surrounding provinces. (Transactions of the Sixth Congress, Tokyo, 1925, vol. II, pp. 660-663. Far Eastern Association of Tropical Medicine, Tokyo, Waibunsha Printing Co., Kagomachi, Koishikawa-ku, 1926).

Possibly one of the earliest historical data in connection with leprosy was that mentioned by Father Collin in his "*Labor Evangelica en Filipinas*" wherein he mentioned a leprous infidel who came to the town of Alang-Alang, Leyte in about 1601 in order to be baptized into the Christian faith. Father Collin states:

> It was a remarkable case, that, of the conversion of an old man, who hurriedly came one afternoon alone by sea. Although he hardly had hands as he was afflicted with leprosy, he was able to row in a very small banca. Upon reaching our house between the towns of Alang-Alang and Dalac, Leyte, the first thing he asked was that for the love of God, he be baptized and be pitied because he was very old and sick. His legs were almost eaten up by the disease, also. He said that for a long time he had desired to be a Christian because a Spaniard had told him that those who were not Christians would go to hell, but much as he wanted to be converted, he was unable to do so as he could not come before. The priest kept him for two days catechizing him and preparing him for conversion. After predisposing him for conversion according to his capacity, the priest baptized him; gave him alms and ordered the datos of the town to take good care of the poor old man. It was a singular source of consolation for a man so sick, without hands or feet, to have been able to come to town. Undoubtedly our Lord exceptionally helped him and his Guardian Angel guided his little banca that he might not get drowned or eaten by crocodiles.

In 1852 Father Pablo Klein prescribed the following scientific treatment for those afflicted with leprosy as found in his "*Remedios fáciles para diferentes enfermedades*":

> *"Lavarla con agua en que haya estado remojandose algún cuerpo muerto, como sucede hallarse algún difunto en algún rio, o estero. Dénsele baños con abstersivos, como son: apalla, salag-salag, saloquiqui, casanghan, malongay, macabuhay, manungal, lactang, lamparahan balocas, barogtoñgon, pañgaguason, capanatolot, corteza de molauin. Untura de azufre, salitre, ó tartaro, con zumo de limon, en que la corteza de limon se haya remojado; ó untura de aceite de lagartijas; tabili, butique. Gaste cangilon de venado raspado, tomando mañana y tarde peso de un real."*

Possibly the earliest publication exclusively devoted to this subject of which we have a record in our Philippine bibliography in connection with leprosy in this Archipelago, is Pedro Robledo's *La Lepra en Filipinas,* a pamphlet published by the *"Correspondencia Medica"*, Madrid, 1883. The author wrote this in Vigan, Ilocos Sur, on May 18, 1882. He describes one of his methods of treating leprosy in this wise:

> *"Esta mujer, 50 años de edad, se sometió al tratamiento curativo, que usó por espacio de 17 meses. empezando por la "tintura de azufre" y "Madar", hasta que pude preparar la tintura del "indigo orientalis", de que ella misma me habló hacian uso los igorrotes de los montes de Lepanto (Luzon), para curar sus numerosas y asquerosas erupciones de la piel, y quienes por su mediación me la proporcionaron. Esta planta parece del mismo género y familia de la "indigofera tintórea," con la cual puede confundirse, si no se tiene en cuenta que es más alta, las flores y la raiz es más gruesa.*
>
> *Obtenida la tintura, empezó á hacer uso de ella en Enero de 1880, con cuyo tratamiento, no sólo consiguió andar con más soltura, sino que la afección herpética de los muslos, desapareció por completo, disminuyendo de una manera considerable las manchas y los tuberculos."*

Dr. Luis E. Guerrero, from whose two treatises on leprosy we have in this paper quoted at length, says that in Albay there is a tree that produces oil similar to chaulmoogra which the Filipinos used even in pre-Spanish days for the cure and treatment of leprosy.

INTERNATIONAL EXPOSITIONS

Before the American occupation began in 1898 the Philippines participated in several International Expositions held in different countries of the world: In London in 1859, Philadelphia in 1876, Amsterdam in 1882, Madrid in 1887, 1889 in Paris, Manila in 1895 (Exposición Regional). In these expositions many Philippine scientific specimens were exhibited. I consider it necessary to include a list of all those specimens herewith in order to give a comprehensive knowledge of the interest taken in science in this country in that era. It does not matter whether the exhibition of those scientific specimens kept us abreast of the latest advances in science or not. What is important is that a start was made and on this foundation it is possible to build safely a strong scientific structure. It is, however, unfortunate that we cannot find any list of the scientific treatises, books and publications included in those exhibits.

For the sake of brevity I shall merely confine myself to listing the scientific specimens exhibited at the Exposición Regional de Filipinas held in Manila in 1895, on the premises of the old Normal School, omitting those that have no relation to our subject.

1.er grupo: Orografia é hidrografia.—Descripciones, planos ó relieves de montes, cordilleras ó regiones montañosas.—Id. de cuencas hidrograficas.—Aplicaciones de estos estudios.—Fuentes naturales, aguas potables.—Hidrografia maritima; planos y estudios.—Estudios geograficos de regiones ó provincias de estas Islas.—Aguas minerales.—Descripciones y planos de los manantiales y regiones en que se encuentran.—Análisis de estas aguas, muestras de las mismas, aplicaciones terapeuticas, estadisticas de los resultados obtenidos en los tratamientos, comercio de las aguas minerales, sus precios, cantidades vendidas.—Balnearios.—Planos, construcciones, organización, régimen y tarifas de los mismos.—Estadisticas de concurrencia y de los resultados obtenidos.

2.o grupo: Geología.—Descripciones memorias ó monografias geologicas.—Planos, cortes, dibujos ó relieves.—Muestrarios de rocas, minerales y fósiles que tengan por objeto ilustrar las memorias, planos ó cortes, ó que convenientemente clasificados sirvan para dar idea de una región del Archipelago.—Analisis quimicos y microscopicos de rocas minerales y fosiles.—Hidrografia interna: alumbramiento de aguas, pozos artesianos.—Vulcanologia; descripciones, planos relieves, dibujos y rocas de volcanes o regiones volcanicas.—Seismologia; estudios, estados, planos y curvas que se refieren á terremotos.—Aparatos de todas clases y metodos de estudios sistematicos.

3.o grupo: Antropologia, estudios etnograficos, craneologia.—Lenguaje y escritura de los habitantes de estas Islas no civilizados, religiones, ritos, costumbres.—Tatuages, armas, trages, habitaciones, idolos, utensilios domesticos.—Artes é industrias.

4.o grupo: Mineria.—Descripciones del vacimiento y explotación de canteras de todas clases.—Muestrarios de los productos brutos y elaborados.—Fabricación de la cal—Cales hidraulicas ó cementos.—Fabricación de pólvoras de regocijo.—Descripciones de criaderos metaliferos, de su yacimiento y explotación, proyectos, memorias planos, cortes y dibujos.—Muestrarios industriales de minerales de metálicos.—Analisis y ensayos docimasticos de minerales metálicos.—Preparación mecanica de las minas industriales.—Descripciones, proyectos, analisis, ensayos y laboreo de criaderos de carbon.—Muestrarios de carbon.—Preparación mecanica, o lavado de carbones.—Aprovechamiento de menudos.—Modelos o aparatos, maquinas y herramientas para el arranque, ventilación, alumbrado, extracción y transportes interior y exterior de los minerales metalicos y combustibles.—Modelos o aparatos y maquinas para la preparación mecanica o lavado de minerales metalicos y combustibles.—Estadistica minera; estados, producción precios de costo y de transporte mercados, comercio, etc.

—Comparación con los productos extranjeros o de las colonias proximas.

5.o grupo: Metalurgia.—Descripciones, memorias planos, cortes y dibujos de los procedimientos de beneficio de los minerales.—Fundiciones y procedimientos aplicables a los minerales de cobre filipino. Id. de los de hierro.—Id. de los de azufre.—Analisis y ensayos docimasticos de minerales y productos metalurgicos.—Muestrarios de minerales y productos metalurgicos.—Fundentes y combustibles empleados.—Analisis y muestras.—Productos obtenidos, en bruto o manufacturados.—Refundición de materiales y alcaciones.—Aplicaciones.—Productos elaborados.—Modelos y hornos; aparatos y herramientas empleados.—Estadistica, producción, precios, exportación é importación de metales en bruto y manufacturados.

6.o grupo: Meteorologia.—Memorias y estudios meteorologicos.—Cuadros y curvas relativas al mismo asunto.—Instrumentos meteorologicos:—Observatorios; meteorologicos: su organización, trabajos y publicaciones.—Estudios relativos á fenómenos magneticos.—Memorias o monografias relativas á fenomenos especiales.

SECCION 2a.

1.er grupo: Colecciones o ejemplares vivos, ó conservados por cualquier procedimiento, de animales utiles o perjudiciales.—Productos animales.—Pieles, cuernos, plumas, nidos, dientes, nacar, perlas, etc.

6.o grupo: Flora forestal.—Herbarios, dibujos, memorias, articulos y documentos de cualquier clase relativos á la flora forestal.

7.o grupo: Aprovechamientos forestales.—Colecciones de maderas, gomas, resinas, carbones, aceites, feculas, plantas textiles y tintóreas: sus productos y aplicaciones.

10. grupo: Plantas medicinales; sus propiedades, aplicaciones y principios activos á que se deben sus efectos medicinales.

SECCION 3a.

Agricultura

1.er grupo: Muestras de tierras propias para los diferentes cultivos de estas Islas.—Estudios relativos al clima, proyectos, planos y procedimientos de los desmontes, descuajes y returaciones; procedimientos, planos y memorias de saneamiento de terrenos y desecación de pantanos y marismas.

7.o grupo: Productos de horticultura, arboricultura y jardineria.

SECCION 4a.

Industria fabril y manufacturera

1.er grupo: Planos, memorias, aparatos o modelos de aparatos para el refino de azucar.—Fabricación de alcoholes, esencias y aceites.—Fabricas de arroz o pilanderias.—Fabricas de jarcia.—Muestrarios valorados de los productos de estas industrias, con expresión de las cantidades que pueden ofrecerse al mercado.

2.o grupo: Fabricación de ladrillos ordinarios, comprimidos, refractários, tejas, baldosas y atenores.—Tinajas, bangas, macetas y otras vasijas de barro ordinario o vidriado.—Cemento comprimido.

4.o grupo: Herreria y cerrajeria.—Productos valorados de estas industrias.

23 grupo: Fabricación de jabones; primeras materias, artefactos, procedimientos, productos, jabones duros, blandos y de tocador.

CONCLUSION

Such were the beginnings of science in the Philippines during the Spanish régime. We cannot, without qualification, boast of a very remarkable record, because the course of its progress has met with many difficult obstacles although it has emerged not without important achievements—achievements that are more than sufficient as a contribution from such a very small country with such limited facilities as was the Philippines.

Today, a Filipino heads the world-famous Philippine Bureau of Science, a number of Filipino scientists have earned recognition abroad by their distinguished contributions, and the future is bright because our people are becoming scientific-research-minded, while our Government is lending active support to the people's demand for research facilities. The part of science in the economic and industrial development of the country is recognized and our scientists are being given enthusiastic encouragement.

In this connection I would suggest that considerations of climate as factors of efficiency in scientific investigations, study and inventions be not overlooked in our attempt to accelerate our advancement on the scientific side. There seems to me some merit in the idea that our Government scientific laboratories should be located in those places where experiments could be performed with the least possible physical and mental strain and without the handicap of the warm climate such as prevails in Manila. We should bear in mind that one of the great handicaps of inventors and scientists in tropical countries is a warm climate, which is not conducive to continuous mental effort. As a matter of fact scientists seek to escape it as much as possible in their laboratory work. In America and Europe as well as in Japan scientists generally work only during cool day and rest during the summer. They have long ago realized that climate is a great factor in scientific research which either serves as a handicap or a blessing. Hence we might say that climate is essentially civilization and civilization climate.

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PIONEERS IN PHILIPPINE SCIENCE

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Pioneers are persons. Other papers in this collection deal with the beginnings of medicine, chemistry, natural history, etc. in our Islands; but my distinctive theme is men. I seem also to be limited in time to the American epoch, and bound by today's meaning of the term pioneer, which is reasonably restricted to the early part of this epoch. After some more years, every one of us active today will be shifted to the class of pioneers. Also, I am limited closely by the space allowed me. Minor participants in great events acquire historical interest. The name of the janitor of the Government Laboratory was more than once reported by the Philippine Commission to the Secretary of War. My space limits me to the eminent few. Finally, on the principle that history belongs to those missed by its eraser, I must decline to assign a place to my colleagues still present here. It is enough to have to presume to locate in history my friends gone from the field but still active elsewhere: Sherman, McGregor, Banks, Elmer, Beyer and Curran, to mention only six, were certainly worthy pioneers, but they are still too close to me for focus, let alone perspective.

First among the pioneers there must be placed three men who may be lost from the record of discoveries because their own scientific publications were of minor importance, but who exercised an influence on the development of science, greater than is often within the power of a scientist.

Dean C. Worcester was the only American who brought to his service here any previous knowledge of local science and industry. As a member of the Philippine Commission and Secretary of the Interior, science and industry were his province. He selected the technical men to develop every field of science except medicine, where also his influence was very great, and regularly, out of a governmental revenue which was a small fraction of that which frightens us today by its meagerness, he managed to get funds to support their work. The amount of this support would look pitifully little now; but it was remarkable as a proportion of the total revenue. No other factor is nearly so responsible for the development of science here as Worcester's steady provision of these funds. With all this credit to Worcester, it is only fair to remember that the Commission had another member, Dr. T. H. Pardo de Tavera, better informed in some, and interested in almost every field of human knowledge, whose interest supported Worcester's. Worcester's though, was always the dependable force. There may not be one of us but remembers him most vividly for his verbal bludgeons, or who fails to remember that it was his steady support which kept our work alive.

Captain George P. Ahern, U. S. Army, had been military instructor in the Montana State College, where he had fortified his interest in forestry with some technical education. When the army found itself administering the Philippines, responsibility for forestry fell naturally upon Ahern, and it was left with him in the civil government. Forestry as a bureau is the oldest in our Government. Unless it be a book on Philippine trees, published in 1902, prepared with the help of men in the forest service under Spain, he never was personally active in research. He had, however, a remarkable ability to recognize and secure the men to advance science under his administration. The man who assembled the first full faculty of the Forest School has a secure place among the early promoters of science.

Perfectly trained in America and in Europe, in both chemistry and medicine, bound by a curious law to carry on original investigations, Paul C. Freer was the third pioneer whose personal output of research here was inconsiderable. Nevertheless his place as leader in the establishment of science here is secure. Director of Science officially, he was personally the leader of scientists. His interests had no limits. His appreciation of good work in almost any field of science was of the real kind which depends not upon friendly enthusiasm but upon understanding of the soundness of the work. In spite of this strictly intellectual attitude his soundness earned him the enthusiastic backing of his staff. And if, with his support, they performed the investigations, his, personally, was the final service without which their work would have remained unknown. He brought it before the world through the Philippine Journal of Science. His finest and fittest monument is not the building which makes so good a picture, but that journal.

First place among the men active in actual research must belong to Richard P. Strong. He came to the Islands in the Army as an assistant surgeon, and in 1899 was appointed by the Secretary of War as chairman of a board for the investigation of tropical diseases in the Philippines. With the establishment of the Government Laboratories, he became director of the biological laboratory, where he surrounded himself with men like Napoleon's marshals. The brightest of the bright pages of the history of Philippine Science will be that of the conquest of disease. In this Strong was the leader of research with a more than worthy second and successor in W. E. Musgrave. A very distinguished administrator, Victor G. Heiser, gave direct effect in human life and health to the discoveries of the investigators. Dr. Strong resigned his positions in the bureau of science and in the university after Freer's death, and has continued his distinguished career as professor of tropcial medicine at Harvard, with service in various lands where disease has most urgently demanded control. As a high official of the Rockefeller Foundation, Heiser is an occasional visitor to the Islands.

As must be done in other fields, so in medicine: the enumeration of all except the leaders, and the details as to the countless studies and publications are left to the historians of the specific sciences.

In chemistry, after Sherman, who is now in the Islands, and Bliss, who did not stay long, Herbert S. Walker worked first on the coconut, and then specialized on sugar, in which field he has since become a recognized expert, here and in Hawaii. Luck contributed to care in selection when Freer secured as chemists Gilbert N. Lewis and Raymond F. Bacon. The former was here only about a year, the latter long enough to establish his reputation. Both grew through reputation to eminence. When the novel exigency of chemical warfare suddenly demanded America's best talent, Bacon was called as head of the chemical service with the expeditionary forces, and Lewis as chief of the defense division. A. J. Cox succeeded Lewis here, in charge of inorganic chemistry, and remained in the service to succeed Freer as director of the bureau. Even preceding Cox in attention to industrial chemistry was George F. Richmond, who left our service to apply in Indo-China his discoveries as to the use of our materials for the manufacture of paper.

The Bureau of Mines was established in 1901, with Lieut. C. H. Burritt, U. S. Volunteer Cavalry, as director. He was succeeded in 1903 by H. D. McCaskey, presently absorbed with his bureau by the Bureau of Science. He published a number of papers and reports and saw research in geology and the administration of the mining industry through one reorganization. Among his productive associates were A. J. Eveland and Maurice Goodman. The foremost figure in Philippine geology, however, is Warren D. Smith, who came to the division of mines in 1905, and was its chief from 1907 to 1914. Since that time, he has been head of the department of geology in the University of Oregon, returning once on leave for two more years in the Philippines.

Although Otto Scheerer was in this field before him, the first of the official pioneers in ethnology was David P. Barrows, chief, 1901, of the Bureau of non-Christian tribes, later director of education, and eventually president of the University of California. His successor in charge of the ethnological survey, and the most productive pioneer in this field was Albert E. Jenks, now long chairman of the department of anthropology in the University of Minnesota. Merton L. Miller, N. M. Saleeby and Emerson Cristie also have honorable places in this roll. Otley Beyer is still active here. Beside being the official representative of all science, Mr. Worcester found time for some active participation in ethnology and in ornithology.

Except for this, Richard C. McGregor has had the field of ornithology to himself. Chas. S. Banks was likewise the lone pioneer in his field, joined later by Willie Schultze. Still later many men became active in the various branches of zoology. Major Edgar A. Mearns, U. S. Army, covered the field of natural history in his explorations, but wrote chiefly on mammals.

The first study of our snakes was by Dr. Thompson of the U. S. Navy, but the development of this field was by Laurence C. Griffin of the University of the Philippines.

Alvin J. Seale pioneered in the field of ichthyology, beginning in 1907, and developed it through the establishment of the Manila Aquarium. In later years, he established, and now superintends, the Steinhardt Aquarium, in San Francisco.

The reputation of Philippine science depends hardly more upon achievement in medicine than in descriptive botany, the latter under the leadership of Elmer D. Merrill, and very largely his personal work. Merrill came to the Islands in 1901, with the foundation of the Bureau of Agriculture, served for a time in the Bureau of Forestry also and in 1903 transferred to the Government Laboratories. From 1918 to 1924 he was director of science. He is now director-in-chief of the New York Botanic Garden, the place of prime eminence in his field in America. His output of publication, both of descriptions of new plants and of laborious interpretations of basic but half-intelligible early works on Oriental botany, established his work as the secure and ample foundation of all such future work in this region. Beside A. D. E. Elmer, still active here, he had at times a very able collaborator in C. B. Robinson. Early botanists of other kinds were H. N. Whitford and F. W. Foxworthy. Both came early in 1904, the former as a botanical collector, the latter as a teacher. Both went finally to Forestry, and were founders of the school of forestry in the College of Agriculture. Whitford developed tropical forest ecology; was later professor of tropical forestry at Yale; and is now one of the authorities on rubber. Foxworthy specialized on the identification of the kinds of wood, and on their uses; and later became Forest Research Officer in the Federated Malay States,—the only man not a British subject in the British civil service.

Space does not permit me to mention the many other real contributors to science, even of the earliest days, nor to carry the list farther in time, when the establishment of the University and the development of trained Filipinos introduced almost countless able men, who must receive appreciation in other papers of this compilation.

There is, however, one class, fortunately short, who must not be passed over in silence, our martyrs to science. Murdered, in the performance of their duty in the field, were:

H. M. ICKIS, of the Division of Mines, April 1, 1908.
H. D. EVERETT, Forester, May 11, 1908.
C. B. ROBINSON, Botanist, December, 5, 1913, in Amboyna.

I. DIVISION OF GOVERNMENT, FOREIGN AND EDUCATIONAL RELATIONS

PROMOTION OF SCIENCE BY THE PHILIPPINE GOVERNMENT

By VICTOR BUENCAMINO

Acting Under-Secretary of Agriculture and Commerce
Chairman, Division of Government, Foreign and Educational Relations

Scientific progress in the Philippines is one of the outstanding achievements of American occupation of the Islands—the product of American-Filipino cooperation. The work that has been accomplished constitutes a valuable contribution to science and is recognized as such by the scientific world. This progress and this recognition are due to the impulse that has been given by the Philippine government to scientific endeavor.

No portrayal of scientific progress here would be complete if no mention were made of the labors of those pioneers who must be given credit for laying down the foundation of scientific work in the Philippines. To the medical men of the American army goes the honor of starting such a foundation. As soon as Manila was occupied, the military government was impressed by the fact that the very unsatisfactory health and sanitary conditions of the Islands could be successfully coped with only by the establishment of laboratories. So in 1899 a small building situated on the banks of the Pasig River was commandeered and the first laboratory of the Philippines was established with First Lieutenant R. P. Strong of the U. S. Army in charge.

Research work was given impetus with the arrival about this time of the Johns Hopkins Hospital Commission for the study of Tropical Pathology, headed by Dr. Simon Flexner who later became the head of the Rockefeller Institute in New York. Shortly afterwards Drs. W. E. Musgrave and J. J. Curry were added to the staff of the laboratory.

The Bureau of Health, which was a military body, started a municipal laboratory in the latter part of 1899, with W. J. Calvert in charge. The two laboratories were closely associated in their work and studies, especially in connection with the first epidemic in the Philippines in 1909.

On September 1, 1900, the laboratory was moved to a more commodious building on Calle San Marcelino with the arrival of new equipment from the United States, and continued there until July, 1901. The first Army Board for the Study of Tropical Diseases was appointed at this time. With the return of Drs. Strong and Musgrave to the United States the laboratory was disbanded and the property removed to a small building in the hospital, where it remained without much use until 1902, when Dr. Musgrave returned and reopened the laboratory. Shortly thereafter, a second Army Board of Tropical Diseases was appointed. The institution became known as the Board of Health Laboratory or "Municipal Laboratory" and served as the connecting link of continuous laboratory investigation during the period between the abandonment of the Army "Pathological Laboratory" under Dr. Strong as director and the creation of the Bureau of Government Laboratories with Dr. Freer as head.

Actual scientific work by the Philippine government began with the establishment of civil government in 1901. Upon the initiative of Dean C. Worcester, the Secretary of the Interior, famous not only for his civil work in the Philippines but even more so for his work along scientific lines, the Bureau of Government Laboratories was established and legalized by Act 157 of the Philippine Commission in 1901.

The establishment of this Bureau was the beginning of a new research era in these Islands. Dr. Paul C. Freer, professor of Chemistry of the University of Michigan, was appointed its director on June 21, 1901, and arrived in Manila and assumed his duties on September 25, 1901. During his time he was accorded the position of dean of investigators and of his colleagues in the scientific field. Dr. R. P. Strong came back from America and became the director of the biological laboratory of the bureau and assumed his duties on January 1, 1902.

The Philippine government fully realized the importance of the work that the Bureau was doing, especially during the years that the country was suffering from frightful epidemics of rinderpest, hog cholera, surra, and from amoebic dysentery, dengue, malaria, cholera, and small pox. One of the largest expenditures of the civil government during this initiation period was the appropriation of a large sum to house the ever-expanding scientific work that was being done. A modern building designed especially for the promotion of science was built at a cost of ₱600,000. It was constructed mainly for laboratory work with its own power, light vacuum, steam and gas plants. The building was occupied on September 25, 1904.

Medical organizations were formed about this time to aid in promoting the health of the people and the sanitation of the country. They received sympathetic aid from the Philippine government. The Manila Medical Society was organized in 1901. The Philippine Islands Medical Association, which is a state branch of the American Medical Association, was organized in 1903. The Far Eastern Association of Tropical Medicine, which is an international association, was organized in Manila in March, 1908.

In 1905 the Philippine Government was considering whether it would be more advisable to set aside funds for the establishment of a medical school in the Philippines or to use the money to send to America a number of young Filipinos to study the profession of medicine to the end that eventually they would return to their country well equipped for the field of practice. The Government decided that greater advantages would accrue from the establishment of a medical school where its laboratories, teachers and hospitals would serve as an inspiration to others and as an impetus to the higher work of investigation and to science in general. A law appropriating the necessary funds was enacted by the Philippine Commission in December, 1905. A building was constructed and opened its doors to its first class in June, 1907. On the first of December, 1910, the Medical School was merged with the new government university and its title changed to College of Medicine and Surgery. This title was lately changed to College of Medicine.

The establishment of the medical school suggested the plan of erecting a government hospital. By the bond issued for public improvements the insular government found itself with funds and the requisite appropriation of ₱780,000 was made in August, 1907. This was the beginning of the Philippine General Hospital which every year since its organization has received generous support of the Philippine Government.

From time to time additions have been made to the original buildings and now the Philippine General Hospital has no peer in the Orient and is a monument to the ceaseless efforts of the Philippine Government to attend to the stricken as well as to promote science in the Islands.

The sending of pensionados to the United States has been one of the most valuable acts of the Philippine government for the promotion of science in the Philippines. Inspired by the example of Great Britain in creating the Rhodes scholarships which enabled Indian students to pursue studies in England and by the success achieved by Japan in sending government students to foreign countries, especially to the United States, the Philippine Commission, soon after it was inaugurated, passed Act No. 854 on August 26, 1903, providing for education of Filipino students and appropriating the sum of ₱144,000 for such purpose.

At first no scholastic requirement was made of candidates for pensionados, owing to the fact that at that early period, public education had not sufficiently advanced to require a certain degree of scholastic standing from them. A sort of examination was given throughout the Philippines under the supervision of division superintendents of schools, and from those who passed, the first one hundred pensionados were sent to the United States on November, 1903. Subsequently, candidates were required to have finished the second year of high school, and later, high school graduation was required, and toward the end, before the pensionado system was abolished, only those that had had special training, especially in science, were selected to pursue special courses. The number of pensionados each year became less owing to the fact that, as the facilities for education and special training, such as the establishment of the College of Medicine and Surgery in 1910, became more and more available, the Pensionado Committee adopted the policy of sending only students who were to specialize in certain branches of studies not available in the Philippines. The Department of Agriculture and Natural Resources, now the Department of Agriculture and Commerce, became the most important beneficiary of the pensionado system because by the nature of its work, the Department has need of more technical and scientific men than any other branch of the government. The great majority of the pensionados who were sent to the United States to specialize in all branches of science are now with this Department, especially in the Bureau of Science, and are now carrying on the work started by the American pioneer scientists, with credit to themselves.

The latest act of the Philippine Government to promote science was the creation of the National Research Council of the Philippine Islands for the promotion of research work along scientific lines. The most prominent scientists and technical men of the Philippines have been appointed by the Governor-General as charter members. This body has recently been organized with Dr. Manuel L. Roxas, Under-Secretary of Agriculture and Commerce, as the head, with the title of Commissioner of Research.

The purposes of this council are clearly stated in the body of the law creating it, as follows:

(1) In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, starting studies of problems of the national defense, and of contributing in other ways to the public welfare.

(2) To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

(3) To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative as fundamentally important to the advancement of science.

(4) To gather and collate scientific and technical information at home and abroad, in cooperation with governmental and other agencies and to render such information available to duly accredited persons.

SCIENTIFIC RESEARCH IN OUR UNIVERSITIES

By ARTURO GARCIA
Of the University of the Philippines
Chairman, Section of Educational Relations

GENERAL CONDITIONS

Scientific research in our universities is carried on under much less favorable conditions than in universities in Europe, America and Japan. Such essential requirements as liberal financial support (either from the University or from private grants), research foundations, faculties large enough to permit whole sections to devote their entire time to research and above all, the recognition and appreciation of research accomplishment, are facilities and advantages almost unknown in the Philippines. In fact, through the above encouragements, research work has now become a desirable career in those countries.

In glaring contrast, research in our universities may be said to have been undertaken only through individual initiative to satisfy a desire for self-improvement and to discharge a moral obligation to add to the general scientific knowledge of the world. During Spanish times, conditions were even more unfavorable, for in those days, the investigator had to publish his productions at his own expense and in some instances, he was even apt to be reminded to confine work to his teaching assignment, because research was regarded as a purely extra-curricular activity.

With American occupation, however, conditions became somewhat improved, particularly in those bureaus of the government which, like the Bureau of Science, were specially devoted to scientific research. The American scientists in such places could at least look forward to being called to better positions at home as one of the few inducements to good work, but the outlook for research in our universities was not much changed. The ambitious instructor found his time almost entirely taken up by heavy teaching loads; he was usually unable to secure the means for the supply and equipment required by his research and even if successful in producing a creditable piece of work, he would still find no adequate appreciation for his special attainment.

SCIENTIFIC RESEARCH IN THE UNIVERSITY OF THE PHILIPPINES

Among the various universities of our country, one could probably say with some degree of certainty, that the University of the Philippines is the only one of the institutions that can lay claim as affording some facilities for real scientific research. During the first years, when the enrollment was still small, the faculty of this University, which was mostly composed of full-time men, could devote more time to research as there were enough assistants for the routine teaching. In addition, the University awarded fellowships abroad as a means of developing the younger men and toward the later years they created a small research fund (₱10,000 yearly for the entire University) and some minor grants in the form of limited revolving funds.

Another factor which, in our opinion, has contributed much to encourage scientific research in our universities, is the improvement of our journal facilities. Through such publications as the *Philippine Journal of Science*, the *Journal of the Philippine Islands Medical Association*, the *Revista Filipina de Medicina y Farmacia*, the *Philippine Agriculturist*, the *University of the Philippines Natural and Applied Science Bulletin*, the *Philippine Journal of Agriculture* and the *Philippine Journal of Animal Industry*, the investigators find the means of publishing their contributions and through the exchanges, they learn what is being done in their lines in other parts of the world.

As the years went by, the cause of research in the University became more and more handicapped by such adverse conditions as—(a) the increase in financial resources which has not kept pace with the growth in enrollment; (b) the consequent heavy teaching loads required and the unfavorable teacher-student ratios; (c) the rapid and untimely loss of foreign senior professors before suitable successors could be developed; (d) the frequent transfers to other government bureaus or private organizations of native senior men shortly after their return from university fellowships; (e) the rapid turn-over in the junior personnel; (f) the appointment of lecturers or part-time professors in unusually large numbers necessitated by reduced appropriations; (g) the inadequacy of research grants and (h) the apparent lack of appreciation of research accomplishments. With the present financial retrenchment policy, these disadvantages became still more pronounced. Both the university fellowships and the research grants have been virtually discontinued and the faculties have been compressed to the minimum and burdened with even heavier teaching assignments. If to this, we further add the need of increasing the enrollment to sustain the financial support of the institution, the inevitable result will be the reduction to an even smaller minimum of the possibilities for scientific research in the University.

Notwithstanding the above, however, the research output of the University of the Philippines may be said to compare favorably with that of other universities having better facilities and more adequate means, thanks to the determination of some members of the faculty honestly to discharge a moral obligation to further scientific progess.

As it is probable that other sections of the Reports of the National Research Council will give detailed accounts of the research activities of each department of the University, we shall confine ourselves to a general outline of the active participation of the University in scientific research as a tribute to those faculty members who have had the inclination and courage to help in the advancement of science in the Philippines.

In medical sciences, we find that the College of Medicine of the University in collaboration with the Bureau of Science, has helped much in doing pioneering research on the causation, treatment, prevention and control of some of the more important tropical diseases, such as—amoebic dysentery, plague, beriberi, yaws, leprosy, malaria. dengue, tuberculosis, etc., about many of which little or nothing was known before. While many of the early findings were changed by later researches, the pioneer work accomplished here has served to arouse the general interest of investigators of neighboring countries in the Far East.

The later researches of the medical faculty were made to cover the various branches of medicine, but more particularly the improved methods of treatment of diseases specially common in, or peculiar to the islands, such as typhoid, dysentery, yaws, leprosy, cholera, beriberi and the more important parasitic diseases of man; the treatment of malignant growths by radiotherapy; the relations of nutrition to growth and deficiency diseases; the determination of physical norms of Filipinos, the pharmacological studies of native medicinal plants, etc., with results more or less encouraging.

In Hygiene and Public Health, over 90 contributions on various epidemiological, parasitological, bacteriological, immunological, vital statistical, and other problems of public health interest and importance, have been produced by the faculty of that School.

In Pharmacy, the University has engaged in pioneering researches on the chemical analysis of Philippine foods; the action of emetine on the treatment of amoebiasis; the phytochemistry of some Philippine economic and medicinal plants and the assays of drugs and chemicals of interest in Philippine materia medica and forensic chemistry. Besides, the researches on the chemical constitution of alkaloids of some Philippine plants are until now without parallel in the history of Philippine chemistry.

In Agriculture, the University from its early years, was obliged to engage in research work on practically all phases of agricultural problems, as there was then no first hand information available for the teaching of Philippine Agriculture. In the words of the Dean of that Faculty—"to the end of the academic year 1933-1934, the College has published 948 Experiment Station Contributions, 397 General Contributions more or less related to agriculture, and published in addition under its auspices, 11 miscellaneous papers contributed by outsiders and translations of important articles of local interest".

In Veterinary Science, there have been researches on parasites attacking domesticated animals, on anatomical topics aiming toward the improvement and preservation of animal resource, and research on immunology of prevailing infectious and contagious diseases, such as rinderpest, trypanosomes and avian pest. Likewise new animal diseases are being discovered from year to year and added to the list under investigation. Animal production and the packing industry have been considerably industrialized through the efforts of researchers.

In Engineering, there are also important research contributions produced by the Faculty of that Collegiate unit.

In Botany—about 200 contributions on diverse phases of botanical problems are to be accredited to the Department of Botany, thanks to their able and indefatigable men and the close relations which always existed between that Department and the Bureau of Science.

In Zoology, over 100 publications are accredited to the Department, covering classification and anatomy of Philippine mollusks, protozoa, snakes, crustacea, coelenterata, fishes and parasitic animals, besides studies on sex of fowls, frogs, etc. and on genetics and eugenics.

In Physics, some contributions on the radium contents of Philippine waters are published, to the credit of the Department.

In Chemistry, thanks to the collaboration with the Bureau of Science and the aid of a small yearly grant from the research fund, the Department has been able to turn out over 50 important contributions on problems of physical and industrial chemistry, many of which promise to be of future utilitarian value.

In Mathematics—the University is probably the only institution of its kind in the Philippines that has made a goodly number of important contributions on various mathematical problems.

The pioneering and important works in Ethnology and Anthropology, emphasizing the old customs, uses and education of the country in the pre-Spanish era, have received favorable attention from abroad.

And, finally, in geology, we find that the Department in spite of its service functions to the Colleges of Engineering, Education, Business Administration, Liberal Arts proper and the School of Pharmacy, has been able to start up a creditable geological museum and to turn out a goodly number of important contributions in collaboration with the Division of Mines of the Bureau of Science.

There is no question that research productivity of the University could have been improved if adequate facilities had been available, especially as regards time, equipment and financial support. However, with the depleted resources of the University at present, it is feared that the research curve will suffer a marked decline, recovery from which will depend mostly on the improvement of the finances of the institution. There is no question also that the best hopes of the people, as far as research is concerned, will be in those government organizations which are devoted entirely to research, for they are the only institutions that have the required time and the adequate means essential to research. Of course, if those private concerns which might engage in industrial development in the future, would be willing to come to the aid of the scientists in the University by substantial grants as was done by the Sugar Association when it established a Department of Research, the outlook might be more hopeful. We dare to say that in many instances the venture might result in a paying proposition as it has happened with the sugar people.

SCIENTIFIC RESEARCH IN PRIVATE UNIVERSITIES

As may be expected, scientific research in private universities that have no endowment and are dependent for their support on students' fees only, is out of the question. The reasons are obvious:—they have not the means of employing full-time faculties and they can not afford to equip proper laboratory and library facilities. Until the finances of such institutions are placed on a sounder basis, their possibilities of contributing to the advancement of scientific research, will be practically nil.

The University of Santo Tomas is probably an exception, because with her large faculties and her tradition, many of her instructors are also ready to devote some of their time to research pursuits. A number of noteworthy contributions in bacteriology and the clinical branches of medicine have been produced by members of their medical faculty and lately, some studies on etiology and treatment of cancer have been conducted by some of their men working in the Cancer Clinics of the Hospital de San Juan de Dios.

CONCLUSIONS

1. That scientific research in our universities is carried on under less favorable conditions as compared with universities in Europe, America and Japan.

2. That research productivity in our universities even under the best of circumstances, will always be less than in other government organizations devoted specially to research.

3. That scientific research in the University of the Philippines is adversely affected by—(a) insufficient financial support; (b) heavy teaching-load and unfavorable teacher-student ratio; (c) the rapid transfers of qualified men to other government bureaus or private organizations shortly after their return from university fellowships; (d) the frequent turn-over of junior personnel; (e) the appointment of unusually large numbers of lecturers or part-time teachers and (f) the apparent lack of proper appreciation of research attainments.

4. The research curve suffered a decline with the early departure of the foreign professors and in the period of development of native personnel recovery was noted with the return of the pensionados and their assignment to responsible positions. A second decline will be brought about by the late reduction of the faculties and the increase of teaching-loads.

5. The research output despite discouragements may, until now, be favorably compared with that of other universities with better facilities and more adequate means.

6. That the discontinuance of the research fund, revolving funds and fellowships will be unfavorable to research.

7. That private universities, with the probable exception of the University of Santo Tomas, are unable to engage in scientific research for lack of financial means.

RECOMMENDATIONS

1. That the University should participate actively in helping to solve important problems of the country by research.

2. That more free time and better financial support should be given to those properly qualified to do research.

3. That collaboration with the Bureau of Science and other research organizations of the Government is desirable and should be maintained by the University.

4. That efforts should be made to secure some grants from outside capital for the continuance of research work in problems in which they are interested.

5. That more adequate appreciation should be given to research accomplishment.

SCIENTIFIC AND TECHNICAL ORGANIZATIONS IN THE PHILIPPINE ISLANDS

By LEONCIO LOPEZ RIZAL
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Chairman, Section of Government Relations

PRELIMINARY REMARKS

The organizations and institutions that have contributed to the progress and advancement of science in the Philippines would make a long list, hardly possible to enumerate, if among such organizations we were to include institutions that, indirectly, either financially or otherwise, have lent a hand in the development of science in the islands.

This is indeed a very hard task. A thorough and exhaustive search in our libraries would be but a meager help to prepare even a fair resumé of all of them and their achievements. An attempt, however, will be made, but we shall limit ourselves to those institutions, which by the nature of their functions and activities are directly responsible for the present progress of science, and, in general, sketch their contributions to the same.

The Philippines have fortunately been gifted with a number of qualified scientific institutions, at present as well as in the past. Whether or not, however, their efforts have been successful in achievements, to the measure of the present progress of science in other parts of the world, is difficult to say. One fact is apparent, and this is, that the present status of science in the Philippines is far behind our needs and the requirements for the development of our resources. We shall not try to dive to the bottom of the whys and wherefores of it—it may be the lack of stimulus, the failing spirit of high idealism, the distance and relative isolation of our country from the active centers of investigation, or the ignoble positivism in which we are placed, or what not. It is clear, however, that there is a lack of intelligent coordination of our efforts and activities, possibly because our government having turned its interest and attention to many other pressing matters, has disregarded altogether this very important side of human endeavor and prevented us from attaining more positive results.

Now that we are confronting the future, with all the responsibilities of an independent life before us, we feel the most dire need and desire of keeping up with the latest advances of science to cope with the situation. The National Research Council, as a first step in this forward plan of preparing our country for its future life, will undoubtedly do its part toward a wiser orientation of scientific investigations. But whatever important discoveries it may make, whatever valuable achievements it may accomplish, they will be mere academic attainments if the government's support, either financial or legislative, fails in carrying them into practical application. A more constructive plan frankly and entirely free from influences other than the interest of science and its advancement, directed to the rapid development of our resources, is wanting. The creation to the National Research Council is not all that is needed.

Many of the scientific organizations to be mentioned in this article, during the Spanish government as well as during the present American sovereignty, belong to what we may call the group of merely educational and scientific institutions, some to the group affording materials for scientific investigations and studies, and a few others to the group organized exclusively for investigation and research.

Some of those organized during the pre-American occupation are still existing and contributing with their activities up to the present time.

INSTITUTIONS AND ORGANIZATIONS DURING THE SPANISH REGIME

We shall begin with the educational institutions which, as such, have contributed to the foundation of scientific knowledge, studies, and investigations.

University of Sto. Tomas.—The present University of Sto. Tomás was established in 1611 as the Colegio de Ntra. Sra. del Rosario but it was changed to "Colegio de Sto. Tomas" on August 15, 1619, with the corresponding permit of the superior government and the approval of both the ecclesiastic and civil authorities of the islands. The colegio was supported by the Dominican corporation, with the Very Rev. Fr. Baltazar Fot as the first rector. By Royal Cedula of His Majesty, the King, Felipe IV, dated November 27, 1623, this colegio was given official recognition. Pope Inocencio X on November 20, 1645, granted the colegio the title, rights, and privileges of a universsity, with the permit to establish the faculties of theology, philosophy and arts. His Holiness, the Pope, Clemente XII, extended these privileges and rights to the Faculties of Civil and Canon Law and other faculties that, with the available facilities, might in the future be established by the University.

In 1680 and by Royal Cedula issued on May 17, His Majesty, the King, Carlos II, placed this university under his royal protection, and then, by another Royal Cedula of March 7, 1785, of King Carlos III, more than a century after its establishment, the University was given the title of "Royal University". The faculties of theology and philosophy had been established since the foundation of the colegio. In 1737 by Royal Decree of King Felipe V, the Faculties of Civil and Canonical Law were established. In 1871, the faculties of Medicine and Pharmacy were organized, although temporary in character, and in October, 1904, as a dependency of the Faculty of Medicine, the School of Dentistry was added. In 1907, the Faculty of Civil Engineering and Architecture was created, with the right to confer the degree of Bachelor of Science in Civil Engineering and Architecture and Master of Science in Civil Engineering.

The University has not only contributed to the teaching of the sciences, especially medicine, dentistry, pharmacy, and engineering but has also created a library with a good number of scientific works, a laboratory of physics and chemistry and a museum of natural history for the use of the faculty and the students. On the first graduates in medicine and pharmacy degrees were conferred in 1877, as follows: Physicians—José Lozada, Justo Panis, Felipe Zamora, Evaristo Batlle, Pedro Robledo, Nicanor Padilla, and Narciso S. Aguilar; Pharmacists—Fernando Benitez, Rosendo Garcia, Leon Ma. Guerrero, Aniceto Merenguel, Tomás Torres Perona, and Rafael Garcia Ageo.

The faculties of medicine and pharmacy that have been open continuously since its establishment have furnished the majority of physicians and pharmacists of the country and the Faculty of Civil Engineering and Architecture, although of recent creation, produced many engineers now occupying high positions in the government. All these faculties are still in operation while the School of Dentistry has been closed since 1916.

Colegio de San José.—This was the first university established in the Philippines. It was under the administration of the Society of Jesus. The establishment of the Real Colegio de San José was due to Father Diego Garcia, a Jesuit and visitor of the order in the Philippines. This colegio was inaugurated with official permit on August 25, 1601, although the creation of the Colegio was approved by Royal Decree of King Felipe II, June 8, 1585. The first "cátedras de Moral y Latinidad" had, however, already been functioning since 1595, under the name of Colegio Maximo de San Ignacio. The first students were thirteen in number, among them a nephew of D. Francisco Tello and a son of Dr. Antonio de Morga. In the beginning it was supported by private donations until the year 1610 when the colegio received a legacy from the "Capitan Adelantado" of Mindanao, Don Esteban Rodriguez de Figueroa. In 1723 (1822 ?) King Felipe V conferred on it the title of "Royal Colegio" by Royal Cedula of May 8, 1721, and since then it has been known as "Real Colegio de San José". Until 1768 it was under the direction and administration of the Jesuit fathers. After the expulsion of this order, the colegio was put under the administration of the Escuela Pias, but later the governor-general of the Philippines in his capacity as Vice Patrono Real was acknowledged as the only administrator and director in compliance with a royal order.

By Royal Decree of October 20, 1875, issued upon the recommendation of the Consejo de Estado and the Philippine government, the Faculties of Medicine and Pharmacy of the University of Sto. Tomás were ordered to be located and operated in this college, and the income of the colegio, after deducting all expenses for charity and welfare work, was to be expended for the maintenance and operation of these faculties. This colegio not only contributed to the maintenance and support of the faculties of medicine and pharmacy, but also created and established a library for both faculties, arranging for this purpose a suitable space in its own buildings. A portion of the land behind the building has also been apportioned and prepared for garden purposes, for the growth and cultivation of native as well as European medicinal plants.

Escuela de Náutica.—The idea of establishing a nautical school in the Philippines was due to D. José Basco y Vargas who was governor-general of the Islands from 1778 to 1787. A school similar to what we have at present was created and organized by Royal Decree of January 1st, 1820. The school offered a four-year course in navigation, including the studies of cosmology, physics, hydrography, and meteorology. The establishment of this school, which was in operation until shortly before the American occupation, was made at the urgent request of the Board of Commerce. The school was supported by the so-called "Fondos de Averias".

Escuela de Botánica y Agricultura.—By a decree of the Gobierno Superior of September 13, 1858, this school was established in Arroceros under the supervision and inspection of a board. In 1861 by another decree, the school was placed under the immediate supervision of the Real Sociedad Economica de Amigos del Pais. D. Sebastian Vidal y Soler was its first Director and D. Regino Garcia y Basa served as assistant.

It is not the intention of this paper to give complete information about all educational institutions that have directly or indirectly contributed to the progress of science in the Philippines, but it is believed worth while to mention other establishments of teaching, such as the Ateneo Municipal de Manila, San Juan de Letran, San Beda College and others that may be considered as centers of learning.

Hospital de San Juan de Dios.—This hospital was founded in 1596 by La Hermandad de Misericordia (a fraternity founded by a clerigo Juan Fernandez de Leon in 1594). The institution was dedicated especially to the care and treatment of poor Spaniards, not in the employment of the government. In 1656 this hospital was given up to the Brothers of San Juan de Dios; then, by a decree of August 29, 1866, abolishing this order, the hospital was placed under the supervision of a "Junta Inspectora" appointed for the purpose. In 1863 this was destroyed by an earthquake but several years later it was reconstructed through private contributions and public donations. The hospital is completely supported by the Hacienda de Buenavista located in San Rafael and San Ildefonso, Bulacan, and several real properties in the city of Manila. As a section or branch of the Hospital de San Juan de Dios, the Hospital de Convalescencia in Bagumbayan in which convalescents were taken care of, was established in 1643. This hospital (San Juan de Dios) still subsists and is being used partly for the clinical instruction of medical students of the University of Sto. Tomás.

Hospital de San José.—This hospital was established in 1641 by the Brothers of San Juan de Dios in Cavite, and supported by alms and monetary donations of private citizens. Its administration was undertaken by the San Juan de Dios Brothers and when this order was abolished, the hospital was placed under the supervision and administration of the Vice-Patrono Real. Later a "Junta Inspectora" was created to take charge of its administration. Apparently, this hospital was bigger than the San Juan de Dios Hospital, as Bowring, in his "Una visita a las Islas Filipinas", says that this hospital had a capacity of 250 beds for soldiers, poor, and delinquent persons, the San Juan de Dios Hospital having had a capacity of only 112 beds.

San Lazaro Hospital.—This hospital was founded in 1578 by Brother Juan Clemente of the Saint Francisco Corporation. He dedicated his leisure time to giving medical attendance and treatment to poor people suffering from different illnesses, using the lower floor of the convent for such purposes. As the number of patients increased he asked for alms and contributions which he used for the construction of two ward buildings of light material, one for male and another for female patients, in front of the convent. In 1583, the hospital was burned down and another building was constructed in the place now occupied by the present Hospital de San Juan de Dios, which was previously filled up and placed in a sanitary condition through the work of the patients. This was again destroyed by fire in 1603 and, after more efforts, another hospital of strong materials was constructed outside the Walled City. For fear of the depredations of the Chinese pirate, Cogsen (Kong Sin?), the hospital was demolished in 1662, and a bigger one was constructed of brick in the year 1678. During the English invasion in 1762, while the islands were under the *ad interim* government of the Archbishop of Manila, Don Manuel Antonio Rojo, this was utilized by the English as the base for their siege battery. Then, later, at the recommendation of Spanish engineers, the hospital was again destroyed in 1673, to be reconstructed in 1784 in the place which it at present occupies. The reconstruction work was terminated in 1784 (?). By Real Cedula of June 24 of 1784 His Majesty the King made the concession of the house and hacienda de Mayhaligue for its support, under the direction of Fr. Juan de Mata. The building is now known as the Hospital de San Lazaro. The hospital, which at the beginning was used for the treatment of poor patients, was later on utilized for lepers in 1631 when the 150 Christian lepers exiled from Japan were admitted to this institution.

Other hospitals and asylums for the care and segregation of lepers were also founded and established in different parts of the archipelago, among them the Hospital de Lazarinos de Palencia, Hospital de Lazarinos de Cebu, and others of less importance and smaller capacity in the northern part of Luzon and in the Mohammedan provinces.

The Hospital de Lazarinos de Palencia was founded in 1872 through the efforts of His Grace the Bishop Father Francisco Gainza in a place not very far from the province capital. The cost of constructing the building was covered partly by public charity and with the amount of ₱6,800 donated by the Franciscan corporation. In a similar way the Bishop of Cebu was able to establish a leper hospital known as the "Hospital de Lazarinos de Cebu" in 1850. The hospital de Lazarinos constructed in 1814 in Laoag, Ilocos Norte, was at the expense of Fr. Vicente Febras (Agustino).

Likewise, we may mention here the existence of the Hospital de Aguas Santas in Los Baños, Laguna. This hospital was constructed in the year 1602 with light materials (nipa and bamboo). For the construction and maintenance of this hospital, the towns of Bay and Pila respectively, donated the necessary parcels of land in Bay and Los Baños and the hacienda of Jalajala. To San Pedro Bautista, protomartyr of Japan, we owe the discovery of the thermal springs of Mount Makiling which he found while visiting Los Baños, Laguna. In view of this discovery, the lay brother Diedo de Sta. Maria was sent in 1593 to make the necessary chemical analysis of the waters.

With the income of the hacienda and the donations of the devotees a big strong-material building was constructed, together with a convent and a church, which were administered by Franciscan fathers until the year 1640. This hospital was burned down in 1676, but was reconstructed in 1877 through public donations. The buildings still exist and after being used for a time they were abandoned.

Real Hospicio de San José.—This institution was used as a welfare institution in 1810 in compliance with a Royal Decree of December (September ?) 27, 1806, and supported by legacies of several persons. It was closed as a consequence of some political movements in America, and also because of lack of funds, but it was reopened in 1828. By Royal Decree of October 22, 1831, the Hospicio de San José was granted a subsidy of 1½% of the taxes on rice exportation. This having been abolished by superior decree in 1849, the Hospicio was given an annuity of ₱1,000 from the "Fondos de Comunidad",[1] and by Royal Order of September 12, 1861, the amount of ₱15,000, under the condition that it be used as an asylum for the insane coming from the provinces. It was also used to house orphans. Established first in Nagtahan, it was transferred in 1840 to the Island of Convalescencia.

Among the medical institutions that have contributed to scientific advancement we may also mention—the Hospital de S. José in Cebu, under the administration of the Cebu diocese; the Hospital de Marina de Cañacao; the Hospital Civil de Cavite; the Lazareto sucio de Mariveles under the control and supervision of the Junta de Sanidad y Beneficencia. Also worth mentioning is the Enfermeria de Naga established in 1583 by the religiosos of Albay and Camarines, in Camalig, and abolished in 1660 to be reestablished in Naga; the enfermeria de Sta. Cruz, Laguna, first established in the town of Majayjay, then transferred to Lumbang and later to Sta. Cruz, the capital of the province. There are also enfermerias of Cebu under the administration of the Bishop, etc.

ORGANIZATIONS DIRECTLY CONCERNED WITH SCIENTIFIC STUDIES

In this group, institutions and organizations, either official, semi-official, or private, which are not only executive in character but also have the function of making scientific studies and investigations, are included. It is not believed that the list is complete but efforts have been made to include if not all such institutions, at least the most important ones.

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[1] The "Fondos de Comunidad" or "Cajas de Comunidad" was constituted by contributions of "medio real" (7.5 centavos) required from each native and Chinese inhabitant of the Philippines in accordance with the "Leyes de Indias" and the "Ordenanza de Intendentes". From these funds, the salaries and remunerations of school teachers, vaccinators, etc., were also paid.

Inspección General de Beneficencia y Sanidad.—This was a permanent organization equivalent to our Department and Bureau of Health and Welfare. It had under its control and direct supervision; the Instituto Central de Vacunación (Junta Central de Vacunas), the "casa central de vacuna", "direcciones de sanidad maritima de los puertos", "subdelegaciones de medicina y farmacia," "cuerpo de médicos titulares", "cuerpo de beneficencia municipal", "cuerpo de vacunadores", "hospitales civiles", "lazaretos", "cuerpo de matronas titulares", and "balnearios". By decree of the gobierno general of June 5, 1880, and by recommendation of the "director general de administración civil", it was decreed that the organic law of Health in force in Spain by decree of November 28, 1855, be provisionally enforced in the Philippines. This decree gives all provisions regarding the functions, duties and dependencies of the health office.

A sort of advisory body, "junta consultiva", "Junta superior de Sanidad", was also in existence, previous to the above decree, composed of the Director General de Administración Civil as president, one vice-president and six elective members, eight ex-officio (natos) members and one secretary. This "junta" was abolished by the Real Orden of November 5, 1834, although it provided that the superior government might, at any time and whenever it was believed necessary, reorganize the same.

Junta Central de Vacunación (*later, Instituto Central de Vacunación*).—This organization, which had the duty of preserving, manufacturing, and propagating the vaccine virus and at the same time performing prophylactic inoculations through the "cuerpo de vacunadores", was created by Royal Decree of December 20, 1806. This Board (junta) was composed of His Excellency, the Governor-General, as president, six members, two "facultativos de vacuna" and one "secretario facultativo".

Cuerpo de Médicos Titulares was an organization under the supervision of the "Inspección General de Beneficencia y Sanidad" having as its functions, among other things, to give medical attendance to sick employees and poor persons, to perform vaccinations against smallpox, to examine animals before slaughtering, etc. They were distributed in the different provinces or districts.

Cuerpo de Matronas Titulares.—This was composed of the authorized midwives to assist during deliveries. There were "Matronas de Primera Clase" for Manila and some provinces and "Matronas de Segunda and Tercera Clase" for the provinces.

Lazarettos.—These institutions were established for maritime quarantine. The regulations for these Lazarettos were promulgated in the form of "Reglamento de Sanidad Marítima para las Islas Filipinas" by Royal Order of La Reina Regente of July 19, 1890. There were two kinds of lazarettos: "lazareto sucio" and "lazareto de observación". One "lazareto sucio" was established in Mariveles, and four "lazaretos de observación", one each in Cebu, Iloilo, Bani and Zamboanga.

Balnearios.—Official spas were established in different parts of the islands taking advantage of the therapeutic properties of some springs and waters, that had previously been examined.

There were many "balnearios" during the Spanish régime. The most important and most popular for their supposed curative virtues were those of San Miguel de Mayumo, Bulacan, known as Aguas Sulphidricas de San Rafael, Aguas de Sta. Matilde, and Aguas ferruginosas bicarbonatadas de S. José. There were also those of the provinces of Laguna known as Aguas Santas (alcalinas bicarbonatadas) in Los Baños, Aguas de Bombongan of the same quality in Pagsanhan, Laguna, and the Aguas de galás (sulphídricas) in Mabitak of the same province; those of Albay, such as that of Tiwi, or Aguas (sulphidratadas) de Jigabo and the Aguas (ferruginosas sulfatadas) de Tancalao, mineral waters that have been highly praised by F. Jagor in his "Viajes por Filipinas" and many other springs and mineral waters distributed in the Islands.

Direcciones de Sanidad Marítima de los puertos.—The functions and duties of these offices are enumerated in the same *Reglamento* (previously mentioned) containing the regulations for lazarettos. There were four direcciones de sanidad marítima in the Philippines, one in the port of Manila, one in the port of Iloilo, one in Cebu and one other in Zamboanga.

Inspección General de Minas.—This office has among its functions not only the studies and regulations of mineral resources of the islands but also to make geologic and mineralogic investigations and to prepare special geologic maps of the

Philippines. It was created by Royal Decree of March 9, 1837, but it was not organized until 1839 when D. Isidro Sainz de Baranda was appointed as its first Inspector-General. The first Regulations on Mines and their exploitation and development were published by Royal Order on January 29, 1846. These regulations were in force until August 6, 1868, when the Royal Decree about the "Regimen de la Minería en Filipinas", issued on May 14, 1867, was published. The personnel of the office discovered and described many mineral veins in different regions of the Islands, the most important and valuable ones being these: of *gold* in Mambulao, Paracale and Labo, Camarines Norte, the gold lode in the Island of Panaon, Leyte (quartz) which has been exploited with modern machinery; several lodes in the Mt. Province, in Misamis and Surigao, in Atimonan, Tayabas, in Gapan, Peñaranda, Nueva Ecija, Cebu, Panay, etc.; of *coal* (lignites) in Cebu (1827) in Albay, in Batan, Samar, Negros, Mindoro, etc.; of *iron* in Angat and S. Miguel de Mayumo, Bulacan, in Laguna, Morong (Rizal), in Camarines Norte (magnetic), etc.; of *copper* many and abundant lodes were discovered in Lepanto, Mt. Province, in Camarines Norte, in Masbate, and in the island of Panay; of *sulphur* in La Laguna de Casihoy (Leyte) in the island of Biliran, etc.; of *marble* in Romblon, in Mariveles, Bataan, etc.

Exploitation of many of these mineral lodes have been attempted, but they usually failed on account of the difficulties encountered, not only for lack of adequate labor and means of communication (roads and transportation) but especially because of lack of capital. By Royal Decree of June 14, 1876, the technical personnel of the *Inspecciones de Minas* made valuable geologic studies of different regions of the archipelago. These studies were carefully prepared and later submitted to the "*Comision Central del Mapa Geológico de España*" and published in "*El Boletin Geológico*" of the said commission."

Servicio Meteorológico (*Observatorio Meteorológico de Manila*).—The meteorological service during the Spanish time was under the direction of the Fathers of the Society of Jesus. It was founded in 1865 after the strong typhoon that hit the Islands, causing much damage, many casualties and losses in ships. The institution was known as the "Observatorio del

Ateneo de Manila". With the few instruments and the apparatus available for weather observations, this "observatorio" rendered such satisfactory service, especially in the prediction of typhoons, that many natives as well as foreigners and foreign institutions, volunteered to make donations for the purchase of some instruments necessary for the expansion of the service. Likewise, the government of His Majesty, being aware of the practical activity and need of its services, converted this observatory into an official institution by Royal Decree of April 28, 1884, and adopted for it the name of "Observatorio Meterológico de Manila". Several meteorological stations were established; one central in the city of Manila, and 12 others in the provinces (1886).

This observatorio subsisted up to the present time and is what at present is known as the "Weather Bureau", one of the official bureaus of the present government.

Comisión de la Flora de Filipinas.—With the object of making studies and investigations necessary for the preparation of Philippine flora as well as of collecting data and materials for the same purpose, a committee of foresters (*ingenieros de montes*) was appointed in compliance with the Royal Decree of July 21, 1876, creating the "Comision de la Flora de Filipinas".

The "Comision" had its own Regulations which, among other things, provided for the study and scientific description of the Philippine flora in general, (forestal or otherwise), the description of the new species found, the preparation of a general herbarium; the study of the different methods of plant cultivation and exploitation, and also, the preparation of a descriptive report of the archipelago from the geographic, orographic, geognostic, hidrographic, and agronomic view points, including the drawing of plans and the outlining of a general program for reforestation.

A catalog of the species found and described was completed in 1879. An herbarium was founded and a report containing a synopsis of families and genera of several plants in the Philippines was submitted. The synopsis constitutes a volume of 400 pages with an atlas of 100 plates containing the pictures of 1,900 different species drawn by Mr. Regino Garcia.

The commission also published a catalog and a booklet describing the flora of the archipelago represented in a collection of plants exhibited at the International Exposition of Amsterdam in 1883.

By Real Orden of May 24, 1880, the Commission was abolished and in its place the "Seccion de Botanica" was created having more or less similar functions and duties under the "Inspección General de Montes".

For the purpose of continuing the studies on Philippine fauna and by order of the corresponding authorities, the commission was also entrusted with the work of making the preliminary investigations and studies of the fauna of the islands in 1885. For this purpose, one of the assistant botanists of the commission was replaced by an assistant zoologist with the same administrative rank.

Comisión Agronómica de Filipinas.—Under the "Inspección General de Montes", this commission was created by Royal Order of November 15, 1881. Its functions and duties were the following: the propagation and teaching of agronomy through model farming; the creation and preparation of agricultural and live stock statistics; the preparation and publication of monographs of plants and insects; and, creation and maintenance of an agronomic museum.

This commission was declared an independent institution, separate from the "*Inspección General de Montes*", by Royal Decree of July 8, 1884. It continued its functions.

Comisión Especial de Estudios Geológicos y Geográficos de Filipinas.—This special commission was created for the purpose of giving greater impulse to the studies and investigations on geology which were being made at the time by the "*Inspección general de Minas*". It was organized by Royal Decree of February 15, 1885. Aside from its duty of studying the geology of the islands, the commission was also entrusted with the duty of making geographic investigations. D. Enrique Abella y Casariego, D. Francisco Saez, and D. Enrique d'Almonte y Muriel constituted the first commission.

Comisión de Estudios de las Aguas Minero Medicinales.—By request of the "*Director General de Administración Civil*", the governor-general of the Philippines, D. Joaquin Jovellar y Soler, decreed on December 15, 1884, the creation of a scientific commission to study and make the necessary chemical analysis of the mineral waters in the Island of Luzon. The Commission was appointed on January 24, 1885, and was organized on January 31, of the same year with the following members: D. José Centeno, mining engineer, as president, D. José de Lacalle y Sanchez as member physician and D. Anacleto del Rosario y Sales as member pharmacist. D. José de Lacalle y Sanchez was later replaced by D. José de Vera y Gomez. By Royal Order of March 9, 1887, the commission was directed to extend its work to all the waters and springs of the archipelago.

This commission published in two different tracts the results of the examinations and studies made of the mineral waters of Luzon and of the rest of the archipelago.

Laboratorio Municipal de Manila.—This was not an institution of investigation and study but this laboratory is mentioned because of the kind of examinations done in it. It was created by decree of the general government dated September 13, 1887, under the inspection of the "Dirección General de Administración Civil " and the control of the "Gobierno de Provincias". Its functions were to make examinations not only of food, water, and other substances from the standpoint of public health and legal medicine but also examinations of all specimens for clinical purposes.

Laboratorio de Medicina Legal.—Under the dependency of the judicial branch of the government, a laboratory of legal medicine was functioning during the Spanish régime with the object of performing all necessary examinations for legal purposes. The laboratory was under the direction of a physician assisted by a pharmacist-chemist.

Real Sociedad Económica de Amigos del País.—Upon the recommendation of His Excellency, the Governor-General of the Philippines, D. José de Basco y Vargas, His Majesty, the King of Spain, issued a Real Cedula of August 27, 1780, creating a society known as the *"Real Sociedad Económica de Amigos del País"*...This society was inaugurated officially in 1781 with the purpose of studying the local conditions as regards commerce and industry and also to cooperate with its efforts and works for the advancement and progress of science in general. After seventeen years of existence, the society was dissolved by misunderstanding between some members and the indifference of others. On November 17, 1819, however, the society was reorganized by order of the then governor-general of the islands, although on account of the cholera pandemic which hit the Philippines, the work of the society was paralyzed until 1860 when it was resumed.

In spite of the difficulties encountered, the work of the society has been fruitful in practical results in that it has not only contributed to the issuing of the Flora Filipina of Fr. Blanco, to the development of some industrial machinery invented in the Philippines, the provision of the water service to the city, etc., but also has been able to establish a library of 3,500 volumes in arts, science, agriculture, etc., as well as a museum of natural history.

Museo-Biblioteca.—In 1887 a library-museum was created but it was not organized until 1891. The institution was divided into two sections: One for the library and the other for the museum composed of four subsections, anthropology and ethnography, natural history, fine arts, and Philippine industries, and another section of preparation of materials.

PRIVATE ORGANIZATIONS

Apparently only a few private organizations that were more or less concerned with the progress of science were established in the Islands during the Spanish era; these were the Colegio Farmacéutico de Filipinas, and several scientific pharmaceutical and medical bulletins.

Colegio Farmacéutico de Filipinas.—This is an organization founded by a group of pharmacists of Manila on January 3, 1892. The association published a journal known as the "*Revista Farmaceutica de Filipinas,*" for the protection of professional interests and as a means of scientific diffusion of investigations and studies made by local scientists. The first number of this Revista was published on January 3, 1893, D. Tomás Torres y Perona, one of the first graduates in the local Faculty of Pharmacy, having been its first Director, with Drs. Alejandro Albert, Anacleto del Rosario y Sales, Gabriel Garcia y Ageo, Joaquin Garrido, Juan Caro y Mora, Leon Ma. Guerrero, Mariano Garcia del Rey, Mariano Oirola, Pedro Acebedo, Ramon Alvarez, Ramon Ampuero, Tomás Alcantara, Ulpiano Rodriguez, Vicente Rodriguez Lanuza and Vicente Gonzales as collaborators.

La Correspondencia Médica was another scientific journal published monthly and dedicated to clinical medicine and surgery. The first number was issued in October 1893 with Eduardo Castañer as editor. From the perusal of several numbers of this journal one may see the variety of local investigations performed as well as the local tendency in science. This journal was edited by its owner with the cooperation of a group of physicians.

Cronica de Ciencias Médicas de Filipinas.—This was another scientific Journal founded by a group of local physicians and pharmacists for the same purpose as the previously mentioned ones. Its editor was D. Alfonso Maseras who had the cooperation of the following collaborators; D. Antonio Trebles, Dr. Benito Valdes, Dr. Francisco Lopez Lubelza, D. Gumersindo del Valle, D. Gabriel Garcia Ageo, Dr. José de Vera y Góhez, D. Juan Caro y Mora, D. Joaquin Garrido, D. Leon Ma. Guerrero, Dr. Pedro Saura, D. Ramon Fina, D. Tomás Torres y Perona, D. Ulpiano Rodriguez, and Dr. Vicente Cavanna. The first number of this journal was issued on July 2, 1895. Articles on medicine, surgery and chemistry have been published in it.

INSTITUTIONS DURING AMERICAN SOVEREIGNTY

Some of the institutions and organizations established during the Spanish time still exist, and are still rendering to science those services for which they were founded. These are the University of Sto. Tomás, the Ateneo de Manila, the San Juan de Letran College, the San Lazaro Hospital, the Hospicio de San José, the Hospital de San Juan de Dios, the Servicio Meteorologico, etc. We will not, therefore, mention them again, but will limit ourselves to a brief account of the different organizations created under the American Flag in the Philippines.

EDUCATIONAL INSTITUTIONS

There were founded not only several other Universities such as the University of the Philippines, the National University, the University of Centro Escolar, the Far Eastern University, Manila University, Philippine Women's University, but also other high educational establishments in the Philippines from the beginning of the American Occupation to date.

University of the Philippines.—The University of the Philippines is the state University supported by Insular appropriation. It was created by Act 1870 of June 18, 1908, for the purpose of providing higher and professional instruction. This original statutory law of the university was later amended by Acts No. 2024 of January 30, 1911, and No. 2483 of February, 5, 1915.

Among others, the University has established the following colleges: *The College of Medicine and Surgery,* which was formerly the Philippine Medical School organized by virtue of Act No. 1415 of December 1, 1905, and opened to students on June 10, 1907. When the University was founded in 1908, the former Philippine Medical School became the College of Medicine and Surgery (December 8, 1910). Two different schools are under the College of Medicine and Surgery; the *School of Pharmacy,* which was a continuation of the former course in pharmacy given since June 5, 1911 under the control of the College of Liberal Arts and placed under the control of this college by action of the Board of Regents on February 12, 1914; and the *School of Dentistry* established as a department, in 1915, by authority of the same Board and later reorganized into a school with the same rank as that of the School of Pharmacy. Four-year courses were given, leading to the degrees of D.D.S. and D.D.M. After a series of misunderstandings, the Board of Regents decided to close the School of Dentistry in 1931. The *College of Liberal Arts* was inaugurated on June 3, 1910. A department of chemistry in this college gives advanced courses in chemistry leading to the degree of Bachelor of Science in Chemistry. Its curriculum, however, was changed lately so as to confer instead the degree of Bachelor of Science in Industrial Chemistry. The *College of Agriculture* under the law creating the University, was the first college organized. It began its classes on June 14, 1909 in a provisional building with 56 students enrolled in the first year. The College has at present its own permanent buildings in Los Baños, Laguna. The *College of Veterinary Science* was opened to the students in June, 1910, at Pandacan. In 1912 the first veterinary clinic and hospital were operated on the grounds adjoining San Lazaro Hospital at Tayuman Street. The college confers the degree of Doctor of Veterinary Medicine. The *College of Engineering* was established on June 13, 1910. The first course given in this college was civil engineering, consisting of five years of study leading to the degree of Bachelor of Science in Civil Engineering. With one more year of study the degree of Master of Science in Civil Engineering is conferred. On July 12, 1915, the Board of Regents authorized the adoption of courses in Mechanical, Electrical and Mining Engineering under the same regulations as that of the Civil Engineering course. The *School of Forestry* was created by Act of the Legislature No. 2578 on February 4, 1916. Since June 10, 1910, however, due to the urgent need of technically trained forest rangers, twenty forest pensionados were appointed and instruction was begun in June of the same year. This school was under the administration of the College of Agriculture. On February 15, 1917, by authority of the Board of Regents, a higher course in Forestry leading to the degree of Bachelor of Science in Forestry was offered. The *School of Hygiene and Public Health* was established in this University in 1927, offering post-graduate courses, for physicians, leading to the degree of Certificate in Public Health. The School was created due to the pressing need of better trained health officers in the Philippines.

National University.—This University was formerly known as the "Colegio Filipino" founded in April, 1901, just after the establishment of the civil government in the Philippines. Five years later, it changed its name to Colegio Mercantil. It was founded by Mariano Jhocson and incorporated in the same month of the same year by its founder and Messrs. Emmanuel Jhocson, Crispulo Jhocson, Apolonio de Guzman and Faustino Martin. Formerly intended for the teaching of bookkeeping, accounting and commerce, on October 26, 1916, however, the institution was reincorporated under the name of National Academy, expanding its courses of instruction by decision of the Board of Trustees adopted on August 1, 1916. One year before this reincorporation, the College of Law was organized and opened classes to students, and was given government recognition in 1921. Its *College of Liberal Arts* was established in 1917 and officially recognized on February 15, 1918, by the government. Then on account of the pressing need of again expanding the courses of instruction, the Board of Trustees reincorporated the institution on January 17, 1921, and approved on March 15 of the same year the name of National University. With this change of name, other colleges were established, as follows: the College of Education (July, 1921); the College of Commerce and Business Administration; the Conservatory of Music; the *College of Pharmacy,* which was established on July 8, 1922, and given government permit on March 19, 1924; and, lastly, the *College of Dentistry,* which was organized and recognized by the Secretary of Public Instruction on November 20, 1924. In June, 1925, the *College of Engineering* was opened. Mechanical, mining and civil engineering courses are given, leading to the corresponding degrees.

Centro Escolar University.—The origin of this university may be taken as that of the Centro Escolar de Señoritas which was founded in Manila in 1907. This institution was given official recognition on December 22, 1913. After several years of existence, on March 31, 1932, the Centro University was organized and subsequently incorporated on May 19 of the same year with Miss Librada Avelino (the founder of Centro Escolar de Señoritas) and nine other members as incorporators. The University offers among other courses of instruction, the following: Courses in pharmacy, in dentistry, law, and preparatory medicine. The *College of Dentistry* offers a four-year course in dentistry leading to the degree of Doctor in Dental Medicine which was duly given official recognition in June, 1932. The *College of Pharmacy* offers a four-year course in pharmacy, and was also authorized by the Department of Public Instruction, in June, 1932, to confer the degree of Bachelor of Science in Pharmacy. This college also offers a one-year post-graduate course in pharmacy and a special post-graduate course leading to the degree of Analytical Chemist. As a separate department, the University gives also a four-year course in chemistry leading to the degree of Bachelor of Science in Chemistry. Besides the preparatory courses in medicine leading to the degree of Associate in Arts, the University also established a College of Medicine. This college, however, could not continue and had to be closed.

University of Manila.—Like the National University and the Centro Escolar University, this institution is another university established through private initiative and effort. It was formerly established under the name of "Instituto de Manila," for secondary instruction, by Dr. Apolinario E. de los

Santos, at the beginning of the American Occupation. Due to its rapid and continuous growth the College of Liberal Arts of the present university was opened during the school year of 1920-1921 by resolution of the Board of Trustees. In May, 1921, the Instituto secured control of the National Law College which became the present College of Law of the University. The institution, however, did not take the present name until October 5, 1921, when it was reorganized by resolution of the members of the corporation, and reincorporated on November 3, 1921, as "University of Manila". This University was given official recognition while still known as Instituto de Manila on March 9, 1916, and as different courses were offered subsequent permits were granted by the Department of Public Instruction.

Far Eastern University.—This is the most recently established university in the Philippines. It was also established by private initiative. It is the result of the amalgamation of two different colleges: the Far Eastern College of Liberal Arts, and the Institute of Accounts, Business and Finance. It was founded on October 27, 1933, and incorporated on November 3, 1933. The University has five colleges denominated as Institute of Accounts, Business and Finance, Institute of Law, Institute of Arts and Sciences, Institute of Education and Graduate Institute.

Afable College of Medicine is a College of Medicine incorporated under the Philippine laws in June, 1932. It gives courses for the first two years in medicine for which official recognition was granted under Act 1459.

Manila College of Pharmacy.—This Institution was organized on November 29, 1916, and incorporated on December 4 of the same year. The college gives courses in pharmacy for which official permit was granted on April 19, 1917. In 1929 a *College of Dentistry* was established which was likewise given official recognition in June of the same year.

Philippine Dental College.—This college, established for the purpose of giving courses in dental medicine, was founded since 1913 upon the initiative of private individuals. On July 1, 1914, it obtained its papers of incorporation and was granted official permit under Act 1459 on March 25, 1916.

College of Oral and Dental Surgery.—Recently established in 1933 after having been incorporated on March 29, 1933, this College was opened to students, offering courses in dental medicine under the laws of the Philippines. Official recognition was granted this College by the Department of Public Instruction in June of 1933.

Mapua Institute of Technology.—This institution was established about 10 years ago and incorporated on January 22, 1925. It offers courses in Architecture and Engineering leading to the degrees of Bachelor of Science in Architecture and Engineering. Post-graduate courses are also offered. Official permit under Act No. 1459 was granted to it in June 1926, one year after its establishment.

Adamson School of Industrial Chemistry.—This school has been established since August, 1932, and was incorporated on September 9, 1932. It gives courses in chemistry especially as applied to industry. Official permit was granted in 1934.

Other schools giving courses in chemistry and recently established, such as the *Paterno Institute of Applied Chemistry,* the *Quisumbing School of Chemistry,* and others, should also be mentioned.

Nautical School.—This is an official institution worth mentioning. It may be considered as the continuation of the old "Escuela de Náutica" of the Spanish régime. This school was created by Act No. 74 in 1901 under the Department of Public Instruction. On February 28, 1914, it was reorganized by Act No. 388 placing it under the control of the Bureau of Education.

School of Agriculture.—Under the same category as the former, the School was created by the same Act No. 74 of January 21, 1901, under the Department of Public Instruction. This school was created in view of the necessity of training men sufficiently capacitated to handle our problems in agriculture. By Act No. 512 of November 10, 1902, the control of this school was transferred to the Bureau of Agriculture.

HOSPITALS IN THE PHILIPPINES

The hospitals in the Philippines constitute at present a vast organization extended throughout the whole archipelago. We have a good number of official as well as of private hospitals rendering service, not only as educational centers for the mass on modern medical treatment, but also as wards for clinical instruction utilized by several universities and colleges of medicine in Manila. In view of the number of existing hospitals, it is not believed necessary nor possible, within the limitation of this sketch, to give even brief information on all and every one of them. A list of the existing hospitals at present is appended and will give an idea of the hospital activities in the Islands. However, it is thought advisable to mention a few of them which, on account of the capacity, location, organization and other circumstances, are considered of some importance.

Philippine General Hospital.—This hospital which was completed in September, 1910, is an official organization supported by Insular funds. It was formerly known as the *Philippine Civil Hospital* created on October 1, 1901, by Act No. 247. When the Board of Health was reorganized by Act No. 1407, this hospital was, by a provision of the same Act, merged with this Bureau as a part of its activity. By Act No. 1989 approved on April 19, 1910, the hospital became the Philippine General Hospital, continuing, however, under the administrative control of the Bureau of Health, until February 3, 1916, when Act No. 2563 was approved declaring it an organization independent from this Bureau. All the clinical teachings of the College of Medicine of the University of the Philippines are given in the wards of this hospital. Later on, the necessity was felt of constructing a hospital in the southern islands of the archipelago and subsequently funds were received and another hospital was erected in Cebu. This hospital known as *Southern Islands Hospital,* is also supported by the government and is under the administrative control of the Philippine General Hospital. By Act No. 4007 known as the Reorganization Act of December, 1932, the Southern Islands Hospital was transferred from the control of the Philippine General Hospital to that of the Bureau of Health. Both the Philippine General Hospital and the Southern Islands Hospital were transferred by this act from the Department of the Interior to the Department of Public Instruction.

San Juan de Dios Hospital.—This hospital, founded during the Spanish regime, still exists at present. It affords all the clinical material for the instruction of the medical students of the "Facultad de Medicina" of the University of Sto. Tomas. (For further information, see Institutions under the Spanish regime.)

St. Paul's Hospital was founded in 1905 by His Grace, the Archbishop of Manila, and supported by the income of the Archdiocese of the city. Before the creation of the Philippine

General Hospital, the wards of this institution (St. Paul's Hospital) were used as clinics for the students of the former Philippine Medical School (1907-1910). A School of Nursing has been operated by this hospital since 1908. It was given official permit June 3, 1921. This hospital was the first private hospital organized in the Philippines under the American regime. A branch of it exists in Iloilo, Iloilo.

Santiago Hospital.—This hospital was founded in 1902 with the name of "Hospital Español de Santiago" in the city of Manila, but it is now known as Santiago Hospital with its own building located in San Pedro Makati, Rizal Province. It was founded by the Spanish community, formerly as an infectious hospital for the hospitalization of Spaniards, who having to comply with the sanitary regulations of compulsory hospitalization, preferred to enter this hospital rather than the government San Lazaro Hospital. It is at present a general hospital, open for admission of patients of different nationalities and for requiring all sorts of diseases, except those requiring compulsory segregation in government institutions.

Chinese General Hospital.—This hospital was founded by Mr. Carlos Palanca in 1891 during the Spanish regime. Several years later, on account of the then existing circumstances, it was closed and abandoned until the year 1917 when by the efforts of Dr. Tee Han Kee, supported by the Chinese community, a new hospital, now known as Chinese General Hospital, was founded. Although primarily founded for members of the Chinese community in Manila, admissions are permitted for members of other nationalities. It has a school of nursing which was inaugurated in 1921.

St. Luke's Hospital.—This is another mission hospital and one of the first etablished in the city of Manila since the American occupation. It was founded in 1907 by the Episcopal Mission under the efforts of Dr. M. N. Saleeby and Miss Ellen Hicks. It is owned by the Episcopal Church. Some of the clinics of the Afable Medical College are given in this hospital which has also a School of Nursing opened in 1907, and granted official recognition on June 3, 1921. The hospital has its own buildings adjoining its church in Magdalena Street, Binondo, Manila.

Mary Johnston's Hospital.—In 1908, Dr. Rebecca Parish founded a hospital in the district of Tondo. The hospital is classified as a mission hospital; it is owned and supported by the Women's Foreign Mission Society of the Methodist Episcopal Church of U. S. A. Children and maternity cases are given preference in this hospital. Since its foundation, a School of Nursing which contributed to the promotion of the nursing profession in the Philippines has been established under the control of this hospital, with official recognition granted on June 8, 1921.

Mary Chiles Hospital.—This hospital was founded by Dr. W. N. Lemmon, in 1911. It is owned by the United Christian Missionary Society of America. It opened a school of nursing in 1912 which was continuously operated until March of 1934. The hospital is at present rented and has been run by Dr. Florendo (a private physician) since March 16, 1934. The school of nursing has accordingly been closed.

Other hospitals.—Many other hospitals, government and private, are in operation, not only in the city but also in the provinces, by provision of Act No. 3114 as amended by Act No. 3168. All the hospitals founded by virtue of the above acts are placed under the control and supervision of the Bureau of Health. A list of government hospitals as well as those owned by private organizations or individuals, with their names, location, classification and bed capacity, is given as an appendix.

A total of 156 hospitals, including leprosaria, leper treatment stations, and infirmaries, are in operation in the islands. Out of this total, 52 are government hospitals, 8 are official leprosaria and leper treatment stations, 2 infirmaries of the University of the Philippines, 33 semi-government hospitals, 7 army and navy hospitals, and 54 hospitals of private organizations or individuals.

GOVERNMENT BUREAUS, OFFICES AND ORGANIZATIONS

Aside from the government institutions of learning and welfare organizations mentioned which have more or less directly contributed to the promotion of science, there are government bureaus, offices, or organizations that on account of their executive functions are also directly concerned with scientific studies and investigations. They are the following:

Weather Bureau.—This bureau is entrusted with functions similar to those of the old "Servicio Meteorológico" of the

Spanish time, like forecasting weather, storm warning, observation of meteorological and astronomical phenomena, studies and investigations of same, etc. This office was created by Act 131 of the Philippine Commission approved on May 22, 1901 and reorganized by the first reorganization Act No. 1407, enacted in October 26, 1905. A monthly bulletin of the observations and special reports on the chief meteorological phenomena and studies made on same are being published by this bureau.

Bureau of Science.—By Act No. 156 approved by the Civil Commission on July 1, 1901, the Bureau of Government Laboratories was created for the purpose of performing biological and chemical examinations as well as for the production of vaccines an sera. It was also entrusted with the duty of making scientific studies and investigations on the causes, pathology, and methods of diagnosing and combating diseases of men and domestic animals. These different chemical and biological laboratories were later consolidated into what is at present known as the Bureau of Science by virtue of Act No. 1407 which also provided for the merging of the old Bureau of Mines with the Bureau of Laboratories. The Bureau of Science publishes the results of the studies and investigations being performed by the different investigators and issues monthly the Philippine Journal of Science.

Bureau of Health.—By general order No. 15 issued on September 29, 1898, by the Headquarters of the Provost Marshall General a Board of Physicians was appointed to constitute the Board of Health for the city of Manila and suburbs. The following formed the first Board of Health: Major F. S. Bourns, Chief Surgeon U. S. Volunteers, Capt. C. L. Mullens, Assistant Surgeon, U. S. V., Dr. C. E. McQuisten, Acting Assistant Surgeon, U. S. Army, and Drs. T. H. Pardo de Tavera and Ariston Bautista Lim as honorary members. This order also specifies the functions and duties of the Board. On October 8, 1898, the Board published its first Rules and Regulations and on August 26, 1899, its personnel was changed by appointing Dr. Guy L. Edie as the first Commissioner of Public Health. During this period a bacteriological division was added to the then government laboratories and a Plague Hospital was established for the treatment and isolation of plague cases. The Board continued in existence until Act No. 157 was approved by the Civil Commission on July 1, 1901, and subsequently Dr. L. M. Maus was appointed as Commissioner of Health. By Act No. 187 the Board of Health which was formerly for the city of Manila and suburbs became the Board of Health for the Philippine Islands. The urgent need of extending the activities of the Board to the different parts of the archipelago resulted in the enactment of Act No. 307, October 2, 1901, and Act No. 308 December 3, 1901, establishing respectively the Provincial Board of Health and the Municipal Board of Health.

On November 1, 1905, the Board became the Bureau of Health by virtue of Act No. 1407 enacted on October 26, 1905, which also provides for the appointment of a director and the necessary organization of the Bureau. Later on, in July, 1915, this was reorganized under Act No. 2468 approved by the legislature on February 5, 1915, providing for the change of its name Philippine Health Service, and also for the creation of the Council of Hygiene, the health fund and the sanitary divisions. By the provisions of Act No. 4007, (1932) the name was again changed to Bureau of Health, although continuing under the same essential organization, except in some minor details, such as the transfer of the Division of Maternal and Child Hygiene from the Bureau of Public Welfare and of the Southern Islands Hospital from the Philippine General Hospital to the administrative control of the Bureau of Health.

Bureau of Mines.—At the beginning of the American occupation a bureau for the study of mining resources was organized; then, reorganized by Act No. 17 enacted on October 10, 1900, as amended by Acts No. 916 of October 1, 1903, and No. 1067 of February 26, 1904. When the Bureau of Science was created by consolidation of the government laboratories, the Bureau of Mines was merged and transferred all its personnel and activities as one division of the former by virtue of Act No. 1407 of 1905.

The *Bureau of Forestry* entrusted with the duty of conserving and managing the public forests, of regulating their use and keeping them in a productive state, was created by Act No. 16 of October 10, 1900, and reorganized by Act No. 1407, approved in 1905.

Bureau of Agriculture.—This Bureau was created by Act No. 261 enacted by the Civil Commission on October 8, 1901. Its functions are, among others, to conduct investigations and disseminate useful information as regards agricultural resources of the Philippine Islands, to study methods of cultivation, the practicability of introducing new and valuable agricultural products and domestic animals, and to establish farm stations in different parts of the islands. It continued with its former organization and activities until 1930 when by the provisions of Act No. 3639, approved by the Legislature on December 7, 1929, it changed its name to Bureau of Plant Industry and separated its animal division to become an independent bureau with the name of Bureau of Animal Industry. The Bureau publishes a journal, bulletins and reports on important investigations and studies.

Bureau of Plant Industry created by Act No. 3639 and reorganized by Act No. 4007 (See Bureau of Agriculture.)

Bureau of Animal Industry.—This bureau was also created by Act No. 3639 and lately reorganized by Act No. 4007 (See Bureau of Agriculture).

Bureau of Public Welfare.—This bureau was the outcome of the former Public Welfare Board created on February 5, 1915, by Act No. 2510 of the Legislature. This Board was later reorganized and its name changed into Public Welfare Commission, by the provisions of Act No. 2988 approved on February 24, 1921, with a commissioner as the head of the Office. In 1933, on account of the reorganization Act No. 4007, its name was again changed and it became the Bureau of Public Welfare, being transferred from the control of the Department of the Interior to the Department of Public Instruction.

Bureau of Coast and Geodetic Survey.—The office of coast and geodetic survey established at the very beginning of the American government in the Philippines and administered under the direction of the Coast and Geodetic Survey of the U. S. Department of Commerce and Labor became what at present is known as the Bureau of Coast and Geodetic Survey, by the provisions of Act No. 1407, reorganizing in 1905 all the offices and bureaus of the Philippine Government. The Bureau was under the Department of Commerce and Police. In 1933, however, it was transferred to the Department of Public Works and Communications.

Among the government bureaus and offices already enumerated we shall also mention other official organizations created for purposes concerning some scientific studies or investigations, whether related or not to existing bureaus or offices.

Committee on Infant Mortality.—This committee was created by Act No. 2116 enacted on February 1, 1912, for the purpose of studying the causes of the high infant mortality in the Philippines and to submit the recommendations necessary to remedy the condition. It was originally contituted by Dr. W. E. Musgrave, as chairman, and Drs. Proceso Gabriel and Luis Guerrero as members. On February 11, 1913, Act No. 2246 was approved extending the term of the committee with the same functions and activities and at the same time increasing the number of its members to five. Accordingly, Drs. José Albert and Joaquin Quintos were appointed as additional members. The committee worked for about two years and submitted an extensive report which was printed in 1914, although not many copies of it were distributed.

Committees on Typhoid Fever.—Three committees for the study of the prevalence, causes and control of typhoid fever in the Philippines, especially in the city of Manila, were appointed by administrative action of the Director of Health. All of them submitted their reports and many of their recommendations were carried out. The first committee was appointed in 1916 by special order No. 11 of November 24 of the same year, and was composed of Dr. Hugh de Valin, Dr. P. Gabriel and Dr. H. W. Wade. Due to the absence of Dr. de Valin, the committee was reorganized, appointing Dr. L. R. Thompson in place of the former and adding two additional members: Dr. J. H. Linson and Dr. Rufino Abriol. A report was submitted and published in part in the Annual Report of the Philippine Health Service. The second committee was appointed by Administrative Order No. 4, paragraph 7, of April 7, 1922, and the third one was created by Special Order No. 7 of July 8, 1924, as amended by Special Order No. 8 of August 4, of the same year. Dr. L. Lopez-Rizal served as chairman of both committees with Dr. C. Leach, Major Roland, A. Davidson, Dr. Proceso Gabriel and Dr. M. V. Arguelles as members for the second committee and Drs. M. V. Arguelles, R. G. Padua, Francisco Gomez and Faustino Estrella as members, and Drs. G. R. Lary and Col J. F. Siler as advisers for the third committee. The committees submitted their reports in 1922 and 1925, respectively.

Committee on Leprosy.—This is a committee known as the Advisory Committee for the Control of Leprosy created by Executive Order No. 44 of January 4, 1927, composed of the Secretary of Public Instruction as member and chairman, six other members and one secretary. The composition of this committee was changed by Executive Orders No. 98 of January 17, 1928, No. 106 of May 21, 1928, No. 217 of November 5, 1929, No. 363 of March, 1932, No. 379 of July 1932, No. 382 of June, 1932, and No. 385 of August 19, 1932, amending the first one, No. 44. The purpose of the committee is to handle problems on leprosy and to advise as to the methods and procedures to be adopted from the administrative and technical view points.

Committee on Malaria Control (advisory).—This committee was created by Executive Order No. 39 of November 23, 1926, with the Secretary of Public Instruction as chairman, five members and one secretary. The original executive order was later amended by Executive Orders No. 63 of May 26, 1927, No. 169 of May 16, 1929, No. 247 of April 26, 1930, No. 304 of February 24, 1931, No. 318 of June 6, 1931, No. 362 of March 10, 1932, No. 383 of June 26, 1932, and No. 406 of February 23, 1933, changing the composition of its members. The committee is still functioning and entrusted with the work of advising on the plans and campaign for the control of malaria in the islands.

Committees on Beriberi Investigation.—Two committees were appointed for the purpose of studying and investigating the causes and factors contributing to the prevalence of beriberi in the islands and to recommend means and measures to reduce its high incidence. The first committee was appointed upon the suggestion of the Far Eastern Association of Tropical Medicine, by Administrative Order, dated November 20, 1923, of the Secretary of Public Instruction. It was composed of the following members: Dr. F. Calderon, Dr. José Albert, Dr. Jose Fabella, Dr. F. O. Santos, Major A. P. Hitchens, Mr. A. H. Wells (chemist), Dr. Isabelo Concepcion, Dr. P. Gutierrez, as members, and Dr. L. Lopez Rizal as chairman. The committee submitted its report on August 4, 1925. The second committee was approved by Administrative Order dated October 18, 1926, of the Honorable the Secretary of Public Instruction, and was composed of the following members: Dr. F. Calderon, Col. Ed. B. Vedder, Major A. P. Hitchens, Dr. Luis Guerrero, Dr. Liborio Gomez, Dr. José Fabella, Mr. A. H. Wells, Dr. Isabelo Concepcion, Dr. J. Albert, and Dr. F. O. Santos, as members, with Dr. L. Lopez Rizal as chairman. This committee submitted its report in September, 1928.

Committee on Cholera Vaccine.—For the purpose of studying the advisability of implanting and generalizing the use of anticholera vaccination in the Philippines, the Director of Health by Special Order No. 11, paragraph 9, dated November 10, 1919, appointed a committee composed of Dr. J. P. Bantug as chairman, and Drs. O. Schobl and Proceso Gabriel as members. After careful study and experimentation, the committee recommended the use of the cholera vaccines in its report submitted to the Director in 1920. The studies on cholera vaccination were furthered and some changes in the composition of the committee was made by Special Order No. 4, paragraph 16 of April 6, 1921.

Committee on Mental Hygiene.—Due to the recommendation and suggestion of the Colegio Médico-Farmacéutico de Filipinas after a discussion on mental hygiene problems held in its building in 1932, a committee on mental hygiene was appointed by His Excellency, the Governor-General, by Executive Order No. 400 issued December 31, 1932, for the purpose of studying the different factors and problems related to mental hygiene in the islands. After a year of study the committee submitted a preliminary report for the year 1933. The members of this committee are: Dr. Elias Domingo, chairman, Drs. T. Joson, J. Vergara, J. Fernandez, L. Pardo, M. Icasiano, Maria P. Mendoza, and Miss Edna A. Gerken.

Committee on Nutrition.—In view of the prevalence in the Philippines of many diseases the incidence of which is more or less directly influenced by the poor nutrition of the masses, a problem which aroused much discussion and interest on the part of the medical profession as well as of the laymen, His Excellency, the Governor-General of the Philippines, deemed it necessary to appoint a committee to study the situation as regards the nutrition of the different groups of the population. The committee was appointed by Executive Order No. 440 dated September 1, 1933, and is working as a coordinating agency for the different activities on nutrition of the various government and private offices and organizations.

Many other committees or organizations similar to those which have been described herein, having for their purpose the study of various aspects of science, were also created by executive orders, or by executive and departmental orders which we refrain from mentioning but which may, however, be found recorded in the different offices of the government.

National Research Council of the Philippine Islands.—This organization was created for the purpose of promoting research in sciences, of coordinating all researches and investigations, of gathering scientific and technical information, etc. It was created by Act No. 4120 of the Legislature approved on December 8, 1933, but its final organization took place on March 23, 1934. It published its Bulletin No. 1 in July, 1934.

PRIVATE ORGANIZATIONS

Private organizations have also contributed to a large extent to the promotion of science in the Philippines, not only since the beginning of the American occupation, but also, long before the Spanish government ceased. A brief account of the most important private associations and organizations established since the American occupation is hereinbelow given.

Colegio Médico-Farmacéutico de Filipinas.—Due to the pressing need of a solid association that, under the existing circumstances, might look after the welfare and interests of the medical and pharmaceutical professions, as well as to work for the promotion of science, the Colegio Médico-Farmacéutico was founded on June 8, 1899, by a group of leading native physicians and pharmacists of the Philippines. This is the first native medical organization so far established in the islands, that has fought for the rights and privileges of pharmacists and physicians and has helped, with its scientific meetings and assemblies and its monthly publication, to foster the medical and pharmaceutical sciences in the Philippines.

Manila Medical Society.—This society was organized on September 15, 1903, by the different elements of the medical community in the city of Manila. It also contributed by the works of its members to the progress of science in this part of the world through its scientific monthly meetings and its Bulletin. It may be said that the association originated what, is at present known as the *Philippine Islands Medical Association,* organized as a Philippine medical association, affiliated with the

American Medical Association. It organized different branches or daughter societies in different provinces of the Islands more or less after the pattern of the mother American Association. It holds annual scientific meetings and publishes its monthly medical journal, which is the continuation of the former Bulletin of the Manila Medical Society.

Gota de Leche (*Protección de la primera infancia*).—This organization was founded for the protection and care of infants in 1907 through the philanthropy of Mr. Dogherty, who donated the necessary amount for the building and the equipment. It was first established on San Pedro Street (now Evangelista) until it constructed its own building in Calle Lepanto.

The Far Eastern Association of Tropical Medicine was organized in Manila on March 1, 1908. This association held its first scientific meeting in Manila in 1909 and eight other congresses in the following countries: Hongkong, China, 1912; Saigon, Indo-China, 1913; Dutch East Indies, 1921; Singapore, F. M. S. 1923; Tokyo, Japan, 1925; Calcutta, British India, 1927; Bangkok, Siam, 1930, and Nanking, China, 1934, attended by the delegates and members of the countries affiliated.

The *Philippine Islands Antituberculosis Society* was organized in August, 1910, for the purpose of campaigning against the ravages of tuberculosis in the islands. It held the first National Tuberculosis Congress in the Philippines in 1926 sponsored by the government. This congress was held by authority of Act No. 3237 approved November 27, 1925.

The *Philippine Pharmaceutical Association* was organized in 1920 for the purpose of promoting pharmaceutical science and of looking after professional interests. It publishes a monthly journal and organizes scientific conventions and exhibitions.

The *Philippine Scientific Society* was organized in 1923 in Manila, and has held annual meetings. By resolution of its members, however, the meetings, beginning next year, will be biennial. The first and Second Philippine Science Conventions were held in 1932 and 1933 respectively under its auspices.

The *Los Baños Biological Club* was organized on November 15, 1923, for the purpose of fostering investigations and studies in biology by the members of the university colleges established in Los Baños, Laguna. It holds monthly scientific meetings except during summer.

Society for the Advancement of Research.—This association was organized on September 11, 1928, but was not definitely and formally inaugurated until September 10, 1930.

Philippine Society of Parasitologists.—This society was founded on August 20, 1930, for the advancement of the studies and investigations on parasitology. It holds monthly and annual meetings.

Journal Club of San Juan de Dios Hospital.—This club was organized among the members of the staff of San Juan de Dios Hospital in August, 1930. The purpose was to organize scientific meetings and to discuss the most important cases found in the clinics and wards of the hospital.

International Leprosy Association.—This association was founded on January 23, 1931. It held a meeting in Manila in the same year, attended by many delegates from different countries. The association publishes a journal on Leprosy.

Philippine Society of Stomatologists.—This organization was founded on April 30, 1931, composed of the practicing dentists in the city of Manila. It holds scientific meetings annually.

Philippine Public Health Association.—The idea of establishing an association of this kind was due to the need of having all public health workers organized for the promotion of public health. Preliminary work of organization was done immediately after the return of Director Jacobo Fajardo of the Bureau of Health from his trip abroad, but the first meeting of the organization was held in July, 1932. The association, however, was not formally organized until October 7, 1932, when its constitution was approved. It holds annual meetings and since its organization two meetings have already been held.

The *Philippine League Against Cancer* was established for the purpose of investigation of the problems of cancer and to study the causes and factors contributing to the incidence of this disease and also to formulate means and ways of controlling it. The organization of this league was worked out for several months before it was finally and definitely organized in 1934. It was incorporated on August 2, 1934.

Philippine Veterinary Medical Association is an association holding an annual convention for the promotion of veterinary medicine. It held its first convention in 1929.

Philippine Society of Civil Engineers.—This society was formerly the Philippine Institute of Engineers and Architects, incorporated on February 25, 1920. When the latter was reorganized and reincorporated on June 10, 1933, it took the name of Philippine Society of Civil Engineers.

Philippine Engineering Association.—This is a new association of engineers established just recently in Manila, for more or less the same purpose as the preceding society. It publishes a bulletin under the name of Philippine Engineering News.

As a supplement to this list of private associations we believe it is of some interest to add the following scientific journals, bulletins, etc., regularly issued, but giving preference to private ones. We are aware that the list is far from being complete.

Seismological Bulletin of the Weather Bureau, 1900.

Bulletin of the Philippine Islands Weather Bureau, Published in 1900.

Meteorological Bulletin of the same Bureau, published in 1900.

Philippine Journal of Science, published by the Bureau of Science in monthly numbers since 1906.

Bulletin of the P. I. Bureau of Animal Industry, published since 1931 by this Bureau.

Philippine Journal of Animal Industry, published by the Bureau of Animal Industry since 1934.

Technical Bulletin of the Bureau of Animal Industry. Its first number was published in 1933.

Gazette of the Bureau of Animal Industry began in 1931.

Quarterly Bulletin of the Bureau of Public Works, since 1912.

Water Supply Bulletin—Bureau of Public Works, 1923.

Natural and Applied Science Bulletin, published since October 1930 by the University of the Philippines.

Philippine Agriculturist, Los Baños, published since 1911.

Makiling Echo a quarterly publication of the Bureau of Forestry since 1921.

Philippine Agricultural Review, published by the Bureau of Agriculture from 1908 to 1929—in 1930 this Review became the *Philippine Journal of Agriculture.*

Monthly *Bulletin of the Bureau of Health* began its publication in July, 1931.

Health Messenger—Monthly publication of the Bureau of Health. Began in 1931.

Bulletin of the San Juan de Dios Hospital, published by the Hospital since 1927.

Revista Filipina de Medicina y Farmacia, published monthly by the Colegio Médico-Farmacéutico de Filipinas since 1910.

Journal of the Philippine Pharmaceutical Association, published by the Association in Manila since 1928.

Bulletin of the Manila Medical Society, a publication of the Manila Medical Society started in 1909. It is no longer published.

Journal of the Philippine Islands Medical Association—A monthly publication. Its first number was issued in 1921.

Construction—Monthly Journal of Engineering. Began in 1931.

Modern Home—Quarterly supplement of Architecture of "Construction", 1933.

Philippine Islands Dental Journal published monthly since 1931.

Welfare Advocate, published by the Public Welfare Commissioner's Office since 1927.

Medico-Dental Digest.—Publication began in 1931.

International Journal of Leprosy, published by the International Leprosy Association, Manila, in 1933.

Medical Gazette published in 1934.

Philippine Journal of Public Health—1934. Published by the Philippine Public Health Association.

Revista Boie, published monthly since 1919.

Unitas—Monthly publication of the University of Sto. Tomas (only during school course) since 1921.

Bulletin of the P. I. Antituberculosis Society—a publication on tuberculosis started in January, 1915, but discontinued since the year 1926.

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APPENDIX

LISTS OF HOSPITALS IN THE PHILIPPINES, THEIR NAMES, LOCATIONS, CLASSES AND BED CAPACITIES *

GOVERNMENT HOSPITALS

(Under the Bureau of Health, Department of Public Instruction)
Maintained either from Provincial Health Fund, Provincial General Fund, or Municipal General Fund

Name of Hospital	*Location*	*Class*	*Bed Capacity*
1. Antipolo Emerg. Hospital **	Antipolo, Rizal	General	6
2. Eladia Memorial	San Miguel, Bulacan ..	"	12
3. Iloilo Emerg. Hospital *	Mandurriao, Iloilo	"	24
4. Ilocos Norte Emer. Hospital	Laoag, I. Norte	"	12
5. Leyte Provincial Hospital	Tacloban, Leyte	"	20
6. Margosatubig Emerg. Hospital ..	Margosatubig, Zamb. ..	"	12
7. Mati Emerg. Hospital	Mati, Davao	"	6
8. Naga Provincial Hospital	Naga, Camarines Sur ..	"	22
9. Pikit Emerg. Hospital	Pikit, Cotabato	"	8
10. Puerto Princesa Hospital	Pto. Princesa, Palawan	"	26
11. San Pablo Hospital	San Pablo, Laguna ...	"	20
			168

Hospitals Financed by Insular Aid and Provincial Fund

1. Bayombong Hospital	Bayombong, Nva. Viz.	General	20
2. Bontoc Hospital ..	Bontoc, Mt. Province ..	"	35
3. Bukidnon Public Hospital	Malaybalay, Bukidnon .	"	14
4. Butuan Public Hospital	Butuan, Agusan	"	42

* From the December record of the Division of Hospitals, Bureau of Health.

** In operation only when necessity arises.

GOVERNMENT HOSPITALS—*Continued*

Name of Hospital	*Location*	*Class*	*Bed Capacity*
5. Cervantes Emerg. Hospital	Cervantes, I. Sur	General	8
6. Cotabato Public Hospital	Cotabato, Cotabato ...	"	40
7. Cuyo Hospital	Cuyo, Palawan	"	20
8. Davao Public Hospital	Davao, Davao	"	40
9. Kiangan Hospital .	Kiangan, Ifugao	"	15
10. Lanao Public Hospital	Dansalan, Lanao	"	50
11. Lubuagan Hospital	Lubuagan, Kalinga ...	"	8
12. Rizal Memorial Hospital	Dapitan, Zamboanga ..	"	30
13. Sulu Public Hospital	Jolo, Sulu	"	46
14. Zamboanga General Hospital	Zamboanga, Zamboanga	"	80
			448

Hospitals under Act No. 3114, as amended by Act No. 3168

Name of Hospital	*Location*	*Class*	*Bed Capacity*
1. Albay Provincial Hospital	Daraga, Albay	General	35
2. Antique Provincial Hospital	San Jose, Antique	"	10
3. Batangas Provincial Hospital	Batangas, Batangas ..	"	30
4. Bohol Provincial Hospital	Tagbilaran, Bohol	"	8
5. Bulacan Provincial Hospital	Malolos, Bulacan	"	30
6. Capiz Prov. Hospital	Calivo, Capiz	"	30
7. Ilocos Sur Provincial Hospital	Vigan, I. Sur	"	8
8. Laguna Prov. Hospital	Sta. Cruz, Laguna	"	55
9. Nueva Ecija Prov. Hospital	Cabanatuan, Nva. Ecija	"	50
10. Occ. Negros Prov. Hospital	Bacolod, Occ. Negros ..	"	62
11. Or. Misamis Prov. Hospital	Cagayan, Or. Misamis .	"	25
12. Pampanga Provincial Hospital	San Fernando, Pam. ..	"	50

GOVERNMENT HOSPITALS—*Continued*

Name of Hospital	Location	Class	Bed Capacity
13. Pangasinan Provincial Hospital	Dagupan, Pangasinan .	General	50
14. Sorsogon Provincial Hospital	Sorsogon, Sorsogon ..	"	25
15. Tarlac Prov. Hospital	Tarlac, Tarlac	"	30
16. Tayabas Prov. Hospital	Lucena, Tayabas	"	80
			578

Hospitals Financed by Insular Fund

Name of Hospital	Location	Class	Bed Capacity
1. Baguio Hospital ..	Baguio, Benguet	General	89
2. Insular Psychopathic Hospital	Mandaluyong, Rizal ...	Insane	800 [1]
3. Maternity House and Children's Hospital	Gral. Solano	Maternity and Children	110
4. San Lazaro Hospital	Sta. Cruz, Manila	Infectious	679 [2]
5. Southern Islands Hospital	Cebu, Cebu	General	110
6. Culion Leper Colony Hospital	Culion, Palawan	Leper	500
			2288

SEMI-GOVERNMENT HOSPITALS [3]

Name of Hospital	Location	Class	Bed Capacity
1. Abuyog Maternity House	Abuyog, Leyte	Maternity	5
2. Argao Maternity House	Argao, Cebu	"	10
3. Bacolod Maternity and Children's Hospital	Bacolod, Occ. Neg.	Maternity and Children	60
4. Balayan Maternity House	Balayan, Batangas ...	Maternity	6
5. Barili Maternity House	Barili, Cebu	"	9
6. Bato Maternity House	Bato, Leyte	"	4

[1] Dormitory beds.
[2] Including 406 dormitory beds for lepers.
[3] Partly supported by insular funds and partly by private contributions.

SEMI-GOVERNMENT HOSPITALS—*Continued*

Name of Hospital	*Location*	*Class*	*Bed Capacity*
7. Cadiz Maternity House	Cadiz, Occ. Negros	Maternity	8
8. Cantilan Maternity House	Cantilan, Surigao	"	8
9. Cebu Maternity House	Cebu, Cebu	"	57
10. Escalante Maternity House	Escalante, Occ. Negros	"	4
11. Guihulngan Maternity House	Guihulngan, Or. Negros	"	4
12. Hilongos Maternity House	Hilongos, Leyte	"	6
13. Isabela Maternity House	Isabela, Occ. Negros ..	"	27
14. Jimenez Maternity House	Jimenez, Occ. Misamis	"	14
15. Kabankalan Maternity House	Kabankalan, Occ. Neg.	"	17
16. Laoag Maternity House	Laoag, Ilocos Norte ..	"	12
17. Maasin Maternity House	Maasin, Leyte	"	6
18. Mambajao Maternity House	Mambajao, Or. Misamis	"	10
19. Masbate Maternity House	Masbate, Masbate	"	3
20. Opon Maternity House	Opon, Cebu	"	4
21. Ormoc Maternity House	Ormoc, Leyte	"	4
22. Pagsanjan Maternity House	Pagsanjan, Laguna ...	"	9
23. Pitogo Maternity House	Pitogo, Tayabas	"	5
24. San Miguel Maternity House	San Miguel, Bulacan ..	"	2
25. Silay Maternity House	Silay, Occ. Negros ...	"	24
26. Sorsogon Maternity House	Sorsogon, Sorsogon ...	"	11
27. Surigao Maternity House	Surigao, Surigao	"	8
28. Tacloban Maternity House	Tacloban, Leyte	"	6

SEMI-GOVERNMENT HOSPITALS—*Continued*

Name of Hospital	*Location*	*Class*	*Bed Capacity*
29. Tanauan Maternity House	Tanauan, Leyte	Maternity	22
30. Tuburan Maternity House	Tuburan, Cebu	"	6
31. Unisan Maternity House	Unisan, Tayabas	"	3
32. Victorias Maternity House	Victorias, Occ. Negros	"	6
33. Municipal Hospital and Sanatorium ..	Cavite, Cavite	Tb.	6
			386

LEPROSARIA AND LEPER TREATMENT STATIONS

1. Bicol Treatment Station	Legaspi, Albay	Trt. Sta.	141
2. Culion Leper Colony Hospital *	Culion, Palawan	Leper	500 *
3. Eversley Childs Treatment Station	Mandawe, Cebu	Trt. Sta.	600
4. Mindanao Central Treatment Station	Sta. Cruz, Zamb.	" "	50
5. San Lazaro Hospital *	" " Manila ..	Leper	406 *
6. Western Visayas Treatment Station	Sta. Barbara, Iloilo ..	Trt. Sta.	250
7. Lanao Treatment Station	Dansalan, Lanao	" "	(**)
8. Sulu Treatment Station	Jolo, Sulu	" "	20
			1967

INSULAR GOVERNMENT HOSPITALS

(*Under the Bureau of Public Welfare*)

1. Welfareville Hospital	Mandaluyong, Rizal ...	General	100

(*Under the Department of Public Instruction*)

1. Philippine General Hospital	Taft Ave., Manila	General	651

* Already included in "Hospitals Financed by Insular Fund."
** Not reported.

INSULAR HOSPITALS—*Continued*

Name of Hospital	Location	Class	Bed Capacity
(Under the Department of Justice)			
1. Bilibid Prisons Hospital	Sta. Cruz, Manila	General	300
2. Iwahig Penal Colony Hospital	Iwahig, Palawan	"	82
3. San Ramon Penal Colony Hospital ..	Zamboanga, Zamb. ...	"	32
			414
(Under the University of the Philippines)			
1. U. P. Infirmary ...	Padre Faura, Manila ..	General	20
2. U. P. Los Baños Infirmary	Los Baños, Laguna ...	"	20
			40

FEDERAL GOVERNMENT HOSPITALS

Name of Hospital	Location	Class	Bed Capacity
(Military and Naval)			
1. Camp John Hay Hospital	Baguio, Benguet	General	50
2. Camp Stotsenburg Hospital	Angeles, Pampanga ...	"	72
3. Cañacao Hospital .	Cavite, Cavite	"	150
4. Fort McKinley Hospital	Pasig, Rizal	"	220
5. Fort Mills Hospital	Corregidor, Cavite	"	150
6. Petit Barracks Hospital	Zamboanga, Zamboanga	"	26
7. Sternberg General Hospital	Arroceros, Manila	"	250
			918

PRIVATE HOSPITALS

Name of Hospital	Location	Class	Bed Capacity
(Mission Hospitals)			
1. Bethany Hospital .	Tacloban, Leyte	General	34
2. Davao Mission Hospital	Davao, Davao	"	40
3. Dumaguete Mission Hospital	Dumaguete, Or. Negros	"	50
4. Emmanuel Mission Hospital	Capiz, Capiz	"	70
5. Frank Dunn Mission Hospital	Vigan, I. Sur	"	35

PRIVATE HOSPITALS—*Continued*

Name of Hospital	*Location*	*Class*	*Bed Capacity*
6. Hospital Notre Dame de Lourdes .	Baguio, Benguet	General	30
7. Manila Sanitarium and Hospital	Malate, Manila	"	45
8. Mary Chiles Hospital	Sampaloc, Manila	"	95
9. Mary Johnston Hospital	Tondo, Manila	"	120
10. Milwaukee Hospital	Legaspi, Albay	"	29
11. Misamis Mission Hospital	Cagayan, Or. Misamis .	"	52
12. Presbyterian Mission Hospital	Tagbiliran, Bohol	"	24
13. Sallie Long Read Hospital	Laoag, I. Norte	"	40
14. St. Luke's Hospital	Binondo, Manila	"	125
15. St. Mary, the Virgin Dispensary and Hospital	Sagado, Mt. Prov. ...	"	25
16. San Juan de Dios Hospital	Intramuros, Manila ..	"	236
17. St. Paul's Hospital	Intramuros, Manila ..	"	120
18. St. Paul's Hospital	Iloilo, Iloilo	"	100
19. Union Mission Hospital	Iloilo, Iloilo	"	86
20. United Brethern Hospital	S. Fernando, La Union	"	38
21. Brent (Zamb.) Mission Hospital ..	Zamboanga, Zamboanga	"	35
			1429

(*Society Hospitals*)

1. Camilla Simpson Hospital	Olangapo, Zambales ..	General	25
2. Chinese General Hospital	Sta. Cruz, Manila	"	150
3. Chinese (Chong Hoa) Hospital ...	Cebu, Cebu	"	20
4. Clinica Medico-Quirurgica del Dr. Pio E. Valencia ..	Cebu, Cebu	"	17
5. Davao Oriental Hospital, Inc. . ..	Davao, Davao	"	30

PRIVATE HOSPITALS—*Continued*

Name of Hospital	*Location*	*Class*	*Bed Capacity*
6. Dagupan Hospital	Dagupan, Pangasinan .	General	8
7. Dr. Cruz' Maternity and Women's Hospital	Tondo, Manila	Maternity and Women	30
8. Harrison Hospital and Maternity ...	Pasay, Rizal	General	15
9. Hospital de Calauan	Calauan, Laguna	"	12
10. Hospital Español de Santiago	Makati, Rizal	"	34
11. Hospital San Diego	Tacloban, Leyte	"	25
12. Hospital Sta. Teresita	Legaspi, Albay	"	15
13. Japanese General Hospital	Sampaloc, Manila	"	20
14. Lerma Hospital ..	San Fernando, La Union	"	17
15. Manila Height Hospital	San Juan, Rizal	"	100
16. Pasig Hospital	Pasig, Rizal	"	10
17. Mercy Hospital ..	Pasay, Rizal	"	20
18. San Ramon Maternity and Children's Hospital	S. Roque, Cavite	Maternity and Children	14
19. St. Raphael's Hospital	Lucena, Tayabas	General	25
20. St. Joseph's Hospital	Quiapo, Manila	"	75
21. St. Theresita's Hospital	Sampaloc, Manila	"	65
22. Santol Tuberculosis Sanatorium ...	Caloocan, Rizal	Tb.	225
23. The Sacred Heart Hospital	Paco, Manila	Maternity and Children	16
24. Virgin Milagrosa Hospital	Naga, Cam. Sur	General	20
			988

(*Industrial Hospitals*)

1. Binalbagan Hospital	Binalbagan, Occ. Neg.	General	4
2. Calamba Sugar Estate Hospital	Canlubang, Laguna ..	"	24

PRIVATE HOSPITALS—*Continued*

Name of Hospital	*Location*	*Class*	*Bed Capacity*
3. Del Carmen Hospital	Del Carmen, Pampanga	General	37
4. Ilco Hospital	Fabrica, Occ. Negros ..	"	50
5. Japanese (Mintal) Hospital	Davao, Davao	"	100
6. Kolambugan Hospital	Kolambugan, Lanao ...	"	12
7. Pathfinder Hospital	San Jose, Mindoro	"	10
8. Plantation Hospital	Kabasalan, Zamboanga	"	50
9. Hospital de la Central Azucarera de Tarlac	S. Miguel, Tarlac	"	26
			313

OUR FOREIGN SCIENTIFIC RELATIONS

By VIDAL A. TAN
Of the University of the Philippines
Secretary, Division of Government, Foreign and Educational Relations, and Chairman, Section of Foreign Relations

I. GENERAL REMARKS

Our foreign relations, in so far as the advancement of science in the Philippines is concerned, have been rather limited. In fact most of our contacts have been made only recently, during the last thirty years. The paucity of our connections with the outside world of science is traceable to two primary causes. The first is our relative immaturity in scientific endeavors; and the second is our financial condition as a people which makes of our geographical isolation a serious handicap..

However, in spite of these obstacles, the progress of science in this country has not been altogether unheard of in other countries. Neither have we been entirely isolated from nor unaware of the inspiring progress which science has made elsewhere for the enrichment of civilization and the enhancement of the happiness and comfort of mankind.

It is true that we cannot boast of lavishly equipped scientific expeditions to the North Pole or to the jungles of Africa. It is true that we have not sent Filipino scientists to foreign centers of learning, there to pursue leisurely pure research work, ignoring time and expense. But within our modest means we have tried our best not only not to lag behind, but also to forge ahead.

II. SCIENTIFIC CONGRESSES

Our government has been until lately quite liberal in allowing our scientists to attend various scientific conventions, thus preserving those personal contacts which are so vitalizing.

In 1908, the Philippine Government sent two delegates to the Sixth International Congress on Tuberculosis held in Washington, D. C., from September 28 to October 5. At this meeting Dr. Victor G. Heiser presented a paper entitled, "The Tuberculosis Problem in the Philippine Islands and the Elimination of

Intestinal Parasites as the First Solution"; and Dr. Fernando Calderon, his "Notes on Tuberculosis in the Philippine Islands."

In the same year the Philippines went one step further by founding the Far Eastern Association of Tropical Medicine. The first meeting of the association was held in Manila, on March 5, 1910. Representatives came from the Federated Malay States, the Netherlands East Indies, Japan, Hongkong, Ceylon, India, Java, and the Strait Settlements.

The Second Biennial Congress of the Far Eastern Association of Tropical Medicine was held in Hongkong, from January 20 to 27, 1912. At this meeting we were represented by Dr. Victor G. Heiser, Dr. Paul C. Freer and Dr. R. P. Strong.

In 1931, the International Conference on Leprosy was held in Manila, from January 9 to 23, under the auspices of the Leonard Wood Memorial. The conference was attended by representatives from the League of Nations, the British Empire, the Governments of India, Formosa, Federated Malay States, Dutch Guiana, Japan, Hawaii, French Indo-China, Philippine Islands, and such other entities as the Rockefeller Foundation, the Henry Lester Institute of Medical Research in Shanghai and others.

The other scientific congresses in which we have participated are listed below in their chronological order. As shown by the Proceedings of these congresses, a number of papers have been contributed by representatives from the Philippine Islands.

1912—*Eighth International Congress of Applied Chemistry*
Washington, D. C., September 4 to 13.
Philippine delegate:—DR. PAUL C. FREER.

1913—*Third Biennial Congress of the Far Eastern Association of Tropical Medicine.*
Saigon, French Indo-China, November 8 to 15.
Philippine delegates:—DRS. VICTOR G. HEISER, E. L. WALKER, M. A. BARBER and C. S. BUTLER (U. S. Navy).

1914—*Third International Congress on Tropical Agriculture.*
Imperial Institute, London, S. W., June 23 to 30.
Philippine delegate:—MR. O. W. BARRETT of the Bureau of Agriculture.

1920—a. *General Engineering Congress.*
Batavia, Java, May 8 to 15.
Philippine delegates:—Messrs. J. PAEZ, EMILIO QUISUMBING, LUIS FRANCISCO, O. H. BEYER, Ex-auditor DEXTER, A. TOLEDO, Director T. GUINGONA, and TEODORO KALAW.

b. *First Pan Pacific Scientific Conference.*

Honolulu, Hawaii, August 2 to 20.

Official delegates for the Philippines:—DRS. W. J. FISCHER, LEON MA. GUERRERO, ELMER D. MERRILL, and FATHER MIGUEL SADERA MASO.

1921—*Fourth Congress of the Far Eastern Association of Tropical Medicine.*

Weltevreden, Batavia (Dutch East Indies) August 6 to 13.

Official delegate for the Philippines:—DR. T. H. PARDO DE TAVERA. DRS. S. V. DEL ROSARIO and L. LOPEZ RIZAL were the representatives of the Philippine Bureau of Health.

1923—a. *Pan-Pacific Science Congress.*

Melbourne and Sydney, Australia, August 22 to September 3.

Official Representatives for the Philippines:—MR. VICTORIANO ELICAÑO, DR. CRISTOBAL MANALANG, REV. MIGUEL SELGA, and DR. STANTON YOUNGBERG.

b. *Fifth Congress of the Far Eastern Association of Tropical Medicine.*

Malaya, Singapore, September 3 to 17.

Official delegates for the Philippines:—Hon. E. A. GILMORE, Prof. F. G. HAUGHWOT, DR. W. H. WADE, DR. L. LOPEZ RIZAL and DR. P. D. GUTIERREZ.

1925—*Sixth Biennial Congress of the Far Eastern Association of Tropical Medicine.*

Tokyo, Japan, October 12 to 17.

Official delegates for the Philippines—DRS. L. LOPEZ RIZAL, CRISTOBAL MANALANG, OTTO SCHOBL, and DR. AGERICO B. M. SISON.

1926—a. *Seventh International Dental Congress.*

Philadelphia, U. S. A., in August.

Delegate for the Philippines:—DR. ELADIO R. ALDECOA.

b. *International Health Conference.*

Melbourne, Australia, in November.

Delegate for the Philippines:—DR. EUSEBIO D. AGUILAR.

c. *International Botanical Congress.*

Cornell University, Ithaca, New York.

Delegates for the Philippines:—Messrs. JUAN RODRIGUEZ, JULIAN AGATI, ALEXANDER GORDON, FELIPE T. ADRIANO, and DR. WILLIAM H. BROWN.

d. *Third Pan-Pacific Science Congress.*

Tokyo, Japan, October 30 to November 11.

Official delegates for the Philippines:—DRS. ANTONIO ALVIR, WILLIAM H. BROWN, MR. VICTORIANO ELICAÑO, DRS. JOSE M. FELICIANO, BIENVENIDO M. GONZALEZ, ALBERT W. HERRE, HILARIO LARA, REVS. ROQUE R. ROAÑO, and MIGUEL SELGA. DR. ALVIR was the representative of the Philippine Scientific Society.

e. *First National Congress on Tuberculosis.*

Manila, P. I. December 13 to 18.

Delegates for foreign countries:—DR. VICTOR C. VAUGHAN, delegate for the United States. Col. E. H. BURNS, delegate for the National Tuberculosis Association of the United States. Major General H. M. NEEB, delegate for the Dutch East Indies, and Col. PHYA DAMRONG, representative for the Siam Red Cross Society.

1927—*Seventh Congress of the Far Eastern Association of Tropical Medicine.*

Calcutta, British India, December 5 to 24.

Official delegates for the Philippines:—DRS. JOSE FABELLA and OTTO SCHOBL, and MAJOR A. PARKER HITCHENS; and the other members of the delegation were:—DRS. WALFRIDO DE LEON, GABRIEL INTENGAN, and CRISTOBAL MANALANG.

1928—*First Pan-Pacific Women's Conference.*

Honolulu, Hawaii, August 9 to 19.

Official delegates for the Philippines:—DRA. PAZ MENDOZA-GUAZON and Mrs. SOFIA R. DE VEYRA.

1929—a. *Third Triennial Conference of the International Society of Sugar Cane Technologists*

Souerabaya, Java, June 7 to 19.

Official delegates for the Philippines:—DRS. LEOPOLDO B. UICHANCO and MANUEL L. ROXAS.

Private delegates for sugar central

Southern Luzon:—Messrs. F. GANA, J. HEMEDES, and JUAN O. CHIOCO.

b. *Fourth Pacific Science Congress.*

Batavia and Bandoeng, Java, May 16 to 25.

Official delegates for the Philippines:—DRS. WILLIAM H. BROWN, LEOPOLDO A. FAUSTINO, ROBERT L. PENDLETON, REV. WILLIAM REPETTI, DR. LEOPOLDO B. UICHANCO, Prof. ARTHUR F. FISCHER, and Messrs. JOSE S. CAMUS and PLACIDO DACANAY.

c. *World's Engineering Congress.*

Tokyo, Japan.

Delegates for the Philippines: Messrs. JOSE BAGTAS, ANTONIO TOLEDO, NICANOR CORTEZ, T. MACABULOS, and TEOFILO REYES.

d. *In the same year, the Philippine Government was invited to send delegates to the Pan Pacific Surgical Conference held in Honolulu, Hawaii.*

1930—*Second Pan-Pacific Women's Conference.*

Honolulu, Hawaii, August 9 to 23.

Official delegate for the Philippines:—MRS. PETRA V. LIGOT.

1931—*International Conference on Leprosy.*

Manila, P. I., January 9 to 23.

Delegates for foreign countries:—DR. ET. BURNET for the League of Nations, DR. R. G. COCHRANE for British Empire, MAJ.-GENERAL J. D. GRAHAM for India, DR. G. GUSHUE-TAYLOR for Formosa, DR. V. G. HEISER for Rockefeller Foundation, DR. LEE S. HUIZENGA for Mission Hospital, Jukao, Ku, China, DR. A. N. KINGSBURY for Federated Malay States, CAPT. P. H. J. LAMPE for Dutch Guiana, DR. J. LOWE for India, DR. J. L. MAXWELL for Henry Lester Institute of Medical Research, Shanghai, DR. E. MUIR for Calcutta School of Tropical Medicine, DR. E. E. NEFF for Mogokai Central Leper Hospital, Fiji, PROF. DR. B. NOCHT for the League of Nations, DR. M. OTA for Japan, DR. J. C. TULL for Singapore, DR. N. E. WAYSON for Hawaii, DRS. LEROY-DESBARRES and H. JOYEOUX for French Indo-China.

1932—*Fifth Pacific Congress.*

Victoria, Vancouver, British Columbia, Canada. May 23 to June 4.

Attending delegate from the Philippines:—Rev. W. REPPETTI, S. J. The official delegates, Messrs. L. FAUSTINO and Father MIGUEL SELGA were unable to attend.

1934—*The Ninth Congress of the Far Eastern Association of Tropical Medicine*

Nanking, China, October 3 to 8.

Philippine delegate:—DR. ANTONIO G. SISON; DR. SISON was elected vice-president of the association for the Philippine Islands.

III. MEMBERSHIP IN SCIENTIFIC ORGANIZATIONS

Our connections with scientific organizations abroad have been established mainly through individual membership in such organizations of Filipino scientists now scattered in the different branches of the government, in some of the institutions of higher learning and in a few commercial houses. As exceptions to the above statement, however, the membership of the College of Medicine, University of the Philippines, in the American Association of Medical Colleges, and that of the School of Pharmacy of the same university in the American Association of Colleges of Pharmacy should be mentioned.

The following list gives most of the scientific societies wherein our scientists are holding membership.

The Institute of Agriculture of Rome
The American Society of Agricultural Engineers
The American Society of Agronomy
The American Association of Anatomists
The Society of Automotive Engineers
The Society of American Bacteriologists
The Botanical Society of America

The Indian Botanical Society
The American Breeder Association
The American Chemical Society
The Society of Chemical Industry of London
Deutsche Chemische Gesellshaft
The Boston Society of Civil Engineers
The Conchological Society of Great Britain and Ireland
The Crop Protection Institute
The American Society of Electrical Engineers
The Entomological Society of America
The American Society of Foresters
The National Geographic Society
The American Public Health Association
The American Horticulturists Society
The Connecticut Horticultural Society
The American Society of Ichthylogists and Herpeologists
Deutsche Keramische Gesellshaft
International Association of Leprosy
The American Mathematical Society
The Mathematical Association of America
The American Society of Mechanical Engineers
The American Malacological Union
The American Medical Association
The Institute of Mining and Metallurgical Engineers
The American Museum of Natural History
Deutsche Gesellshaft fuer Naturforscher und Arzte
The Paleontological Society of America
The American Society of Parasitologists
The American Phyto-Pathological Society
The American Pharmaceutical Association
Deutsche Pharmakologische Gesellshaft
The American Physical Education Association
The Oriental Physical Education Association
The American Poultry Association
The World's Poultry Association
The International Faculty of Sciences (London)
The American Association for the Advancement of Science
The Pan-Pacific Science Club
The Wisconsin Academy of Science
The Sigma Xi
The International Society of Soil Science
The American Soil Survey Association
The American Society of Tropical Medicine
The German Association of Tropical Medicine
The Royal Society of Tropical Medicine and Hygiene
The Far Eastern Association of Tropical Medicine
The American Veterinary Medical Association
The American Society of Zoologists

IV. EXCHANGE PROFESSORS AND OTHER CONTRACTED SCIENTISTS

From time to time we have been fortunate in securing the services, though only for short periods, of eminent scientists from Europe and America. Most of them were engaged to give lectures in the University of the Philippines, some come as messengers of good will from friendly nations and one has just arrived as an exchange professor from the University of Michigan to give some lectures in botany in our state institution. Through these means, this center of learning has been able to have the following professors:—

In 1922, DR. WILLIAM S. CARTER, formerly Dean of Texas Medical School and until lately Associate Director in the Division of Medical Sciences of the Rockefeller Foundation. He came to the University of the Philippines at the expense of the Rockefeller Foundation to head the Department of Physiology of the College of Medicine.

In 1927, DR. EARL BALDWIN MCKINLEY, State Director, International Health Division of the Rockefeller Foundation, and formerly Director, School of Tropical Medicine at Porto Rico, served as a professor and lecturer on sanitary bacteriology in the School of Hygiene and Public Health. In the same year, Engineer J. J. MIELDAZES, special member of the field staff of the International Health Division of the Rockefeller Foundation, lectured regularly on sanitary engineering at the School of Hygiene and Public Health, University of the Philippines. He was relieved by Dr. MORIARTY of the same field staff of the International Division.

In 1929, Professor R. GOLDSCHMIDT, *Director of the Kaiser Wilhelm Institute of Biology.* He lectured on sex-determination in the Colleges of Liberal Arts and Agriculture, University of the Philippines.

In 1932, Professor RICHARD WOETERECK, *Research Professor of Zoology in the University of Leipzig and Director of Biological Laboratory of Seeon, Bavaria.* He lectured in the College of Agriculture, University of the Philippines.

In 1934, Professor B. NOCHT, *Emeritus Director of the Hamburg Institute of Tropical Medicine* and formerly vice-president of the Health Section of the League of Nations. He came here to lecture in the School of Hygiene and Public Health, University of the Philippines.

In 1934, DR. FRANCISCO L. UREÑA, *Medico por Oposición de la Beneficencia Municipal de Madrid* lectured in the College of Medicine, University of the Philippines.

In 1935, Professor JULIO PALACIOS was sent by the Spanish Government on a good will tour to this country. He lectured in January in the University of the Philippines and in the University of Santo Tomas on modern scientific topics.

In 1935, Professor H. H. BARTLETT, arrived in January as an exchange professor from the University of Michigan to lecture on botany in the University of the Philippines.

From 1929 to 1930 the School of Hygiene and Public Health of the University of the Philippines has been favored by the Rockefeller Foundation by sending to the Philippines as visiting professors to head each of the departments of parasitology and of sanitary bacteriology and immunology, respectively, such distinguished scientists as Dr. Robert W. Hegner, Professor and Head of the Department of Parasitology of the School of Hygiene and Public Health of Johns Hopkins University, who was succeeded by Dr. Justin M. Andrews, Associate Professor of Parasitology in the School of Hygiene and Public Health of the same university, and Dr. William B. Wherry, Professor and Head of the Department of Bacteriology and Hygiene in the University of Cincinnati who was succeeded by Dr. Wade W. Oliver, Professor of Bacteriology and Head of the Department of Bacteriology of the Long Island College Hospital.

The expenses for salaries and travel of these visiting professors and their families were defrayed by the Rockefeller Foundation, in addition to ₱20,000 donated to the University of the Philippines for supplies and equipments of the School of Hygiene and Public Health. Later the Foundation donated $150,000.00 (₱302,471.31 including exchange) for the construction of the new building of the School of Hygiene and Public Health, completing the symmetry of the buildings that composed the medical science group of the State University.

We have also had the services as professorial lecturers of the following distinguished men of science, among others:

DR. VICTOR C. VAUGHAN, *Chairman, Division of Medical Sciences, National Research Council of America, and formerly Dean of the Medical School of the University of Michigan.*

DR. PAUL F. RUSSEL, *Member, International Health Division, Rockefeller Foundation.*

DR. C. H. YEAGER, *Member, International Health Division, Rockefeller Foundation.*

This source of contact with the scientific world is not only instructive, but also inspiring. It creates lasting friendhips between individuals and nations and serves as an added impetus to our scientific endeavors.

V. FOREIGN SCHOLARSHIPS

Through the courtesy and generosity of the Rockefeller Foundation, the University of Michigan, the National Research Council of America, the International Education Board, and the Guggeinheim Foundation, many Filipino scientists and scholars have enjoyed the privilege of study abroad. In the list of our benefactors, the Rockefeller Foundation stands at the top in the number of beneficiaries.

Through this foundation, Filipino doctors of medicine were able to take advanced work in medicine, especially along the lines of hygiene and sanitation. The same institution donated a two-hundred-thousand-peso building to house the School of Hygiene and Public Health of the University of the Philippines.

The University of Michigan through its Barbour Scholarship has been giving liberal pensions to Filipino women. The recipients of this kind of scholarship are obliged to do their work in the University of Michigan.

The Guggenheim Fellowship has so far been enjoyed by only one Filipino. Dr. Hilario A. Roxas, formerly of the Department of Zoology, University of the Philippines, now of the Bureau of Science enjoyed its privileges for a year. He studied in the Zoologisches Museum der Universitat in Berlin in 1932.

In 1926, Dr. Eduardo Quisumbing, formerly of the University of the Philippines and now of the Bureau of Science, earned the distinction of being awarded a two-year fellowship by the National Research Council of America. Dr. Quisumbing is a botanist. Under this fellowship he pursued advanced work and research in the University of California.

In the same year, Dr. Nemesio B. Mendiola of the College of Agriculture, University of the Philippines, received a fellowship in Agriculture from the International Education Board (with offices in New York City) which enabled him to go to Java.

Recipients of Fellowship from the Rockefeller Foundation

1. JOSE I. ABUEL	Surgery	1925-26
2. NARCISO CORDERO	Physiology	1925-27
3. FIDEL CUAJUNCO	Anatomy	1925-27
4. CARLOS MONSERRAT	Pathology and Bacteriology	1928-29

5. MARCIANO LIMSON	Anatomy	1928-30
6. PABLO I. DE JESUS	Sanitary Engineering	1928-30
7. WALFRIDO DE LEON	Pathology & Bacteriology .	1922-24
8. EMILIO BULATAO	Physiology	1923-24
9. CANDIDO M. AFRICA	Parasitology	1930-31

Barbour Scholars

1. MARIA LANZAR	Political Science	1923-28
2. MARIA PASTRANA	Botany	1927-32
3. ROSA JAVIER	English	1926-28
4. PAULINA VERZOSA	Botany	1929 (6 mo.)
5. MARIA KALAW	English	1932-33
6. PURA SANTILLAN	French	1929 to date
7. ADELAIDA BENDAÑA	Chemistry	1930 to date
8. ROSARIO REYES	Medicine	1933 to date

VI. FOREIGN VISITATION

The first two Barbour scholars in the above list took their doctor's degree (Ph.D.) in the University of Michigan under this scholarship. Dr. Encarnacion Alzona received in 1933 a Barbour fellowship, which, although given by the same foundation, is different from the Barbour scholarship.

Under this heading the writer wishes to include those scientists who came here to conduct certain investigations for their governments. While it is true that to them the Philippines served only as a laboratory, nevertheless their presence in this country furnished a means of contact with other countries that indirectly might have helped us in our scientific development. The first of these dates as far back as 1797 when the well equipped Malaspina Expedition from Spain visited our shores for the purpose of collecting and making studies in navigation, meteorology and hydrography. This expedition is dealt with in greater detail in an article appearing in this report of Director Eulogio B. Rodriguez. In the same paper of the director appear six geologists who came here prior to the American regime.

During the American administration, the Bureau of Science has extended the use of each laboratories and the results of its investigations to Japanese scientists. Under this arrangement the following Japanese army and navy officers have enjoyed the facilities of the Bureau of Science.

1. MAJ. T. FUJURO, I.J.A.		
2. CAPT. KANICHIRA MORISHIMA, PH.D., M.D., *Med. Corps*, I.J.A.	1924-25	Tropical diseases
3. LT. SURGEON KODO YASUYAMA, I.J.N.	1925-26	" "

4. Lt. Col. Bunshiro Tanabe, *Medical Corps*, I.J.A.	1927-28	Tropical diseases
5. Lt. Surgeon Isao Miyao, I.J.N.	1928-30	Serology & immunity
6. Lt. Col. Hayahi Hirano, I.J.A.	1930-32	Tropical diseases
7. Lt. Surgeon Shizuka Arima, I.J.N.	1932-34	" "
8. Maj. Kohei Sugino, *Military Surgeon*, I.J.A.	1934 to date	" "

In 1929, upon the occasion of a solar eclipse, three scientific expeditions visited this country to make certain solar observations and to check up on Einstein's Theory of Relativity. These parties chose different places in the Philippines to make their observations. From information obtained from Dean Edward Hyde, it seems that the German party was not as fortunate as the English, because the sky at the place chosen by the former happened to be covered by clouds at the time of the eclipse. The following list gives the pertinent facts about these expeditions.

SOLAR ECLIPSE EXPEDITIONS MAY 9, 1929

The English Party (British Royal Astronomical Society)

Members:

Drs. L. R. Waterfield, and Lloyd. They were accompanied by Prof. C. Ortigas, College of Engineering, University of the Philippines.

Place of Observation:

La Paz, Iloilo (on the grounds of the Iloilo Normal School)

The German Party (Hamburg Observatory)

Members:

Dr. Baade and Herr Schmidt. They were accompanied by Dean E. Hyde and Prof. Melchor of the College of Engineering, University of the Philippines, and some men from the Philippine Weather Bureau were also with this party.

Place of Observation:

Sogod, Cebu.

The Philippine Weather Bureau Party

Members:

Father Miguel Selga and Father Charles Deppermann, with some assistants.

Place of Observation:

On the grounds of Colegio de San Agustin, Iloilo.

The U. S. Naval Observatory Party

Place of Observation:

Lapus-lapus, Iloilo.

In July, 1933, a Chinese delegation headed by Dr. Rui Feng, director of Forestry and Agriculture for Kwantung, came to study our methods of "management of agricultural and forest resources." [1] The party is composed of Colonel Lui Tingeng, General in Leungyung, Shul Swei-shing and W. K. Smith (technical adviser).

The courtesy shown the various visiting scientists from other lands reveals the broad-minded policy of our government towards science in general. It is with pleasure and pride that we point to this liberal attitude, because science will advance faster and will contribute greater benefits to humanity if its silent workers can cooperate together and place their goal beyond mere geographical frontiers.

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[1] The Manila Daily Bulletin, July 18, 1933.

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THE PHILIPPINES IN THE WORLD OF SCIENCE

By LEOPOLDO B. UICHANCO
Of the University of the Philippines
Chairman, Section of Entomology

A long period—over two hundred years—was to elapse from the implantation of Spanish sovereignty in the Archipelago by Legaspi in 1565 before the colonizers could direct their attention to activities leading to the economic and social development of the country. On August 27, 1780, Charles III of Spain, who was described by Peers (1929) as "far-seeing, patriotic, enlightened, the best ruler Spain had had for generations," issued a royal decree ordering the governor of the Philippines to convene all the learned and competent persons in the colony "in order to form an association of selected persons capable of producing useful ideas." (MONTERO y VIDAL, 1887). Curiously enough, this decree was substantially identical in some respects with Act No. 4120, which the Philippine Legislature was to promulgate one hundred and fifty-three years later.

However, before the royal decree reached Governor José Basco y Vargas in Manila, he had, on his own initiative, unwittingly anticipated it by founding the Sociedad Economica de los Amigos del Pais, which was organized on February 7, 1781, and formally inaugurated on May 6, 1781. Although the society declined rapidly after the departure of its energetic founder in 1787, it was able to accomplish a large number of its avowed objects. "According to its first regulations, it contained the following sections: natural history, agriculture and rural economy, factories and manufactures, internal and foreign commerce, industries, and popular education. Stimulated by Basco, the society undertook with great ardor to promote the cultivation of indigo, cotton, cinnamon, and pepper, and the silk industry * * * The society also recommended that efforts be made to attain perfection in weaving and dyeing * * * In 1821 it founded, at its own cost, a professorship of agriculture and an academy of design, and established special instruction in dyeing. In 1824 it resolved to bestow rewards on the most successful farmers; and it introduced from China martins to fight the locusts that are desolating the fields." (BLAIR and ROBERTSON, vol. 50, p. 51-52).

We also learn (BLAIR and ROBERTSON, vol. 50, p. 61) that in July, 1789, an expedition, under the command of Captain Alejandro Malaspina, was sent out from Spain by the government. The purpose was to make scientific observations and draw plans and maps of the coasts of Spanish America and the Marianas and Philippine Islands, with new sailing routes.

These two events stand out boldly in perspective as indicating early attempts at organized research in the Philippines during the Spanish régime, especially in view of adverse reports of contemporary visiting foreigners, like the French astronomer Le Gentil (1781), who deprecated the suspicious and even antagonistic attitude toward scientific workers at that time. Le Gentil's experience, however, is easily explained when one considers that as late as 1822 an Englishman writing anonymously in Calcutta (1828) observed that "with jealousy of foreigners exceeding even the bounds of credibility, she [the Philippines] invariably refused them admittance, whether for scientific or commercial purposes, or when from accident or influence this was obtained, the people following, and often exceeding the lessons of their rulers, by civil and religious persecutions, and contempt, contrived to make their existence almost a burden."

A fair retrospective appraisal of accomplishments during the three and a half centuries of the Spanish regime, although difficult to make, can be taken up more equitably if the measure used is the relatively crude standard obtaining for that period, and not the more exacting precision balance of a modern, scientific age. Moreover, due allowance must be made for the conditions of those times as they affected creative activity. An atmosphere could hardly be conducive to higher intellectual pursuits where the administrative energies of the government were spent in subduing bandits, suppressing popular discontent, executing rebels, chasing Chinese and Moro pirates, massacring the Chinese in their Manila settlements, resisting invasion by rival colonizers, the Portuguese, the Dutch, and the English, and in frequent disputes between the church and the state, between which stewardship of the country was shared in those days. "How is it strange then," queries Rizal (*La indolencia de los Filipinos*), "that discouragement may have been infused into the spirit of the inhabitants of the Philippines, when in the midst of so many calamities they did not know whether they would see sprout the seed they were planting, whether their field was going to be their grave or their crop would go to feed their executioner." Added to this unfortunate combination of untoward circumstances was the all too common tendency among colonizers to regard their trust as a chance to amass private wealth, through exploitation of the natives. Partly owing to this cause, even the Philippine government for a long time was not self-supporting, so that it had to be helped along with an annual subsidy from the Mexican treasury (*situado de Nueva España*). We who have now been schooled under a different idea of government are apt to regard these shortcomings with impatient disapproval, without considering that the records of early colonization by other powers are marred with even uglier stains. Indeed, on the whole, the Philippines has much to be thankful for; as the price of an early conversion to Western civilization, she paid considerably less in suffering than most Spanish-American colonies. "It was fortunate for the Filipinos that their islands possessed no wealth in the shape of precious metals or valuable spices. [The secret of the Benguet gold fields was then jealously guarded by hostile Igorotes.] In the earlier days of maritime traffic there was little possibility of exporting the numerous agricultural productions of the colony * * * The extortions of conscienceless officials were by no means conspicuous by their absence. Cruelties, however, such as were practiced in the American mining districts, or in the manufactories of Quito, never occurred in the Philippines." (JAGOR, 1859-1861).

Le Gentil's observations just cited were written in connection with his trip to the Philippines, under commission by the French government, to study the transit of the planet Venus. Both the eighteenth and the nineteenth centuries were marked by a number of scientific expeditions, largely for botanical and zoölogical collecting, by European and, later, also by American explorers, the results of whose work materially augmented scientific knowledge about the Philippines and whose accounts of their travels constitute valuable records of conditions of the country in those times. These few explorers, in fact, served as practically the only points of contact of the Philippines with the rest of the civilized world, outside of Spain and Mexico, for these external influences were very carefully excluded. This long period of isolation was most effective in retarding cultural and material development. The work *Flora de Filipinas*, by

Father Manuel Blanco, the first edition of which appeared in 1837, and its large four-volume revision by Fathers Andrés Naves and Celestino Fernandez-Villar, which include the papers of Father Ignacio Mercado and Antonio Llanos (1877-1883) was a tangible evidence of the sterilizing influence of this policy. Merrill (1926 and earlier papers) pointed to the hopeless confusion resulting from Blanco's erection of numerous new species from old-established forms, assignment to the Philippines of non-Philippine species, and other errors that could have been avoided or greatly minimized if the author had established connection with contemporary European botanists and herbaria. "In spite of all the work done in preparing the three editions of the 'Flora de Filipinas,'" adds Merrill (1903), "the result has been to retard, rather than advance, the time when we can hope to see published a complete, or nearly complete, flora of the Islands." "Il est de regretter," vehemently complains De Candolle," que ses revérénds ecclésiastiques * * * ne se soient contentés d'écrire des homélies." Fortunately, occasion for similar criticisms seems to have disappeared markedly in the closing years of Spanish rule, as evidenced by the imposing three volumes of Father Casto de Elera's "Catalogo sistematico de toda la fauna de Filipinas conocida hasta el presente" (1895-1896), which, despite inaccuracies that should be expected in a pioneering work of this kind, bore the stamp of greater authoritativeness, thanks to the help received by the author from the British Museum, as well as from individual French, German, Italian, American, Spanish, and other zoölogists.

"It is impossible," writes Tavera (1905), "not to recognize the humanitarian impulses, truly Christian and equitable, which guided the kings and the Spanish legislators in what they did for the Philippine Islands. It is also certain that the Spanish colonial legislation, influenced as it was by the opinions of persons so conservative and suspicious of all that was not Spanish and Catholic in its nature, shut the Philippine Islands from all contact with other civilization * * * But this result was not due to a system of politics created especially to suit a colony, but was more in the nature of a reproduction in the Philippine Islands of the same political system under which Spain was governed and known to other nations of Europe." This policy of self-sufficiency apparently was reflected even in reticence to take advantage of the benefits from scientific discoveries and inventions originating from extra-Spanish sources. The first telegraph lines were not established in the Philippines (Luzon) until 1873, thirty-eight years after the American Samuel F. B. Morse gave the world his epoch-making invention. Spain was connected with the Philippines by cable in 1880, fourteen years after Cyrus W. Field established permanent telegraphic communication between Europe and America. Telephone lines were unknown in the Philippines prior to 1890, fully fifteen years after Alexander Graham Bell in Boston first startled the world by talking across the wire to his assistant in Cambridge. The steam locomotive was invented by the Englishman George Stephenson in 1825; not until 1891, sixty-six years later, was there any railroad service in the Philippines, when the Manila-Dagupan line was opened to traffic, by an English company, which had spent five years begging the Spanish authorities to grant permission to commence work on the project and another eight years to get the right-of-way in shape. Thomas Alva Edison gave the world the first incandescent lamp in 1879; Manila was to remain content with its flickering wax candles, coconut oil torches and kerosene lamps for sixteen years longer, for an electric light system was not established there until 1895. The arrival at Manila in 1848 of the three English-built steamships, "Magallanes," "Elcano," and "Reina de Castilla" was a historical event, because they were the first steamships ever to call at Manila, although steamships had been cruising the world's oceans for twenty-five years. But what perhaps was most characteristic of this tendency to live in blissful ignorance of the rest of the world was the fact that, although Elcano and the remainder of Magellan's surviving crew upon returning to Spain in 1522, after circumnavigating the globe for the first time, noted that the entry in the "Vittoria's" logbook was one day behind, nothing was done to adjust the Philippine calendar until after more than three centuries had elapsed. The anti-foreign sentiment came to a head when cholera broke out for the first time in Manila in 1820. Insidious rumor was spread among the natives that the foreigners had poisoned the wells, the consequence being that an infuriated mob assassinated English and French residents of the city and after killing twenty-eight of them, attacked the Chinese. (*Official handbook of the P. I.*, 1905).

It will, of course, be erroneous to dismiss the period covered by the Spanish rule as a colorless medley of negative virtues, where the people have, in the words of Jagor, "dreamed away their best days." To be sure, life at the time must have been rather dull. As Jagor puts it, "the pompously celebrated religious festivals were the only events that sometimes chequered the wearisome monotony." However, these somewhat disheartening centuries were not entirely centuries of wasted opportunities. They have important redeeming features which were to have a profound influence on the history of the people. The introduction of a large number of cultivated plants, including tobacco, corn, cacao, coffee, sesamum, indigo, and many fruit trees, changed the aspect of Philippine agriculture in many parts of the country. "Nearly two hundred species [of the one thousand occurring in the vicinity of Manila] are manifestly of American origin and have been introduced into the Philippines since the Archipelago was discovered, and mostly between 1521 and 1815, the latter date being the year when the galleon service between Acapulco, Mexico, and Manila was discontinued." (MERRILL, 1926). Plant introduction, of course, had been going on even before the arrival of the Spaniards to such an extent that, as a result, "practically every species now cultivated in the Philippines for food or for commercial purposes, except abacá, *Musa textilis* Née, has been introduced." (MERRILL, 1926). Unfortunately, like other good things, with these desirable plant immigrants there were unavoidably brought in accompanying evils in the form of weeds. "Many of the dominant weeds which are found in the Philippines practically wherever the soil is more or less disturbed by man, are plants of American origin." As to domestic animals, the Spaniards are credited with the introduction into this country of the horse, which, according to Morga (1609), was not present in the Archipelago before their time, and also the ox and the sheep. Public buildings, churches, *conventos*, highways, irrigation systems, many of them marvels of engineering skill, considering the limited facilities of the time, were built, usually under the direction of friars who were skilled engineers and architects. The influence of these structural efforts soon became widespread in the improvement of construction of dwelling houses among the inhabitants.

Doubtless, from a scientific standpoint, the crowning achievement of the Spanish regime was the establishment of the Manila Observatory. Originally founded by Father Federico Faura in 1865 as an observatory for the Ateneo de Manila, its value to the country soon become apparent. By royal decree of April 28, 1884, the observatory was made official. On the transfer of sovereignty to the United States, the official recognition was extended and the observatory was made the center of the large network of stations of the government's Weather Bureau. The achievements of this observatory might well be a source of pride in any country. In the days when weather forecasting was unknown in the Far East, the Manila Observatory was the first to announce the approach of a typhoon, predicting even its duration and probable course, on July 7, 1879. At the request of mariners and merchants, this announcement service was extended to Hongkong by cable, for the first time in 1880. A curious incident occurred in 1898, in the opening days of American occupation, which throws some light on the early foreign recognition of the benefits from the work of the observatory. The director of the British Meteorological Service in Hongkong, purely on his own responsibility, made representations to Washington requesting suspension of the "scandalous alarm caused by the alarming predictions of typhoons" sent out by the Manila Observatory and published in Hongkong newspapers. Strangely enough, the American Secretary of Agriculture heeded the plea and had the Secretary of War stop the cabling of weather reports to Hongkong. The action immediately caused a stir. The Hongkong Chamber of Commerce in Hongkong, as well as Manila, newspapers entered a vigorous protest with Washington, while the Governor of Hongkong denied that he had anything to do with the move of the director of the Hongkong Observatory. The result was a resumption of the service and a complete vindication of the Manila Observatory. (*Report of the Philippine Commission*, 1901).

The old Spanish mining, forestry, agronomical, and allied services served, at least indirectly, as the foundation of similar government entities in the Philippines under the American flag. It must be remembered that as early as 1806, a bureau of vaccination was created with Governor Aguilar himself as the head. Likewise, although not originating from a formally organized service, bureau, office, or department, some of the earlier Spanish executives formulated advanced ideas for the time about conservation of natural resources, as witness, for instance, Antonio de Morga (1598), who in his report to the king recommended, among other measures, that Chinese ships be prohibited from loading with Philippine lumber, "for they fell the trees for this, and in a short time there will be lack of wood here"; that Chinese and Japanese traders be not allowed to traffic in deerskins, "as the animals are killed solely for their skins, and thus the supply of game will be exhausted"; and that the *salambao* and fine-meshed nets "ought not be employed, and the size of the mesh should be regulated so that the supply of fish will not be exhausted, for already experience has demonstrated that they are not so abundant as formerly." In addition to that of the regular officials of the civil government, the extent of contribution to knowledge that the friars have made in the Philippines is incalculable. "History," observes Tavera (1905), "makes the friars responsible for the errors committed by the Spanish government in these islands, but it would appear that without the aid of the religious orders it would have been impossible for Spain to have fulfilled, even to the extent she has, her promise of civilizing the Filipinos and of helping them along the lines marked out by the European nations."

More than the material benefits that the Philippines received from Spain was the long and thorough preparation of the ground on which the seeds of more vigorous forms of Western civilization were to sprout and take root. The process was greatly enhanced by three significant events. (1) The port of Manila was opened to foreign commerce in 1830, so that, despite restrictions that continued to be in force, the larger numbers of foreign merchants that established themselves in the country brought the Philippines in closer intimacy with the outside world. Moreover, the increased prosperity that ensued, which was further stimulated by the opening of the ports of Iloilo, Zamboanga, and Sual, in 1855, and that of Cebu in 1863, largely released the people's minds to expand over a wider cultural horizon. (2) Like the old Tagalog saying that the mushroom does not grow alone, a further blessing was to come in the opening of the Suez Canal in 1869, which, together with the cable connection established in 1880, brought the Philippines closer to Europe. (3) The school reform of 1863 by which the state established a system of primary education in the Archipelago liberalized learning and raised the standard to the extent of enabling many Filipinos to pursue advanced studies in European universities. It was in fact at this stage that we begin to find native Filipinos taking a hand in scientific work, as, for instance, the pioneer Filipino chemist, Don Anacleto del Rosario, the botanist Dr. Leon Ma. Guerrero, early investigators on beriberi, Drs. Manuel Guerrero and José Montes, and the leprologist Dr. Eliodoro Mercado.

The momentum which was already gaining power toward the closing decades of the nineteenth century was to acquire an unprecedented impulse at the turn of the twentieth. As if presaging the changed tempo of a new order of things, the cablegram of Dewey's famous victory in Manila Bay reached the American people the day before it happened. And this was not the only instance where the relatively insignificant Philippines was to foreordain events for the mighty United States. Taft was first chief executive of the Philippines before he sailed away to become chief executive of the United States. Former secretary of State Stimson stepped into his exalted American position from his seat at Malacañang. Not only in peace, but also in war; General Pershing graduated to the German front from his exploits against the Moros of Mindanao. The convenient metric system had been in common, every-day use in the Philippines for some thirty years, not only in limited scientific circles, but also in commercial transactions, before its partial adoption in the United States to replace the cumbersome English weights and measures was seriously considered. In the field of science, to name only a few—Simon Flexner, Victor G. Heiser, Elmer D. Merrill, Richard P. Strong, Gilbert Newton Lewis, Raymond F. Bacon, Edward B. Vedder, A. S. Pearse, E. B. Copeland, H. T. Edwards, Sam F. Trelease, Otto A. Reinking, and S. F. Light—the Philippines derives no little satisfaction in having discovered men of genuine merit, whom she later on returned to their own people to occupy the positions of trust and distinction they so richly deserve. Jagor (1859-1861), ably seconded by Rizal (*Filipinas dentro de cien años*), with keen insight, foretold the growth of American influence over the South Seas and concluded that "the captivating magic power which the great republic exercises over the Spanish colonies will not fail to make itself felt also in the Philippines. The Americans are evidently destined to bring to a full development the germs originated by the Spaniards." What neither author was able to foresee was the unexpected development in the subsequent drift of events where the Philippines, likewise, exerted a no mean influence over the great republic.

Historians may disagree about the real motives behind the American occupation of the Philippines. But in one point there can only be unanimity of opinion. Hardly had the guns that established the sovereignty of the United States over the Archipelago cooled than efforts were directed toward improving the general conditions of the country. Drawing on all available scientific resources, infant mortality, especially from beriberi and smallpox, which had for centuries constituted such a serious drain on the population, was reduced considerably. Epidemics and other serious diseases of man and his domestic animals were checked after painstaking study. Agriculture developed to a phenomenal degree, not only because of the advantageous trade relations that ensued for the Philippines, but also because improved methods were found, with the aid of scientific experiments, whereby production was increased and costs of farm operation were reduced. Modern sugar mills, embodying the latest equipments and using the methods found to be best by a resident corps of sugar technologists, were erected wherever there were extensive sugar-cane plantations. The exploitation of forestry, mineral, and other natural resources was placed on a rational basis.

It is worthy of note that all these important developments had mainly for their basis results of research activities conducted locally in the different bureaus and laboratories of the civil government, in the medical and veterinary departments of the United States Army, in the field staff of the Rockefeller Foundation, and among the technical personnel of the more enterprising private concerns. Although science is admittedly universal in its scope, there is a large mass of peculiarly local problems the solution for some of which could never have been so successfully attained if we had depended solely on charitable handouts from extra-Philippine sources. Of patently paramount importance is the opportunity given to a considerable body of Filipino researchers to assume responsible rôles in the service of their country. In addition to improvement in health conditions, increased prosperity, and other material benefits that have served to raise the standard of living, a result of no less consequence from the greater extension of science-consciousness in Filipino life is the change in mental attitude. The mysteries of the unknown, instead of begetting superstitious fear, merely stand, until solved, as an intriguing challenge to human curiosity. Four vital agencies have served as a powerful incentive to this general enlightenment; namely, (1) a thoroughly organized public-school system which extends its activities from primary instruction in the remotest barrios to advanced collegiate training in the University of the Philippines; (2) an up-to-date, unmuzzled press in English, in Spanish, and in several Philippine languages, many of these publications aggressive types of modern journalism, and no longer "feeble newspapers, for the items of intelligence, forwarded fortnightly from Hongkong, were sifted by priestly censors, who left little but the chronicles of Spanish and French courts to feed the barren columns of the local sheets," that so depressed Jagor at the time of his visit; (3) improved means of communication; and (4) a strong but benevolent government that assures individual liberty and guarantees protection to life and property.

Because of the tangible bounties reaped as a product of research, the idea all too frequently gains ground that the sole justification of scientific work is the expectation of immediate returns. While certain types of research activity may well be pursued from a utilitarian viewpoint, a policy of restriction to this one end will not only unnecessarily inhibit a well-balanced scientific development, but also destroy the prospects of possibly important practical results along totally unexpected lines. In 1831, for instance, Michael Faraday, in England, was spending days on end thrusting a horseshoe magnet into a coil of wire and determining the direction of the electric current thus generated. He was interested in physics for its own sake, in delving into the secrets of electricity. Swift doubtless had men of this queer sort in mind when he took occasion, in his *Gulliver's Travels,* to turn his sharp wit on the patient scientist who wasted ten precious years of his life trying to extract sunshine out of a cucumber. Faraday could never have planned ahead to conduct an experiment that was to usher a new era in man's civilized life. The dynamo, which was to transform otherwise wasted water power into useful electrical energy and on which in the Philippines alone millions of pesos have been invested, the street car, the automobile even to the latest in "knee-action" and "streamline," the trucks and autobuses which have now become an important factor in transportation in this country, the aeroplane, the telephone, the household refrigerator —all these familiar electrical conveniences that we have come to regard as part and parcel of existence were lineal descendants of Faraday's odd pastime. Heinrich Hertz had not the slightest suspicion that when he juggled with metal plates, steel balls, metal rods, and wire loops that led to the discovery of the Hertzian waves in 1888, he was paving the way for radio communication. Mme. Curie was not looking for radium, to relieve cancer sufferers, when she detected it while she and her husband were working on pitchblende in 1896. It would seem that the efficient pneumothorax treatment of tuberculosis, the wonderful feats of surgery, a thorough understanding of the physiology of body tissues and organs in health and in disease, on which is founded modern medicine, including the present craze about vitamins, would have been impossible if William Harvey, early in the seventeenth century, had not painstakingly watched the movement of the heart in frogs and dogs, leading to his discovery of the circulation of the. blood. The valuable seedling cane variety 2878 POJ not only saved Java sugar planters from financial ruin from the ravages of the sereh disease but has so increased production as to make that country the premier sugar producer of the world. Although the creation of this variety is credited, and rightly so, to the Proefstation Oost-Java in Pasoeroean, it might not have come into being had not a modest naturalist, J. W. Parris, of Barbados, become interested in grass and incidentally found in 1859 that seedlings could be made to grow from sugar-cane seeds. In 1904 Father William A. Stanton, a Jesuit scientist in the Manila Observatory, found relaxation from tending his weather instruments in collecting insects in the Observatory garden. Among the wasps he caught was *Scolia manilae,* which Ashmead described as a new species. The good father had no suspicion that in less than fifteen years the wasp he had discovered was to play the hero in the Hawaiian sugar-cane fields, where it halted the frightful destruction of white grubs. These few examples can, indeed, be multiplied many times; but they doubtless suffice as a warning. Even in these days of restricted funds, attempts at engaging the attention of local scientific workers exclusively in lines where quick dividends are in sight may in the end be the less profitable course.

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RESEARCHES IN PHYSICS

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In progressive countries of the world physics is considered one of the most important sciences today. In the United States, for example, the Government, the different universities, and every big industrial concern, spend every year vast sums of money for researches in both theoretical and applied physics. Here, however, the Bureau of Science, the only Government bureau where one would expect some workers in the field, has not even a single position for a physicist. The work being done in the different universities consists chiefly in training high school teachers in physics and in preparing engineering and pre-medical students. The instructors are busily occupied with undergraduate instruction. Due to this fact and the lack of proper facilities they can not devote any of their time to productive work. It is not surprising, then, that there is not much which can be mentioned as the contribution of our country in the form of research to physics.

There may, however, be cited some of the researches either undertaken here or undertaken by Filipinos while abroad. J. R. Wright and O. F. Smith (1914-1918) studied the atmospheric ionization in Manila and the radioactivity of Philippine waters. C. del Rosario (1926-1932) has made some investigations on the velocity distribution of thermionic electrons, low pressure electric discharge, and soft X-rays. T. P. Abello (1928) has worked on the absorption of ultra-sonic waves by various gases. Elsewhere (1932) the writer has pointed out the important part that physics is bound to take in future researches in the Islands, with the hope of attracting the attention of some of our leaders to this science so that it may receive much-needed encouragement. With a more encouraging atmosphere and proper facilities, there is no reason why some investigation could not be carried out here.

Another important task before us at present is to interest students in this science. To get students sufficiently interested in a science it is not enough to talk to them of its importance. They must be shown that there is some future in studying it. The creation of positions for physicists in a Government bureau, like the Bureau of Science, would surely serve as an incentive to the students to study physics. Besides, a physicist, aside from the work he can do along his own line, he can also be of much help to investigators in other fields, for at present many physical devices and results of investigations in physics are finding beautiful applications in other sciences.

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COASTAL SURVEYS PAST AND PRESENT

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It is an interesting coincidence that systematic surveys of the Philippine Islands coastline and of the United States coasts were undertaken at the same time, just one hundred years ago. It was in 1834 that the Spanish Hydrographic Commission was established in Manila. Still preserved in the archives of the Coast and Geodetic Survey in Washington is topographic sheet No. 1, delineating a section of the shore of Long Island, New York, bearing the date 1834. True, before this date there existed charts covering important harbors and capes, but in both countries the large stretches of intervening coast were unsurveyed.

The Hydrographic Commission never undertook triangulations as a means of control for its surveys but adopted the expedient of astronomic latitudes and longitudes which, regardless of the accuracy of these determinations, can never yield results comparable to geodetic determinations. The large deflections of the plumb line caused by unequal pull of land masses on one side and ocean depths on the other as found in these Islands, make astronomic observations of doubtful value except for the purpose of determining basic position, when other means are impossible.

The plans made in 1900 for a systematic topographic and hydrographic survey of the coasts of the Islands were founded on geodetic control progressively executed to embrace the entire Archipelago. At first detached surveys on astronomic data were a necessity but the objective was never lost. Even these surveys were based on triangulation and provided means for incorporation into an ultimate scheme. By 1927 the coordination of all areas into one connected net had been accomplished and the results published. There still remains a considerable stretch of coast line that has not been surveyed. However, the foundation for the main structure is in place.

The most accurate 50-meter length in the Islands is indicated by fine lines in copper plugs set in the masonry sills of two opposite windows of the Coast and Geodetic Survey Office in the Intendencia Building. It is the comparator to note the small changes in length that occur in invar tapes used in the survey. One may judge the accuracy of the surveys by the fact that the distance between Aparri on the north and Tawi Tawi on the south as determined by triangulation should not be in error by more than 20 meters.

In the extensive land work that is preliminary to the hydrographic survey, the more rapid but less accurate operations are checked at appropriate intervals by more accurate means; consequently as the work progresses the errors do not accumulate. Thus sketching must be guided and held close to true delineation by instrumental means. The plane table is a standard instrument for controlled sketching but it in turn must be held in check by triangulation observations and these again coordinated by geodetic adjustment. Surveys which these methods have yielded are within the practical limits imposed, the best that could be produced.

Aerial photography, a recent adjunct to surveying, produces certain refinements in delineation that cannot be attained by any method of sketching. Its application to such terrain as is found in the Philippines, however, is not yet practicable.

Once the strip of land along the coast dotted with conspicuous signals has been mapped the primary purpose of all this work is undertaken. Sounding launches ply back and forth from shore to deep water on regular lines closely spaced taking and recording depths until the entire area is covered with soundings accurately plotted with reference to the shore signals. When too deep for hand lead, the ship takes up the work and carries it on. Equipped with echo-sounding apparatus the ship travels at full speed taking four soundings a second. In deep water the time between soundings is lengthened to permit the echo to return before the next impulse is sent. Our reports of increased production as the result of this invention are probably comparable to those made by the Spanish engineers in 1847 when the first steam vessel was employed in Philippine surveys.

Readings taken by the leadsman cannot be applied to the chart until they have been reduced to a common plane that corrects for the height of the tide. Scattered along the entire coast line of the Islands are permanent tidal benchmarks to indicate that near by was once a staff against which the local tidal phenomena had been accurately observed, recorded, and referenced to these marks. The vast amount of data thus obtained for the immediate needs of the hydrographic survey has been correlated. The time and height of the tide at any place in the Islands can be accurately predicted years in advance. These predictions cannot, of course, take into account any abnormal condition, such as the recent typhoon that passed close to Manila. The tide which should have been high in the harbor about 2:00 A. M. continued to rise until 6:00 A. M. due to the water forced into Manila Bay by the wind and low pressure.

At the beginning of American occupation there were 125 navigational charts on hand some of which had been based on rather complete surveys but generally they had been made from sketches. The exposed eastern coast was entirely unsurveyed. British, French, and early American surveys in Palawan and the southern archipelago were included in the number. The geographical knowledge of the interior of the Islands was practically embraced in the Atlas of the Philippine Islands by Rev. Father Algue, S. J. printed in 1900. Although on a small scale it contained much excellent information.

At the present time there are 150 navigational charts, 2 coast pilot volumes, 2 triangulation volumes, and 16 topographic maps. The navigational charts with a very few unimportant omissions cover the Islands in four series on the scales 1:1,600,000, 1:800,000, 1:400,000 and 1:100,00. All important harbors, anchorages passes and intricate channels are on charts of much larger scale. The topographic maps are in two series and cover the islands on the scales of 1:1,000,0000, (Map No. 100 in four parts) and 1:200,000 excepting Mindanao which is conveniently shown on the scale of 1:600,000.

When the small stretch of coast in Northeastern Luzon, the west coast of Palawan, and the stretch from Balabac Strait to Sibutu along the southwestern boundary of the territorial waters have been charted the original survey of the Islands will have been completed. The years of labor to produce a chart. As such it cannot long remain true. The great forces of man and of nature are forever at work to make it obsolete. Only constant repair and correction can keep it up to date and safe.

Closely associated with this work is the extremely important problem of geodetic control throughout the interior of the it there will be the constant failure of fit between adjoining Islands, on which practically nothing has been done. Without surveys and boundaries of all kinds. The difficulties of improvised adjustment are costly and prolific sources of strife.

Still another, possibly of scientific interest alone: Close to eastern Mindanao is the greatest known depth of the ocean. Its hidden wonders should be explored and studied. The Philippine Deep dropped on our very door step by the Almighty should not be ignored.

THE PRESENT STATUS OF THE GEOLOGICAL SURVEY OF THE PHILIPPINE ARCHIPELAGO

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During the early part of the Spanish régime as well as in pre-Conquest ages, some of the precious metals, especially gold, were mined [1] but by crude and wasteful methods. No geologic study was made in connection with mining either because the science was altogether unknown or its value was not realized.

Most of the scientific treatises of the period on the subject written by foreign travelers on their way to the Islands or who must have sojourned here. They deal chiefly with earthquakes, volcanoes, geography, or are merely accounts of their travels and of the manner of living of the inhabitants.

Jagor describes the different geologic features and phenomena he found in southwestern Luzon. This was during the period of 1859-1860.[2] This may be considered the first geologic reconnaissance in the Philippines.

In the latter part of the Spanish régime geologic surveys were made. The works of Abella y Cassariego, Montano, and others of the Inspección General de Minas, contributed much to our present geologic knowledge. This institution was abolished in 1886 and was made a section of the Dirección General de Administración Civil de Filipinas. The works of de la Cavada, Von Drasche, and others, including those of the Jesuit Fathers, form an invaluable addition. All of the work of the Inspección General de Minas, which was reëstablished in the early days of American occupation, was turned over to the Mining Bureau. Finally in 1901, after many other changes

[1] BLAIR, E. H., and J. A. ROBERTSON, editors and translators. 1903-1909. The Philippine Islands 1493-1898. Cleveland Ohio. The Arthur H. Clark Company. 55 Vol.

[2] JAGOR, F. 1873. Reisen in den Philippinen, Berlin, Weidmannsche, Buchhandlung.

CRAIG, AUSTIN. The Former Philippines Through Foreign Eyes. pp. 66-69.

had taken place, the functions of the Mining Bureau were transferred to the Division of Geology and Mines of the Bureau of Science.

Since that time, most of the geologic reconnaissances and surveys were made by Adams, Eveland, Fanning, Ferguson, Goodman, Ikis, McCaskey, Smith, Dickerson and others, who contributed much to the scanty and scattered information on the subject then extant.

With the policy of the Government to Filipinize all its dependencies, the staff of the Division of Geology and Mines, became entirely Filipino in or about 1921. These new men have contributed not much less than their American predecessors. The treatises of Faustino, Alvir, Elicaño, Abarquez and Abadilla are among the outstanding ones.

About this time, also, the Bureau of Public Works sought the advice of the Division of Geology and Mines in drilling artesian wells. So more surveys were made, also with the cooperation of the Department of Geology of the University of the Philippines.

About a year and a half ago, in the early part of 1933, some of the bureaus of the Insular Government were reorganized and as a result the Division of Mineral Resources of the Department of Agriculture and Commerce was created by the fusion of the Division of Geology and Mines of the Bureau of Science, and the Mineral Lands Administration Division of the Bureau of Lands. In May, 1934, this Division changed its name to Division of Mines without changing its functions, which are as follows:

(a) Geologic survey
(b) Mining technology
(c) Mineral lands administration

Although geologic survey is given as one of its functions, with the gold fever here in the Philippines that has been prevalent since 1933, the work of this Division has been confined mainly to mining. As the fever is subsiding it is hoped that resumption of the work will soon take place.

There are geologic surveys and reconnaissances being made by different mining companies, but their maps and reports are privately owned and are not accessible to the general public. If these could only be correlated and assembled together they would form, of course, a good nucleus for a complete and permanent geologic survey of the Philippines.

The United States, Canada, Great Britain, Japan, and others have well established geologic surveys that may be taken as one of the factors for their progressive development. The importance of these surveys is not only in connection with the mining industry, but also in the drilling of artesian wells, building of roads and bridges, dams, irrigation and watersheds and other public works and even in forestry and agriculture which are the basic industries of this country.

The need of more complete geologic surveys is very keenly felt, but this should be preceded by good topographic surveys or mapping which the Division of Mines inaugurated during the early part of 1934. It is therefore strongly recommended that the Philippines establish her own geologic survey, especially at this time when we are about to embark upon a new era, the establishment of the Philippine COMMONWEALTH.

THE BEGINNINGS OF MEDICINE IN THE PHILIPPINES

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The beginnings of medicine in the Philippines are shrouded in the mist of time. No great monuments have come down to us recording its early struggles and whatever scant manuscript materials were preserved after the first Spanish settlements were established were consigned to the flames between the closing years of the sixteenth century and the opening of the seventeenth by zealous ministers of the gospel when they began on a more ambitious scale their missionary endeavors for the propagation of the new faith. In thus destroying these remnants of a past civilization, the Friars believed they had erased the last vestige that linked the islanders to their pagan worship but they had also, unwittingly, destroyed the primitive literary sources of our subject. Chirino, indeed, writing in 1602, states that in one town alone in what is now the province of Batangas, not less than 300 manuscripts written in the ancient Filipino alphabet were destroyed. It is, therefore, necessary to recur to the bulky tomes of the early chroniclers to abstract therefrom laboriously the early manifestations of the healing art in the Islands, to traditions among the *curanderos*, and to the almost unexplored material in the possession of native mystics who sincerely believe they hold in the hollow of their hands the gift of health and happiness for their fellowmen.

Although no hard and fast line can be drawn, nevertheless, for a better comprehension of the subject, we shall divide it into three periods: (1) the mythical, (2) the superstitious, and (3) the epiric.

THE MYTHICAL PERIOD

In the mythology of the ancient Filipinos, we find that they believed in what the Tagalogs called *Bathala*, the upreme Being, *Mey-kapal*, the Creator, and known among the Visayas, as *Laon*, together with a host of lesser gods, each possessing its own attributes, besides numerous household deities called *anitos* among the Tagalogs and among the Visayas, *divata,* which were believed to incarnate the spirits of their dead ancestors and as such were regarded primarily as protectors of the home.

As the Supreme Being, *Bathala,* was the dispenser of good and evil in the universe, the minor deities played their subordinate roles, although in the case of *Captan,* he shared with *Bathala* the creative power, because it was he who planted the reed from which sprung the first man and the first woman who were to become the parents of the human race. *Captan* forged the thunder and visited men with diseases and death and could raise the dead to life. Withal he was not omniscient, and it appears that he disliked men because he never enjoyed the products of the earth. Together with *Maguayen,* he hurled the thunder and brought the dead to life.

Among the Bagabos there was *Daragao,* a messenger of *Mangdarañgan* who visited the *rancherias* to make men sick, and among the Tirurayes there were *Bolbol* and *Saitan* who also produced sickness and ate the entrails of the dead. Among the ancient Visaya there was a caste of witches known as *Bugayan,* who made men sick and the fields dry, and among the Tagalogs there was known an evil spirit called *Sitan,* believed to be the devil of Mohammedanism; in Tayabas there were water nymphs known as *Anayo* who punished any stranger that invaded their realm unceremoniously, whereas in Zambales, *Akasi* was the great god who was invoked on occasions of importance and in sickness. *Mangalos* which Delbeke classified as Tormentors, were the spirits who brought about infant diseases and who occasioned death by devouring their bowels.

The *Patianak,* the transformation of an aborted fetus, was a god or a devil feared by almost all of the Malay race. Sometimes it presented itself in the form of a new-born child, and at other times as a dog, a pig, or even a piece of log. It was usually met with in the open fields or lonely places and caused travelers to lose their way.

Among the Subanos it was known as *Pati-anay,* and was believed to be a man, holding in his arms a beautiful child, and, if the child were let loose, it assumed the form of a worm, which should be shunned by a pregnant woman. *Patianak* is said to be derived from two words: *pati,* meaning dead, and *anak* meaning child, although Blumentritt gives a Sanskrit origin to *pati.*

The *Tigbalang*, like the *Patianak*, might assume various forms, many times of gigantic proportions. Its usual form was that of a giant with extraordinarily long extremities. The head was covered with thick gross hairs of which three were prominent for their size and believed to possess mysterious powers. Among the Visayas the *Tigbalang* was known as *Punglo*. Such were a few of the more important deities that might be considered as enemies of mankind. On the other hand, there were others whose chief functions were to heal the sick and otherwise protect man in his daily struggle for life. *Lakhanbakor* or *Lakanbakod* was one of these. It was to the latter gods that sacrifices and offerings were made to appease their anger and among them may be counted the different *anitos*, which, according to Loarca, each had a special task to perform. "Some were in charge of the plantation, others assisted the sailors, still others protected the warriors and others still were in charge of diseases. Such was the power possessed by them, that they were believed to dispose of the welfare, the riches, and the health of the people." Man in his pilgrimage on earth was careful not to offend these spirits and was ready on the other hand to do whatever lay in his power to obtain their favor.

In the palace of the king as well as in the hut of the poor the *anitos* might be found who acted as intermediaries with the Supreme Being. Among the rich Tagalogs the *anitos* were placed in a *bosong-basong*, a costly jewel usually in the form of a golden casket. They came to earth, dealt with men and interceded for them in their necessities to *Bathala*. Therefore, when anyone in the household fell ill, it was the *katalonan*, as she was known among the ancient Tagalogs, (*bailan* among the Mandayas, *balian* or *balyan* among the Bicols, *babailan* or *babaylan* among the Visayas, *baglan* among the Ilocanos) who was usually called upon to offer up the sacrifice instead of the *Sonat*, the *Pontifex Maximus* of the Tagalogs, as his position appeared to be mainly hieratical in character, whereas the *katalonan* had dual duty of a priestess-physician. The *katalonan* in invoking her gods, *nagaanito*, before a *magdiwang*, or the sick for whose welfare the rites were performed, was dressed in the regalia of her office. On her head was the *bosong-bosong* or gold crown only worn on solemn occasions. As to the manner of dressing, Legaspi says, "the priestess dresses in a very queer manner;

she wears a wig of golden hair, a diadem on the head, in her hand she holds a straw fan and a bamboo stick," while Loarca states "the priestesses dress very elegantly; they wear garlands in their heads and glitter with gold and jewels." According to Pigafetta more than one priestess sometimes performed the ceremony. In offering the sacrifice the spectators were invited to participate, and Colin, declared that, for certain sacrifices, the priestess selected from among the spectators the prettiest and best dressed girl who was ordered to give the deathblow to the sacrificial animal. These ceremonies were performed in the presence of the sick person, as stated, with the members of the family present, who took part in the sacrifice by singing, drinking and eating. As to the different kinds of offerings, they were many and varied, the following being the more usual, a fat pig, a chicken, wines—the best t obe had—rice, meat, fish, bananas, tortoise, very large oysters, and not infrequently, perfumes, gold and jewels. All these made up the ancient *boñgoy* (offerings) which were placed in porcelain plates and bowls and neatly arranged on a *dambana* or altar of the ancient Tagalogs. These sacrifices might also be performed in a *simbahan* or *pinaghimisan* (Tagalo), in an *ulañgo* (Visayo) or in a *moog* (Bicol). The ceremonies for the cure of the sick, known as *sakom* among the Bicoles as performed by the *katalonan,* consisted in solemnly reciting, while she was possessed by the *batog* (or the act of being possessed by the devil), the *mantala* which were certain mysterious, cabalistic words manifested by tremors of the whole body, a trance-like state known as *olak* among the Tagalogs. In describing this psychological moment, Fay Cooper-Cole writes: "When about to call a spirit into her body, the medium *katalonan* sets herself in front of the spirit mat, and covering her face with her hands, she trembles violently, meawhile chanting or wailing songs in which she bids the spirits to come and possess her. From time to time she pauses, and holding a plate on the finger tips of her left hand, she strikes it with a string of sea-shells or a bit of lead, in order that the *bell-like sound* may attract the attention of the spirits. Suddenly a spirit takes possession of her body and then as a human the superior being talks with mortals."

Then, through her, as Loarca records, "the devil foretells the future." "They (the *katalonas*) communicate many things which the devil seemed to have told them; and the people put faith in this, but most of the things which they foretell cannot be verified." "Those who are in relation with the devil and pretend to be possessed by him, maintained to have the power to forecast the course of illness; they assert that the devil reveals to them whether the sick person will recover or not." "The priestesses or priests were those who offered the sacrifice to the spirit, and who during the sacrifice came in contact with the spirit of the *anito*. Through this contact, they were able to know what was to be done to pacify the Spirit." ". . . y dicen que les hacen venir en una caña hueca, y que alli habla a las sacerdotisas, que la mayor parte son mugeres las que hacen esta imbocación y hablan con el demonio y él la respuesta dá al público y les pide y quiere el Demonio." "They invoke the devil who descends in a bamboo from whence he speaks to the priestess who in turn communicates his desires and commands to the onlookers."

Thus, the priestess, once possessed, foretold how the sickness would end. If the news was favorable they all feasted and made merry with excessive drinking as testified by the historian of the Legaspi expedition. On the contrary, if the priestess foretold death, she began by praising the excellent qualities of the sick, adding that the *anitos* had singled him out to be one of the selected few, and hence forward he was to be regarded as one of the *anitos*. If the sickness was to end in death, it was because, as believed by the ancient Visayas, the mark was reached as recorded by the god *Sidapan* on the gigantic tree which stood on Mt. Mayas on the Island of Panay.

As to the nature of diseases supposed to be inflicted by the offended deities, it was believed that each was produced by a special spirit which took possession of the sick by substituting for his *hambaruan*, soul, and several were known according to their subjective or objective manifestations. Among the Visayas, *sinda* was the name given to any pain and *alok* to a disease caused by a witch; *Pamaao*, among the Tagalogs, was a disease supposed to be caused exclusively by the *anitos*. *Tiao*, among the Visayas, was one characterized by extreme melancholy and this disease was visited upon those who either disobeyed their parents or their elders.

Among the Zambales, there was the god *Akasi* who was invoked before undertaking any work of importance and in their sickness.

While there were evil spirits causing different diseases, there were also protective deities whose special function was either to heal the sick or protect the well. *Lakhanbakor* or *Lakanbakod* was one of these.

The ancient Filipinos believed a great deal in signs and augurs. The song of a *tigmamanukin* (*Jrena cynogastra,* Meyer) portended evil, the presence of an owl in the neighborhood of the sick was a sign that death was near. A new house in which a snake had been seen was of evil omen and must not be occupied.

THE SUPERSTITIOUS PERIOD

As special aids against evils of all kinds and to defend themselves against their enemies, there were among the Tagalogs those who possessed different forms of *anting-anting,* also known as the *aguimat* among the Tirurayes, to which wonderful virtues were attributed.

In Tayabas there were (and still are) men known as possessing *galing* or *may-galing* whose specialty was to subdue serpents which they could destroy at will, not unlike the *tauak,* men who were believed to have been born with a serpent, and who had the power to neutralize the poisons of the most dangerous snakes. This was the *mannuma* of the Ilocanos. *Sohi* was either a man or a woman who was born with the feet first and possessed the special power of removing any fish-bone that had been lodged in the throat.

Among the most interesting of superstitions were the different love potions that were claimed to win the love of the most obdurate woman. Such, for instance, was the so-called *lomay,* (*aribobó* of the Visayas, known as *manibig* among Negritos; *golo* and *gayuma* among the Tagalogs) prepared by a *mangasalat* or *manyisalat* in the form of mixtures and elixirs of which Father Pavón gives us this interesting résumé:

> Dicen que primeramente se empieza por obtener la nuez de un coco solitario y que dé frente á donde sale el sol, pero antes de descolgar este coco tiene que esperarse en luna nueba y ver que el cielo no esté nublado; una vez asegurado de esto se sube en el coco, antes del toque y rezo de las oraciones, pues si llega el toque de las oraciones hecharía á perder el valor del secreto, una vez asegurado de esto se descuelga el coco raspandolo cuidadosamente, luego se vuelve a reponer cuidando de que todo quepa hermeticamente en la nuez del mismo, se cierra luego muy bien con arcilla o lodo todas las suturas y se entierra en arena caliente.

Hasta el Viernes Santo benidero que es cuando se vuelve a cavar, para recoger el aceyte que es lo que servirá para este objeto.

El mismo día de Viernes Santo se prepara desde muy temprano para recoger las otras hiervas que forman el completo de la preparación y son los siguientes:

Tañgis Tañgis	1	parte.
Tagulilong	1	id.
Tagulisang	1	id.
Amigos	1	id.
Tuncos	1	id.

Las hiervas estas que ellos mencionan suponese que muchas de ellas sean imaginarias, aunque ellos aseguran la existencia de cada uno de ellos, con sus grandes y presupuestas virtudes.

Among the Visayas there was also the *tagaoili,* the special virtue of which was to hold the lover in perpetual bondage.

The *Asuang,* on the other hand, known throughout the Archipelago, was a night witch which assumed the form of a dog a cat, or a bird, or any other animal, and was said to attack abandoned children and solitary travelers. With its tongue, which was horribly long, black and flexible as silk, it extracted the fetus from pregnant women. To him were also attributed the pains during labor.

The presence of the *Asuang* was anounced by the song of the *tik-tik,* a night bird.

The *Mankokolam* or *Mangkokolam,* on the other hand, was an ordinary person supposed to be possessed by the devil. He was usually a man, whereas the *Manggagaway,* was a woman. By means of a doll, a *Manggagaway* might produce in any one who had been the object of her displeasure, a definite organic lesion or some psycho-neurotic state. In this connection, Rizal, in his treatment of the Bewitched, had the following to say:

> Para lesionar un órgano ó una parte cualquiera del cuerpo, la MANGGAGAWAY imagina a la persona que debe enfermar, saca su muñeca, despues clava aguja o alfileres en la parte del cuerpo que quiere que enferme en la persona odiada (otros usan clavitos como en un caso que se vió no hace mucho en el Juzgado de Paz de Masbate, Masbate). Como se ve, el procedimiento es el mismo que el de las brujas europeas de los siglos pasados.
>
> La persona continuará enferma mientras no se retire el alfiler, ó la aguja del cuerpo de la muñeca. No hay emplastos, no hay hierbas, no hay bebidas que la podrán curar; solo la misma MANGGAGAWAY podrá salvarla si la apaciguan, si la enferma le dá satisfacción, o si la obligan. En un pueblo de Luzon llamado B. de la provincia de L.

se cuenta el caso de una mujer que riñó con una MANGGAGAWAY con motivo de un envoltorio conteniendo arroz y dos mangas. Al día siguiente, la mujer enfermó y al instante echaron mano de la MANGGAGAWAY y quisieron obligarla a que curase a la enferma. Esta murió a la semana entre dolores atroces, y la MANGGAGAWAY que se salvó a duras penas de la ira de los parientes fué condenada por el gobernadorcillo a recibir cincuenta azotes diarios. Más, al segundo dia de su condena, la encontraron colgada de las rejas de la carcel mediante una cuerda que habia hecho con el forro de la saya. La infeliz, para morir habia tenido que encogerse mucho y doblar las piernas porque la reja tenia poca altura. "El diablo la ayudó al suicidio," decian los devotos.

Sin embargo de esta creencia general de que solo la MANGGAGAWAY puede deshacer lo que ella ha hecho, no faltan curanderos que pretenden poseer secretos, oraciones, conjuros, amuletos, fórmulas, etc., para deshacer el hechizo. Si lo dicen por seguir la corriente y ponen los remedios, adecuados, no hacen mal, más si obran con convicción, se exponen a muchos desengaños.

La otra forma de hechizo es la que varias veces ha ocupado la atención de los tribunales de hoy en dia y ha excitado la indignación de algunos médicos. Una mujer padece de fiebre, delira, tiene ataques histéricos, o está hipocondríaca; en algun tiempo antes tuvo un altercado, un disgusto, una rivalidad con una de las señaladas por el dedo como MANGGAGAWAY, todos sospecharán el hechizo y el curandero sancionará la sospecha; la enfermedad está conocida. "Ya se vé," dirá una comadre; "manifestó miedo a esa... lo que es yo, cuando reñí con ella, la reté a que me hechizara, por eso no lo ha conseguido." Segun la creencia es infalible contra-hechizo el reto cara a cara.

Declarado el hechizo y por que no se vé ninguna lesión corporal (lo que excluye la sospecha de los alfilers), se explica la patogenia suponiendo que el espiritu de la misma MANGGAGAWAY se introduce dentro del cuerpo de la persona atormentada. La indicación es hacerla salir por todos los medios posibles. Las buenas palabras no sirven; los exorcismos que tan en boga estaban en la Edad Media estan en latin para MANGGAGAWAY y curanderos, así es que, tienen que recurrir a lo más primitivo, a lo que está al alcance de todas las inteligencias: al bejuco, y sí es posible al rabo de raya. La MANGGAGAWAY es la que habla, la que siente, la que vé, etc., dentro de la enferma. Los bejucazos que ésta al parecer recibe en realidad los sufre la otra: la MANGGAGAWAY es la que grita, es la que se queja y la que, finalmente, no pudiendo mas resistir se escapa dejando a la paciente curada y tranquila y lo que es más curioso, sin señal ninguna de los bejucazos mientras que si se examinara el cuerpo de la MANGGAGAWAY se verían en él rasgaduras y cardenales.

And in commenting on the treatment, he favored the opinion that the *herbolario* treatment by autosuggestion was the most appropriate.

As to the prognosis of any given disease, the Visayas practised the *tali* with an egg or stone in order to find out whether the sick would either die or recover. The *tauas* (alum) was also employed frequently as a means of foretelling the course of the disease, especially in children. If the prognosis was unfavorable, the *takga*, the day and hour in which death takes place, had to come inevitably.

In case of death the corpse was given a bath and then rubbed with camphor oil, and among the well-to-do, inclosed in a wooden coffin which was usually hollowed out of a solid log. *Buyo* was also used as a preservative, aloes likewise, and the embalming material poured through the mouth, and Chirino says that this procedure was so efficient that after many years, corpses were found completely intact or preserved.

THE EMPIRIC PERIOD

In the pre-Spanish Philippines there were men who were skilled in the use of healing herbs, "éay tambien buenos médicos que curan con hierbas simples," to quote the language of Loarca. Modern investigators have amply corroborated their therapeutic properties. We have yet a long road to cover before we can exhaust the possibilities of our medicinal plants. Notwithstanding the amount of work that has already been accomplished along this line of research, we still need the cooperation of botanists for the identification and proper classification of the species, pharmacists and chemists for the isolation of the active constituents, pharmacologists for determining their specific actions, pharmacists for giving them appropriate forms or vehicles, and clinicians for the final test at the patient's bedside. In discussing this phase of the subject, I shall touch only the high spots, discussing its relations to (a) Philippine galenicals, (b) opotherapy, (c) vaccine therapy and (d) minor surgery.

Because of the great variety of species and their diverse therapeutic actions, Philippine medicinal plants attracted the attention of the early missionaries, who devoted much time and effort to a systematic study of them. In the absence of trained physicians, as curates of the souls, they could not very well neglect the physical well-being of their parishioners. The first to record his observations was the Franciscan Fr. Blas de la Madre de Dios.

In 1669, Fr. Francisco Ignacio Alcina, S. J., after 33 years of missionary endeavors in the Visayas, left a manuscript entitled: *Historia natural del sitio fertilidad y calidad de las islas e Indios de Bisayas,* the second part of which is known to exist in the Library of the old Ateneo de Manila, if it was not lost during the great fire which destroyed the building in August, 1932.

At about this time also, a Franciscan lay brother, Fr. Jose de Valencia, wrote his *Flora filipina: en la que con minuciosidad se decriben las raices y hierbas, sus figuras, sitios en donde se crían y sus virtudes medicinales.*

Then in 1704, the Jesuit lay brother, George Joseph Camel, published his *Herbarium aliarumque stirpium in insula Luzone Philippinarum primaria nascentium, a Rdo. Fratre Georgio Joseph Camello, S. J., observatarum et decriptarum Syllabus: ad Joanen Raium transmissus,* as an Appendix to Vol. III of Juan Ray's *Historia plantarum.*

In 1712, there was published a special tract on our medicinal plants by another Jesuit, Fr. Pablo Clain: *Remedios fáciles para diferentes enfermedades.* This work was finished in its manuscript form in 1708 and no doubt copies of it had passed from hand to hand before it was finally set to type as the first edition is dated four years later. The following important chapters may be cited: *Señales para conocer si la enfermedad es de calor o de frio,* which deals with the causative agents of disease. Rizal, in this connection, remarks "el aire, el calor, el frío, el vapor de tierra y la indigestión, son las únicas causas patogénicas que se admiten en el pais." Then, in alphabetical order Br. Clain gives the treatments for different diseases, *Remedios fáciles para diferentes enfermedades en Filipinas,* including those of surgical nature like dislocations, how a seton is opened with cautery or caustic, contusions and falls, wounds, fractures, hernia, animal bites and hemorrhage. Another chapter is *Modo de Preparar Algunas Medicinas,* in which specific directions are given for the preparation of: *aguas destiladas, almendradas, ayudas, aceites, paños, baños, bebidas, birretes, bocados, calillas, cataplasmas, colirios, cocimientos, dieta sudorífera, emplastos, fomentaciones, frontales, gargarismos, haplas, infusiones, jarabes, julepes, lamedores, lavatorios, limonadas, liquores, masticatorios, opiatas, orchatas, píldoras, pitrinas, polvos, pur-*

gas, zahumerios, extractos espirituosos, suero de la leche, triaca, ungüentos varios, jaleas y zumos, etc. and lastly an index containing especially the local names of plants and their parts, arranged alphabetically. "An interesting book," is the pithy comment of the foremost Filipino botanist, Dr. Leon Ma. Guerrero.

This book as stated in the Preface provides "a los empíricos de estas Islas de Arte para el manejo de las yervas, y plantas," and when submitted to official censure, Don Joseph de la Torre, *Cirujano mayor del Hospital Real de esta Ciudad, y de su Señoria el Señor Conde de Lizarraga, Presidente, Gobernador, y Capitan General de estas Islas,* on January 4, 1712, emitted the following opinion: "respeto de que todo lo que trata dicho libro, es conforme á los tratados de los remedios ordinarios de la medicina, según lo que han tratado varios autores acerca de dicha ciencia; en cuya conformidad doy la presente certificación." Modern critics should take cognizance of this fact.

In the middle of the eighteenth century, between 1751 and 1754, another brother religious, Fr. Juan Delgado, S. J., in his volume, *Historia general Sacro-profana Política y Natural de las Islas del Poniente llamadas Filipinas,* devoted lengthy chapters to the virtues of a number of medicinal trees, palms, plants, herbs, and vines. This book, however, was not published till 1892. As Dr. Guerrero writes of this excellent treatise.

> Book IV of this work is from every point of view interesting, not only on account of the abundant material contained in it, but also because of the minuteness and accuracy with which certain industrially or medicinally used plants are described. It is a succinct compilation of the economic botany of the Islands, in accordance with the knowledge of the time when the work was written.

The early *herbolarios* had an extensive knowledge of the therapeutic properties of many medicinal plants, and, besides those used for different diseases, they were acquainted with many poisons and their antidotes; their materia medica included also febrifuges, anthelmentics, styptics, sedatives, antiseptics, and those remedies applicable to swellings, furuncles, abscesses, ulcers, wounds, etc., so that Father Delgado had to admit: "Los naturales de estas islas tienen en esas plantas su botica siempre preparada por la mano generosa de la divina providencia para el alivio de sus achaques, siendo ellos mismos, con la experiencia que tienen, los médicos y cirujanos, * * *"

P. Fernando Santa Maria in 1768 edited his *Medicinas Caseras para consuelo de los pobres indios.* The late Dr. Pardo de Tavera, in a paper read before the Colegio Medico-Farmaceutico de Filipinas on *Medicinas Caseras y sus Peligros* in 1923, was most unjust in his criticism of P. Santa Maria's work, although he was preceded in this respect by Fr. Manuel Blanco who, in *Ang mahusay na paraan nang pag-gamot sa mañga may-saquit ayon sa aral ni Tissot,* says:

> Este último (Fr. Sta. Maria's) a excepción de la breve y curiosa exposición que hace de las virtudes de las plantas de Filipinas, en lo perteneciente al modo de curar las enfermedades de nada sirve, y aún en ciertos casos pueden ser muy perniciosas las curaciones empíricas que propone.

We should not forget, however, that medicine until the last quarter of the nineteenth century was based largely on empiricism—on experience—and as this same Fr. Blanco says: "contra la experiencia no hay respuesta." And let it be remembered that Fr. Sta. Maria describes in his little book 208 native plants and their medicinal properties: "la virtud falible de las yerbas" as he himself puts it, cautioning the reader:

> . . . para qualquiera enfermedad pongo varias Medicinas, pero has de saber, que no todas aprovechan igualmente a todos, porque unas actuan a unos, y no sirven para otros; esto nace de la variedad de humores de que se compone el cuerpo humano, y de las edades de los enfermos, y así si una no aprobechare, aplica otra, sin atarantarte, y veras marabillas, y obras como de milagros, * * *

and offering the fruits of his labor, *A la mejor Apoteca de las Medicinas, Maria Santisima del Rosario,* says in the following wise:

> Recibíd, pués, Clementísima Emperatríz bajo vuestra protección esta pequeña obra, para que así sean mas eficaces las medicinas, que en ella constan, y para alivio de los afligidos enfermos, que residen por estas Provincias del Asia; en cuyas soledades, sabeis, Señora, que no tenemos otra Botica, que la verde campiña, y selbas, ni mas Médico, que la piedad de los Ministros de Doctrina que movidos de la charidad, ocurrimos confiados en Vos con estas bien experimentadas medicinas, al consuelo de los pobres enfermos, que ansiosamente nos llaman.

And Dr. Faustino Garcia, in a recent article, says:

> The book by Sta. Maria published in Spanish and Tagalog contains interesting matter, and although many statements on the medicinal efficiency of many plants mentioned may not be accepted now, still there are some that until the present time are up-to-date.

In another part, Dr. Garcia writes, "some valuable medicinal plants were included." And again, "Many of these references to the medicinal use made by the natives still stand the test of modern methods of experimentation, only that in some cases the statements are somewhat exaggerated."

Naturally, in the light of our present scientific knowledge, there are a number of practices recommended in the book that appear loathsome, if not barbaric, and yet, if the book is carefully read by an unbiased mind, there will be found many remedies which later proved to be of real therapeutic value. What would foreign scientists have said if the maggot treatment of osteomyelitis had been evolved by an humble *herbolario*? They would have raised their voices to heaven in solemn horror! And yet, that was a valuable heritage of the Great War. It was a common observation among the abandoned wounded in the battlefields that maggots had salutary effects on infected wounds, the most outstanding of which were the absence of foul odor and the formation of healthy granulation tissue. Many confirmatory reports have since been published, especially in American scientific journals.

Let us humble ourselves and may we always remember Ben Maimon's prayer:

> Oh God! Grant me strength, time and opportunity always to correct what I have acquired, always to extend its domain; for knowledge is immense and the spirit of man can extend infinitely to enrich itself daily with new requirements. Today he can discover his errors of yesterday and tomorrow he may obtain a new light on what he thinks himself sure of today.

There were other therapeutic procedures employed by the *curandero*, some of them appearing to be utterly devoid of any scientific basis. I beseech you not to be hasty in your judgment. Observe, study and ponder! We should remember Rizal's excellent advice in this connection:

> Por absurda que una práctica parezca a la razón, si está admitida por la multitud sin imposición forzosa, algún fundamento ha de reconocer.

In 1879, the work of the Filipino Augustinian, Fr. Ignacio Mercado, on medicinal plants, was incorporated in Fr. Manuel Blanco's monumental edition of his *Flora de Filipinas*, and in 1884, Fr. Felipe Bravo published Fr. Blanco's translation of *Aviso al Pueblo*, containing *Ang Mahusay na Paraan nang pag-*

gamot sa mga Maysaquit ayon sa aral ni Tissot. In 1892 was published Dr. Pardo de Tavera's *Plantas Medicinales de Filipinas,* a work undertaken under royal patronage. The scientific classification of the plants was effected for the first time and discoveries of the active principles of a number of plants incorporated. Two hundred and fourteen species were studied and described, the medicinal properties of each species being assigned. This book was translated into English by Thomas in 1901, who made a number of additions and corrections.

"Father Mercado," writes Dr. Guerrero, "is rather parsimonious in giving the morphological characteristics of the medicinal species described by him, but is, on the other hand, profuse, in the descriptions of their curative properties practically verified by himself."

"El P. Ignacio de Mercado," in the words of Fr. Blanco, "habia explicado con grande aplauso las virtudes de muchas plantas de las islas, acompañandolo todo con hermosos diseños hechos de mano. Esta obra utilísima que formaba un tomo en cuarto, y se hallaba en la Enfermería del Convento de S. Agustin de Manila, ha desaparecido según ya lo havia pronosticado el P. Agustin Maria, otro célebre escritor del mismo Convento. Se conservan no obstante algunos fragmentos sueltos de la obra del P. Mercado, que hacen sentir la perdida del resto." His own work, besides its botanical value, was enriched with original observations on their medicinal properties. He says in his Preface:

> . . . he puesto bastante cuidado en averiguar los nombres que dan los Naturales a las plantas. Es esto mui importante, pues, ellos poseen secretos preciosas de sus virtudes, si bien algunos de ellos no estan mui fundados.

As observed by Dr. Guerrero speaking of Fr. Blanco's work:

> He studied the curative properties of several of the plants included in his above mentioned *Flora,* rejecting with very good judgment the information regarding the same which is nothing but folklore, but was, nevertheless, candidly accepted by his predecessors in the work.

Commenting on Pardo de Tavera's work, Dr. Guerrero says, "the first work written with scientific criterion on the medicinal plants of this Archipelago." And further:

> In this work the indigenous species are mixed with exotic species the presence of which in this country has never been established,

conscientiously prepared and worth being consulted in the absence of the Archipelago. Outside of this, it is a good compilation, conscientiously prepared and worth being consulted in the absence of a more perfect work.

Under the present regime this work has been neglected. A Division for the Study of Medicinal Plants was established in the Bureau of Science under the able direction of the foremost Filipino botanist and one of the first six to graduate from the Faculty of Pharmacy of the University of Sto. Tomas in 1877, Dr. Leon Ma. Guerrero. His first publication in which he classifies and describes the properties of 174 medicinal plants, was incorporated in the Census Reports of 1918, and again revised and enlarged, was incorporated in Dr. Wm. H. Brown's publication, *Minor Products of Philippine Forests* in 1924, in three volumes.

Since then, different Filipino research workers have investigated the active properties of several other plants, isolating their active constituents and establishing in several of them their definite therapeutic values.

The first part of the work, the identification of Philippine plants with medicinal properties, has already in great measure been accomplished by Dr. Leon Ma. Guerrero who, in his latest published treatise, already alluded to, lists 406 species. The isolation of the active principles by the chemist is being undertaken simultaneously at different places under the auspices of different government entities. J. Marañon, A. C. Santos, J. K. Santos, P. Valenzuela, F. Garcia, R. Guevara, D. de la Paz are the most conspicuous among Filipinos who have studied the pharmacologic actions of a number of our medicinal plants. Among the plants investigated are the following:

Artabotrys suaveolens Blume.
Local names: *susong-damulag* (Tag.); *babai-balagan* (Vis.).

Phaeanthus ebracteolatus (Presl.) Merr.
Local names: *kalimatas, kalumatas, lanutan* (Tag.); *puropugui* (Neg.); *takulan* (Ilok.).

Archangelisia flava (L.) Merr.
Local names: *abutra, abustra, lagtang, suma.*

Pycnarrhena manillensis Vidal.
Local names: *ambal* (Tag.); *halot, halikot* (Vis.).

Stephania japonica (Thumb.) Miers.
Local names: *kuren* (Batanes Is.); *maratungui* (Bontoc).

Mahonia philippinensis Takeda.
Local name: *kuning.*
Synonym; Baguio barberry.

Argemone mexicana L.
Local names: *diluariu* (Tag.); *Kachumba, kasubang-aso* (Ilok.).
Synonyms: Mexican or prickly poppy.

Alstonia scholaris (L.) R. Br.
Local names: *dita* (Tag.); *alipauin dalipauen, lipauen* (Ilok.).

Alstonia macrophylla Wall.
Local names: *basikalang, dalakan* (Ilok); *batikalang* (Pang.); *batino* (Tag.); *kuyau-kuyau, malatapai* (Camarines); *tangitang* (Capiz).

Strychnos Ignatii Berg. (*Ignatia amara, I. philippinensis*).
Synonym: Saint Ignatius bean.

Strychnos nux vomica L.

Cinchona ledgeriana Moens.

Cinchona succiriubra Pavon.

Cinchona hybrida.

Datura fastuosa L.
Local name: *talong-punay na itim.*

Datura alba Nees.
Local name: *talong punay.*

Lunasia amara Blanco.
Local names: *apdong-kahoi, lunas, pait, saltiki, santiki* (Tag.); *paitan* (Ilok.).

Dioscorea hispida Dennst.
Local name: *namí.*

Areca catechu L.
Synonyms: *buñga,* betel palm.

Crinum asiaticum L.
Local names: *bakon, bakong* (Tag.); *salibangbang* (Vis.).

Eurycles amboinensis (L.) Lindl.
Local names: *tambal, katungal* (Tag.); *abud, busol* (Vis.).

Abrus precatorius L.
Local names: *kasasaga, saga-saga.*
Synonyms: Prayer bean; jequirity seeds.

Erythrina variegata var. *orientalis* L. (*E. indica*)
Common name: *dapdap.*

As to their therapeutic use, it is a matter of regret that so few of our modern practitioners avail themselves of their known properties, like the *alagao* (*Premna odorata,* Bl.) and *talong punay* (*Datura alba* Nees) in asthma, the *lomboy* or *duhat* (*Eugenia jambolana,* Lin.) in diabetes, the *tambalasan* in dysentery, etc. etc.

Regarding opotherapy the following illustrative case will suffice:

Treatment for appendicitis

a. *Method of preparing the medicament*

1. Take the inner linings of three fresh gizzards of fowls.
2. Place in one tumblerful of water.
3. Reduce the liquid to half over a water-bath.

b. *Directions*

Take a tablespoonful each morning for three consecutive Fridays.

It may be taken daily, if necessary.

Many alleged wonderful cures have been reported.

c. *Comments:*

The basis of this treatment is the common belief that the gizzard of a fowl is a powerful digestant. It cures by absorbing the inflammatory products from the diseased appendix. If it has any direct action, is not this an opotherapic remedy pure and simple?

I disclaim any personal experience on the subject and yet, might not this and similar practices have given rise to a new line of treatment, whose efficacy we now all recognize? Might not opotherapy spring from such a lowly beginning? Again, was not Dr. C. Birch, an American woman physician, led to her discovery, by similar deduction, of a specific ovarian hormone which prevents women born of hemophilic parents from developing the disease in themselves although they are actually able to transmit it to their offspring, and which when given to male sufferers makes their blood coagulate as in normal persons?

As to vaccine therapy, we naturally trace it to variolation. Smallpox vaccine is the most potent agent for the prevention of the disease. No successful substitute has yet been invented. How was the discovery effected? Vaccine therapy now so universally accepted, and its principle applied with success in many other diseases, traces its origin to the simple process of variolation. All the facts connected with the process were known. Inoculation with the pock virus had been practised in the East, including the Philippines, for centuries. It was, however, Lady Mary Wortley Montague who introduced the practice to Europe from Constantinople in 1721. Her husband was on a diplomatic mission there and, upon their return to England, she advocated its use. She soon gained many adherents. It should be remembered that the devastation of this horrible scourge was so universal that it respected neither king nor peasant, claiming its victims by the thousands, that Johnson was moved to apostrophize the evil: "Envious and foul disease, is not there an age a beauty that is free from thee?"

In the obscurity of his country laboratory, a then unknown practitioner, Edward Jenner, was correlating in his own mind the facts so vividly brought to his attention: first, the inoculation with the pock virus and second, spontaneous cowpox and subsequent immunity from true smallpox. A short time before, a country milk-maid had confided to him that she had had the cowpox. Jenner pondered again and again over her positive statement: "Oh! I will not get the smallpox anymore as I already had the cowpox!" This was a momentous period in the history of mankind! Smallpox was to be robbed of its death sting! Correlating therefore all the known facts, Jenner conceived the idea of substituting the pock virus with cowpox and thus won for us, the first real fight against an infectious disease. That feat was accomplished in 1796. In spite of adverse criticism, especially on the part of continental physicians, this achievement was signalized by the English Parliament with repeated liberal grants so that the discoverer might pursue his investigations unmindful of the morrow. What a contrast to our attitude toward our own scientists!

The discovery of this obscure country physician gave rise to a long series of achievements in preventive as well as in curative medicine, branching out later into two distinct lines of specialties: vaccine therapy and serum therapy.

A few old practices in minor surgery have been reintroduced lately into modern scientific medicine, so a brief review of them might not be amiss at this juncture.

Fuente, fontículo or *seton.*—What is the modern fixation abscess but a revival of this old practice? Spanish physicians undoubtedly introduced it from the old world as the *Arancel* of October 1, 1842, the compensation for services in performing it provides that,

Fuentes

Por formar una con caústico y curacion	2 p.
Por formar una si la operación se hiciese de noche	4 p.

Dr. Eliodoro Mercado employed this measure as a synergist in the treatment of leprosy.

Wet cupping accomplished by means of an apparatus made of carabao horn, called *tanduk,* is still much in use in certain parts of Albay, the sight of which will at once recall to mind Bier's hyperemia outfit.

Cautery with the coconut-shell point is a favorite procedure among native *mediquillos.*

The story of early medicine in the Philippines is, in its essentials, that of the world over,—of the ancient Babylonians, Egyptians, Chinese, Hindus, Greeks, and Romans. Mythology and superstition influenced its beginnings and in its further progress, empiricism was the foundation stone of modern scientific medicine.

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DEVELOPMENT OF THE SCIENCE OF ANATOMY IN THE PHILIPPINES

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Although the subject of anatomy as a branch of medical study had been offered as a curricular requirement in the University of Santo Tomas since the latter part of the eighteenth century, the full establishment and rapid evolution of this subject as a science in the Philippines has been effected only since the American Occupation. Its recognition and progress as a biological science is coincident with the establishment, in 1907, and growth of the Philippine Medical School, which later became the College of Medicine, University of the Philippines.

Prior to that time, anatomy was simply regarded as a purely didactic course for the medical apprentice, and was popularly known more for its unpleasantness and horrors, through sporadic demonstrations on dead bodies in an advanced state of decomposition, rather than for its basic importance to medicine. The use of refrigeration or chemical preservation of cadavers for dissection purposes was not practised locally in those days.

Since the foundation of the Philippine Medical School, anatomy as a basic science has been given its due importance and a fundamental standing in Philippine Medicine. This was naturally brought about by the adaption in the Government Medical School of a plan of medical instruction closely patterned after that of American medical colleges. Responsible for this move was Dr. Robert B. Bean, the first American professor called to the chair of anatomy. It was he who started the pioneering work of outfitting the first modernly equipped dissection rooms and laboratories for microscopic anatomy in the Islands and who introduced cadaver embalsamation for dissection purposes.

The first research studies undertaken by Bean were mostly on anthropologic lines, describing and classifying the physical characteristics of different regional inhabitants found in Manila and surrounding provinces. Later he extended his work on anthropometry, particularly on cephalometry and cephalography, to the other racial groups found in other parts of the Archipelago. Although the works of Bean were obtained from materials taken at random, and not covering systematically all the groups of people in the Philippines, yet they are regarded as standard contributions, as up to now they are the only comprehensive anthropometric works on the Philippine Islanders.

Bean's successors in the Philippine Medical School Drs. Elbert Clark, R. Lhamon and R. W. Hammack, and Edward S. Ruth, during their successive incumbencies as heads of the Department of Anatomy, also contributed some anatomical investigations of varying interest and covering a wide range of different subjects on morphology, embryology and development, as well as on animal experimentation. One of the most important contributions of Clark was his experimental research with Vedder on polyneuritis gallinarum, made in connection with the study of etiology of beriberi, a disease which was engaging the attention of our medical men in his time. This work received general recognition abroad as a pioneer contribution on the causation and pathology of beriberi. The researches of Ruth were mainly centered on the subject of embryology, although he also did some investigations on morphology and animal experiments on melanophores. He was mainly instrumental in arousing interest in the science of embryology in the Philippines by inviting the medical profession in general to help build up a collection of Filipino human embryos in the Department of Anatomy of the University. Some studies on monsters and structural anomalies were made from these, and a summary report of the collection was published by him just before he left the Islands.

During the period of American incumbency of the professorial chairs in the Philippine Medical School, research work was pursued with far greater advantages both as to time, recognition and material facilities than it has been during the Filipino administration within the last twelve years. Besides having the advantage of individual preparation for research, the American professors had all the ideal conditions essential to research work, such as small size of classes, relatively bigger teaching staff, and with most of the teaching and routine duties delegated to the Filipino assistants. Under this condition the native personnel did not have the opportunity of collaborating in research and this resulted in a vicious circle that placed the senior positions beyond the reach of the Filipinos. As was to be expected, it caused frequent changes in the rank of the American professors by young American graduates, as it is a fact that no one of them ever intended to stay long in the Philippines, and that research accomplishments obtained in this University constituted a capital for better positions in the United States.

Ruth was the last American to occupy the professorship of anatomy of the University of the Philippines. His immediate successor was Dr. Arturo Garcia, who several years previously was his collaborator in the teaching duties. At that time the selection of permanent Filipino members of the anatomical staff was attended with considerable difficulty. The goal of most of the medical graduates was the clinics and active medical practice rather than laboratory and research positions in the University. This was one of the great handicaps faced by the Department during the time of Filipinization of the service. During the early years of Filipino administration, therefore, a turn-over of the junior personnel was continually taking place. This condition, aggravated by the increased enrollment at that period and the lack of the necessary training and guidance to do research on the part of the native assistants, as aforesaid all entailed not only heavy teaching work for the higher ranking permanent members of the department but also considerably retarded the pursuit of research in anatomy.

Dr. Garcia, foreseeing these handicaps, endeavored from the start to interest the university authorities in sending university fellows abroad to specialize on this branch of science as the best solution in carrying out successfully the Filipinization of the service. Effectively, and after a careful selection from the long line of short-term assistants, and within the first ten years of his incumbency, he was able to send on fellowhips abroad the three first ranking members of the present staff of the Department of Anatomy, Drs. J. C. Nañagas, Fidel Cuajunco, and Marciano Limson. He was responsible in effecting the more recent modernization of the dissection and microscopic laboratories, as well as the complete outfitting with equipments for instruction and research in the Department. His collaborators, Drs. Nañagas, Limson and Cuajunco, all possessing rich experience from the laboratories of America and Europe, have coöperated to carry into full accomplishment the constant desire of Dr. Garcia to raise the local anatomical laboratories up to the same level as those of the better class anatomical departments in the United States and to bring the names of Filipino anatomists to the attention of the principal anatomical organizations abroad.

With the present nucleus of men who have had research experience abroad to form the permanent staff of the Department of Anatomy, research accomplishment appears to be fairly well assured. It is regrettable, however, that notwithstanding such favorable preparation of the staff for scientific investigation, too many conditions have been made and allowed to prevail in the University that tend to discourage rather than promote the accomplishment of research. These conditions have become worse this year. To mention some of them, we have; the insufficiency, and just recently, the virtual abolition of the standing appropriation for research; the required heavy teaching hours entailed by the reduction of personnel and the ever increasing enrollment; the absence of proper incentive and appreciation for research; the reduction of salaries and the adoption of strict rules making research a privilege rather than a duty to be performed by the professors. Under such unfavorable circumstances, it may be said with a fair degree of truth, that whatever research work has been accomplished in recent years has been really done through real love and genuine interest on the part of the staff rather than through any encouragements offered by the University.

Despite the existence of such regrettable handicaps, however, there were contributed from the Department of Anatomy a fairly creditable number of research publications, which covered the branches of morphology, development, anomalies and animal experimentation on the lines of neurology, osteology and embryology. More recently, studies have been started on the anatomy and developmental conditions of the internal secreting glands in Filipinos.

The investigative works on neurology comprised experimental studies on the absorption of the cerebrospinal fluid, the artificial production of hydrocephalus, and the study of the motor cortex on macacus, contributed by Dr. Nañagas; and studies on the innervation and development of the neuromascular spindles by Dr. Cuajunco. The studies on the cerebrospinal fluid have been referred to in standard American books on neurology.

The studies on topographic anatomy and anomalies cover those on the position and size of the appendix in Filipinos by Dr. Garcia, and of the kidneys by Dr. Nañagas; and the anomalies of the extremities and also of the kidneys in pigs, also by Dr. Garcia, and on the anomalies of the heart of still-born Filipino children. Other studies on morphology are those of the vertebral artery by Dr. Cañizares, and on the musculus sternalis and ectrosyndactyly by Dr. Yap.

The studies made on development cover some preliminary reports by Dr. Nañagas on the build, constitution, vital capacity and other physical measurements of Filipinos, particularly comprising the university student population. These reports have aroused wide interest and started lively discussions among medical men, physical educators and welfare workers in the Islands, especially as regards the factors causing poor nutrition and physique and their relations to problems of pulmonary tuberculosis in connection with the low vital capacity found for the Filipinos.

The anatomical studies on the internal secreting glands of Filipinos comprise contributions of Dr. Molina on the parathyroids, and more recently by Dr. Nañagas on the topography, size and development of the thymus in different ages, with special reference to the rate of growth and nutrition in Filipino children and adolescents.

Research work in the field of human anatomy had been also undertaken in the Philippines by men connected with other science departments of the College of Medicine of the state university. Those of the Department of Physiology and of the School of Hygiene and Public Health should in particular be mentioned here. Of the former are included the studies on growth of Filipinos by Drs. Concepcion, Salcedo and Bulatao; and on the relation of the body weight to age and height by Drs. Cordero and Ocampo. From the School of Hygiene and Public Health contributions on the studies of the weights of visceral organs in children and adults were published by Drs. de Jesus, de Leon, A. Garcia, Anzures and Ramos. Dr. Cabigting of the Department of Laboratories of the Philippine General Hospital has also published a paper on the blood examination of normal Filipinos.

The development of the science of anatomy of lower animals has been promoted by the establishment in recent year (1916), through the untiring efforts of Dr. M. D. Sumulong (1921) of a modern plant in the Department of Veterinary Anatomy of the College of Veterinary Science, University of the Philippines. Most of the research work in this branch of anatomy was done after the return of Dr. Sumulong from a fellowship in America. His investigations cover varied subjects on osteology of farm animals; the anomalies of development of higher vertebrates; blood studies and topographic reports on the thyroids, and experimental work on castration.

In conclusion, it is earnestly hoped that conditions in the future may be improved so that more encouragement and better facilities and particularly a more liberal allowance in time and money for the pursuit of scientific research may be offered by the University.

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THE DEVELOPMENT OF EXPERIMENTAL PHYSIOLOGY IN THE PHILIPPINES

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Physiology has long been considered the master key to medicine, and by virtue of the great utilitarian service it has rendered in promoting human welfare, it has attained a distinctive position in the category of the sciences. Nevertheless, in spite of the strong appeal that it offers to scientists in general and to medical men in particular, the progress of physiology in the Philippines has been very slow. Previous to the year 1908, experimental physiology was practically unknown in this country. Physiology was taught exclusively by lectures or recitations and in most schools it was given only as a minor part of anatomy. The development of experimental physiology in these Islands is very closely associated with the development of the Department of Physiology of the College of Medicine, University of the Philippines. This department came into existence in 1908 at the time of the creation of the Philippine Medical School, the forerunner of the present College of Medicine. It started in a small wooden building on the Malecon Drive, the one now occupied by the Municipal Court. The man responsible for the dissemination of modern physiological knowledge in this country was Dr. Hans Aron, a German physiologist whose services were secured by Dr. Paul C. Freer, the first Dean of the Philippine Medical School to serve as professor of physiology in the Philippine Medical School. He was the first man to introduce here modern physiological apparatus for experimental purposes. We still preserve in our laboratory some of these early apparatuses that he brought over with him from Germany. While they may now be considered rather primitive they are certainly representative of the most up-to-date equipment of those days. During the incumbency of Professor Aron the Medical School became a part of the newly created University of the Philippines and was transferred from the Malecon to its present site. We can safely state that nearly all the important researches in experimental physiology in this country originated from this laboratory, and the majority of the physiology professors and teachers who are now in the different schools and universities in the City of Manila received their early training in this Department. It is to be regretted that Professor Aron did not stay long enough in the Philippines to train Filipinos to succeed him in the work. When he left the University in 1910, he was succeeded first by Professor Shaklee, whose incumbency was short, and then by Professor R. B. Gibson, a Yale graduate whose services were contracted in 1912 to become the Head of the Department of Physiology of the College of Medicine. It was Professor Gibson who was able to train a number of Filipinos who later succeeded him in his work. It was also during the incumbency of Professor Gibson that the first experimental work in physiology was published by Filipinos (Gibson, and Concepcion, 1914); (Concepcion and Bulatao, 1916). While Professor Aron introduced here the first experimental methods in the teaching of physiology, Professor Gibson may be said to have modernized it. He brought into the Philippines the well-known Harvard apparatuses to replace the rather cumbersome and more expensive German designs brought over by Professor Aron.

Up to 1915, the College of Medicine, University of the Philippines, was the only place where experimental physiology was being taught. In that year the College of Medicine of the University of Santo Tomas, apparently attracted by the marked progress in physiological teaching carried on by the State University, sent Dr. Jose Paredes, then an instructor in the Department of Physiology in that institution, to the College of Medicine, University of the Philippines, to observe the work and familiarize himself with the technique of some of the experimental procedures in the Department of Physiology. Thereafter the Santo Tomas Department of Physiology started ordering physiological apparatus and in the following year they introduced some experimental courses in physiology in their new curriculum.

When the era of Filipinization came, Professor Gibson, taking advantage of the Osmeña Retirement Act, resigned on September 12, 1919. In November of the same year, Dr. Isabelo Concepcion, the next man after Dr. Gibson, was sent to the United States as a government pensionado for further training in physiology and biochemistry and to prepare him for permanent headship of that Department. His arrival from the

United States in 1921 gave further impetus to the teaching of physiology and especially of biochemistry. He brought with him new apparatus and introduced some experimental procedures in biochemistry which had not been used heretofore. In 1923, Dr. Emilio Bulatao, from the same Department, was appointed as a fellow of the Rockefeller Foundation to take advanced courses in physiology in America and Europe. On his return, in 1924, he introduced improvements in the experimental course in physiology in the College of Medicine. Later on two other Department members of the staff, Dr. Narciso Cordero and Wenceslao Pascual were also sent to the United States to take advanced work in physiology. They both returned to the Philippines in 1928, after having accomplished creditable work abroad. Some of their contributions to experimental physiology may be gleaned from the appended partial list of researches (Bulatao and Cannon, 1925; Cordero et al., 1925-1927; Davis et al., 1928).

Tracing the work from the early period to the present time, one can readily see that very slow progress has been made. From the year 1909 to June, 1934, only about 15 physiological papers have been published by Filipinos in this country. This does not include those papers written and published abroad by Filipinos during their period of training. Analyzing the causes for this slow progress in experimental physiology in this country one may ascribe it principally to the absence of proper scientific atmosphere and the lack of proper understanding and appreciation on the part of the public and of the authorities as to the nature of the work of the scientist. This is the reason why scientific pursuits are not very popular in the Philippines and also explains why the returned scientist after working some time abroad and returning with great enthusiasm gradually becomes stale in his line of specialization. If, perchance, his work is recognized, he is removed from active work in his line to take up work of an administrative nature, with the result that he can no longer progress in his chosen line of work nor train a young scientist to succeed him in the future. For experimental laboratory work cannot be done properly by delegation; and an understudy can learn its intricacies only by being a collaborator with the one who is actually doing laboratory work. In Japan the successful scientist is a very popular person and once he obtains recognition he is rewarded by the government either with a title or some form of a pension. In the Philippines, a successful scientist is looked upon as necromancers used to be in the middle ages. In this country the public man is more popular than the scientist and this is the reason why the law profession is followed by so many of our young men. Have we ever considered the fate of scientists willing to forego the attractions of a public life and spend their time in the comparative obscurity of the laboratory? Will advantage be taken of their love of their work for its own sake, to limit their compensation to a pittance barely sufficient to keep body and soul together, or will they be given enough to enable them to concentrate their energies on the problem at hand and not to the mere matter of making both ends meet? This is food for thought for our legislators, philanthropists, and leaders in and out of our government. To create, therefore, a proper scientific environment, should be the aim of those of us who still retain hopes of a better scientific future for the country. I am looking forward to the time when scientists in this country will be as popular as our public men and to the day when research work will finally be pursued with something like sustained effort, with love of science for its own sake as the main incentive.

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DEVELOPMENT OF BACTERIOLOGY AND IMMUNOLOGY IN THE PHILIPPINES

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The accounts of Fathers Buzeta and Bravo (1850) record the expedition of General Miguel Lopez de Legaspi, who brought to Manila, in 1571, military health officers. He founded the Board of Charity and Health (Junta de Beneficiencia y Sanidad) which handled the general hygiene and sanitation work in Manila. From this period to about 1888 the diagnoses of epidemics and infectious diseases were largely clinical, as the Government had no organized laboratory. Asiatic cholera, for instance, was considered by Benoit (1832) as due to various disorders of the gastro-intestinal tract, such as alcoholism, extreme exposures to heat and cold, intestinal round worms (*ascariasis*) and miasms of all sorts.

Disease control by preventive inoculation began with smallpox vaccination. In 1805, due to a very heavy epidemic of smallpox in the Philippines, King Charles IV dispatched an expedition through Mexico in charge of Dr. Francisco Javier y Balmis carrying a cargo of smallpox vaccine for the people of the Philippine Islands. Healthy mothers and children were on board the ship and through their arms the vaccine virus was passed to keep it from perishing during the trip. Upon its arrival in Manila the seed virus was collected and passed on to other healthy children and thus smallpox vaccination from arm to arm began. The Junta Central de Vacunación was created to undertake the production and application of the vaccine. Dr. José Maria Birotteau (1838) in his introduction says in part:

> Esta expedición dirigida por el Dr. D. Francisco Javier de Balmis llegó a Manila el año de 1805 y tuvo la gloria de depositar en las Islas esta mina inagotable de salud, prosperidad y aumento de población.

A bronze statue of King Charles IV stands opposite the Ayuntamiento today which was erected by the Filipinos with the following inscription: "Al Rey D. Carlos de Borbón en gratitud ál dón benefico de la vacuna. Los habitantes de Filipinas". This was erected in 1824.

The first government laboratory in the Philippines was the Laboratorio Municipal established in 1888 in Manila. Mr. Anacleto del Rosario (Gotzens, 1888), who was a pharmacist by profession, was the first director. He made chemical examinations of foods, wines, beers, milk, mineral waters; and bacteriological examinations of cholera stools and other clinical materials supplied him by the Hospital de San Juan de Dios, and private clinics. He also examined and diagnosed pathological specimens, and made studies of amoeba organisms in cases of dysentery. He was unable to isolate pure cultures of cholera vibrio but saw the bacillus of Eberth (typhoid bacillus). This was really the beginning of bacteriological studies during the Spanish régime. In 1894 the Instituto Central Microbiologico y de Vacunación was created at the Laboratorio Municipal with Dr. Salvador Remón (Retana, 1896) as director. Smallpox vaccine was prepared in this institute. In 1885 General Antonio Luna (Villamor, 1932) became director of the Laboratorio Municipal. He was a pharmacist and a good bacteriologist and probably the most capable of the directors so far. Early in 1896 General Luna was exiled to Spain and upon his return he took part in the Philippine revolution.

In 1898 the American Army of Occupation found the Laboratorio Municipal without equipment as a result of the uprising of 1896. The laboratory was converted into the First Reserve Hospital, which later became the present Sternberg General Hospital. On January 16, 1900, the Secretary of War appointed the U. S. Army Medical Board, (Vedder, 1929) composed of First Lieutenants and Assistant Surgeons J. B. Clayton and Richard P. Strong and Joseph J. Curry. The Municipal Laboratory was again equipped and fitted out for active service. The Board met at once to formulate plans of investigation. Part of the instructions of the Surgeon General to the Board follows:

> Blood examinations and bacteriological research for the purpose of clinical diagnosis as well as to promote our knowledge of the infectious diseases prevailing in the Philippine Islands, etc.

This Board contributed fundamental bacteriological studies on the etiology and immunology of such tropical diseases as dysenteries, malarial fevers, beriberi, intestinal parasites, cholera, bubonic plague and paratyphoid. It was the beginning of the development of modern bacteriology and immunology in the Philippines.

In 1901 the Philippine Commission (1901-1902) created the Bureau of Government Laboratories. Dr. P. C. Freer, a chemist of international fame, was appointed first superintendent of this institution. Dr. R. P. Strong was made director of the Biological Laboratory of the Bureau. Under his leadership the bacteriological and immunological studies in the Philippines became widely known. The work of Strong, Musgrave and Clegg, Ruediger, Woolley, Barber, Ohno, (1905-1909), to mention only a few, had opened up a new period in modern tropical bacteriology and immunology of the Philippines and from 1902 to date may be considered the most productive period in the development of bacteriology and immunology in this country. Since 1906 the institution has been renamed as the Bureau of Science. The high reputation of the institution for the study of tropical diseases may be judged from the fact that bacteriologists, immunologists, and sanitarians from other countries come to Manila for such studies each year. The well equipped laboratories and scientific library as well as the courtesies extended to visiting investigators have earned for this institution not only the interest and admiration of foreign scientists, but above all the distinction of having been considered as a high class scientific institution of the Far East.

In the field of animal diseases, the recognition of rinderpest, anthrax, foot-and-mouth disease, hemorrhagic septicemia, hog cholera, rabies, glanders, tuberculosis, surra, etc. fell to the lot of the same Board of Health that handled the investigations on human diseases. The veterinarians of the Bureau of Agriculture—now Bureau of Animal Industry—from 1901 to the present day have contributed to the bacteriological and immunological studies of diseases of live stock. The greatest single contribution to veterinary science in this part of the world was the development of an efficient vaccine against rinderpest by Boynton (1928) which was improved upon by Kelser, Youngberg and Topacio (1928) which made possible the control of the disease at present and its eradication in the Islands in the near future.

The progress within the last thirty years in the development of immunizing agents against the various infectious diseases so far studied has been nothing short of remarkable.

Today the Bureau of Science manufactures vaccines against cholera, bacillary dysentery, typhoid and paratyphoid, rabies, smallpox, and anti-sera against dysentery and other infectious diseases. Likewise, the Bureau of Animal Industry is now producing anti-rinderpest vaccine, hemorrhagic septicemia vaccine, fowl cholera vaccine, rabies vaccine and fowlpox vaccine to meet the needs for the control of these diseases.

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DEVELOPMENT OF HYGIENE AND PREVENTIVE MEDICINE (PUBLIC HEALTH) IN THE PHILIPPINES

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Hygiene and Preventive Medicine (sanitary science) is a branch of applied biology which seeks to prevent, reduce or eradicate disease by removing or altering the responsible etiological factors. According to a late writer on the subject "It aims to make growth more perfect, life more vigorous, decay less rapid, death more remote." This branch of knowledge has lately been given a new name—"public health"—whose more comprehensive and modern scope is expressed in the following accepted definition:

> The science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts for the sanitation of the environment, the control of community infections, the education of the individual in principles of personal hygiene, the organization of a medical and nursing service for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will insure to every individual in the community a standard of living adequate for the maintenance of health.

The practice of hygiene and preventive medicine spells war—war against disease—and any account of it is not complete without mentioning the heroes of the different fights and the details of their exploits. But as the report required on the subject has to be most brief, details will necessarily have to be omitted. Only salient events tending to serve as milestones in the progress of public health in this country will be outlined under the several divisional headings which generally comprise, in their most modern sense, the various aspects of the community application of this branch of medical science.

EPIDEMIOLOGY AND CONTROL OF COMMUNICABLE DISEASES

1803—Edict passed regarding use of vaccine against smallpox.

1805—Expedition to introduce vaccination (arm to arm propagation of virus employed) arrived.

1806—Board of Vaccination established—later changed to Central Institute of Vaccination to take charge of the preservation and propagation of the virus against smallpox.

1871—Edict of September 29 establishing the office of ship medical inspector.

1884—Lazareto de Mariveles established.

1885—(Edict) Ship inspections and maritime quarantine regulations in all Philippine ports adopted.

1901—Compulsory vaccination law for all enacted.

1902—Scientific method of control of cholera instituted, applying for the first time in this country John Snow's doctrine announced in 1849 regarding mode of communication of cholera, the organism of which Koch discovered only in 1883.

1904—Contaminated water and uncleaned green vegetables and fruits pointed out as important factors of transmission in amoebic dysentery; Stream breeding mosquito (*Anopheles minimus*) first demonstrated as local vector of malaria and the importance of streams as breeding places of insect transmitter here stressed; (later studies showed similar results).

1905—Practical application with great success in Manila of the theory that plague in man comes from the plague-infected rat by means of the rat flea; Cholera vaccine first tried; commission to study amoebiasis appointed.

1906—Leper Colony at Culion opened for more effective and extensive segregation of lepers; Result of local study on vaccination against plague made known.

1907—Leper Law (Act No. 1711) passed, providing for compulsory apprehension, detention, isolation, and segregation of all leprous persons; survey of distribution of animal parasites of man in the Philippines undertaken.

1908—Search for disease germ carriers first instituted.

1909—Appropriation by government of ₱35,000 to commence anti-tuberculosis measures; First sanitary survey made of a Philippine rural community.

1910—Opening of Pasteur prophylactic treatment clinic against rabies.

1911—Distribution of typhoid fever in the Philippines first demonstrated.

1912—Antityphoid vaccination first instituted.

1913—Etiology of amoebic dysentery made more clear and utilization of the knowledge in the detection of carriers and mild cases of the disease proposed here; Dry vaccine against smallpox first tried with successful result (of great practical value in immunization of people in remote barrios where glycerinated lymph vaccine usually arrives already impotent. Dry vaccine used was two months old, whereas ordinary glycerinated lymph vaccine will not always remain potent for a greater period than one week at ordinary room temperature).

1916—Committee to study the cause of prevalence of typhoid fever in the city of Manila appointed.

1919—Schick test first used on large scale to determine susceptibility of Filipino children to diphtheria.

1921—Yaws studied from the public health standpoint and shown to be easily controllable (yaws clinic for administration of neosalvarsan opened).

1922—More intensive field studies and campaign against hookworm in rural communities instituted.

1925—Epidemiological and bacteriological studies of cholera revealed for the first time sea-foods obtained from polluted sources as an important (primary) factor of transmission of the disease in Manila and neighboring towns; attention directed also for the first time to the important role of pollution of the fishing sector of Manila Bay and streams emptying into it in the spread of typhoid fever, dysentery and other gastro-intestinal communicable diseases in the metropolis and neighboring municipalities; Antidysentery vaccination first tried locally.

1924-1926—Mechanism of transmission (through bite of *Aedes egypti* mosquito) of dengue fever successfully studied.

1929—Passage of Act No. 3573 providing compulsory notification to health stations of reportable communicable diseases and making innoculation against dangerous communicable diseases compulsory.

1921-1934—More definite knowledge on malaria distribution, prophylaxis, treatment and control gained. (Malaria found wide-spread throughout the Philippine Archipelago; the disease primarily one of foothill regions, being found wherever there are streams containing the larvae of *A. minimus* var. *flavirostris;* littoral when flat, inland plains, and the mountains above 2000 ft. not malarious; spleen palpations furnish a useful index to the incidence of malaria in Philippine communities, there being positive correlation between degree of splenic enlargement and percentage .of positive blood smears.)

1933—Important role of sea-foods obtained from polluted sources in the spread of cholera further demonstrated; Mode of development of the human intestinal fluke, *Euparyphium Ilocanum* (Garrison 1908), determined making possible the prevention of infestation in man; Rat-bite fever distribution studied and mode of transmission successfully demonstrated by experiment.

SANITATION

1733—Carriedo's first bequest of 10,000 Spanish pesos to the City of Manila for the construction of a public water supply, followed by another 10,000 pesos in 1743.

1852—Filling of low lands and laying of subsurface sewers in Manila.

1857-1860—First public park established.

1876—First health survey (though not in modern sense) made (2 titled physicians composed the committee).

1878—Construction of Carriedo water-works, the first water-works in the Philippines, started, and in 882 inaugurated.

1899—First garbage crematory for Manila established; Rat control first instituted.

1901—First sanitary ordinance enforced (City of Manila.)

1903—Regular mosquito and rat control work instituted in Manila.

1904—First artesian well sunk; Pail conservancy system established in Manila; Antiquated and insanitary methods of collecting night soil were discarded and use of the sanitary odorless excavators required.

1905—Use of chemical (copper sulphate) in water purification for Manila first tried; Law appropriating funds for construction of modern sewerage system for the City of Manila enacted, system inaugurated in 1909; Law regulating establishment and maintenance of burial grounds enacted; Prison sanitation assigned to Bureau of Health.

1906—Cemetery Law (Act No. 1458) regulating the establishment and maintenance of burial grounds and cemeteries and governing public funerals and the disposal of the dead in the provinces; Construction of sanitary sewer in Manila begun.

1907—Act No. 1666 passed, appropriating relief fund for purposes of constructing artesian wells, markets, slaughter-houses, etc.

1908—Act No. 1874—The Employer's Liability Law, making employers liable for injury or death of their employees due to negligence or defects in machinery; New water-works in Manila inaugurated; Most extensive general chemical disinfection tried as emergency measure against cholera.

1909—Creation of the Bureau of Labor with duty among others "to inspect all shops, factories, railways, tramways, vessels, industrial and commercial establishments, and all other places or centers of labor, whether public or private, and to take proper steps to prevent exposure of the health or lives of laborers"; Intensive campaign on proper waste disposal instituted.

1910—Regulations for sanitation of cigar and cigarette factories issued.

1912—Manila water-supply treated for first time with hypochlorite of lime (but not continuously), only in 1923 regular treatment (calcium hypochlorite solution) introduced (apparatus not however automatic).

1914—First "Clean-up Week" inaugurated.

1915—First sanitary commission organized to make comprehensive study of health conditions.

1925—Sewage of Manila purified by hypochlorite of lime as an emergency measure against cholera; General disinfection of fish in Manila by hypochlorite of lime and formalin solutions as an emergency measure against cholera; Construction of Novaliches dam started.

1926—First successful rapid sand filter to purify water of swimming pool constructed at the State University.

1928—Liquid chlorine first employed with automatic control for Manila water-supply; Act No. 3428—The Workmen's Compensation Law, prescribing the amount of compensation for physical disabilities due to accidents or occupational diseases (industrial hygiene and sanitation).

1930—Act No. 3813 passed which provided among other things for the construction of insular, provincial and municipal water-works, drainage and sewer systems.

1930-1934—More knowledge gained on problems connected with waste disposal.

1932—Free Emergency Medical Treatment Act (industrial hygiene and sanitation), regarding medical treatment of laborers passed.

VITAL STATISTICS

1591—First census made although not used then for sanitary science purposes.

1882—Edict establishing Superior Board of Health made priests to act as local registrars.

1899—Superintendents of parochial cemeteries required to allow no burial without permits from Board of Health; Regulation passed in Manila requiring births, marriages and deaths to be registered at the Office of Board of Health; (First time modern vital statistics employed).

1903—First modern census enumeration.

1918—Last census taken to date.

1929—Law enacted making notification of reportable communicable diseases compulsory.

1930—Law enacted establishing civil registry.

1924-1934—Several studies based on local vital statistics made. First life table prepared (1927) based on local data.

HEALTH EDUCATION AND PUBLIC HEALTH TRAINING

1760—Rules on how to prevent diseases posted on all churches.

1843—Cartillas de Higiene published.

1865—Practical Guides in Hygiene and Disinfection published.

1872—First medical school (University of Sto. Tomas) established; (first graduates turned out 1875 from whom first "medicos titulares" selected).

1879—By government decree school of midwifery established in University of Sto. Tomas.

1901—Act to regulate practice of medicine, dentistry and pharmacy passed.

1903—Beginning of informal training of health officers in hygiene and preventive medicine.

1905—Act passed December 1, by Philippine Commission establishing Philippine Medical School, opened in 1907, which later became the College of Medicine of the University of the Philippines, with Hygiene and Preventive Medicine constituting one of the departments.

1909—Hygiene and physiology included in curriculum of all public elementary schools for first time; Nursing instruction at the old Philippine Normal School begun.

1913—Graduate courses in hygiene and tropical medicine offered in the College of Medicine and Surgery of the University of the Philippines (Graduate School of Tropical Medicine and Public Health closed 1919).

1921—Health mobile service for public health education inaugurated.

1922—Public health nursing course first offered.

1923—Sanitary inspectors regular training course first offered.

1924—Health education by radio started.

1925—Courses in hygiene and preventive medicine in State University reorganized; fourth year medical students required to conduct sanitary survey of their communities and to file report to Department (descriptive type in 1926 and combined descriptive and appraisal type in 1931).

1926—Legislature appropriated funds for establishment of a Graduate School of Hygiene and Public Health to provide specialized training for health officers.

1928—Regular courses in health education first offered in the University of the Philippines.

1929—Health Demonstration Units for research in public health and practical training of health workers established by University of the Philippines.

1932—Building donated by the Rockefeller Foundation for the promotion of public health education and research completed and occupied.

FOOD AND DRUG CONTROL AND NUTRITION

1714—Partial restriction on sale of wine introduced.

1810—First restriction put on opium importation.

1906—Enactment of law restricting sale of opium.

1907—Pure food and drug law passed.

1908—Restriction on sale of cocaine passed.

1909—Results of first studies on the diet and nutrition of the Filipino people announced.

1910—Fundamental experimental studies on beriberi rationalized previous clinical knowledge on this disease; Beriberi recognized by scientific authorities meeting in Manila as associated with the continuous consumption of white (polished) rice.

1911—Eradication of beriberi from Philippine (native) Scouts by means of a simple change in dietary definitely demonstrated.

1913-1934—Composition, value and vitamin distribution of many Philippine foods systematically studied; at later part of this period intensive drive for better nutrition of the people instituted.

PUBLIC HEALTH LABORATORIES AND HOSPITALS

1574—Royal Order made possible establishment of first Civil Hospital.

1578—Father Clemente's Hospital established in the convent—mostly for natives.

1585—A hospital was established which in 1632 became known as the San Lazaro.

1596—A hospital was established by the Fraternity of the Misericordia which in 1659 was taken over by the Fraternity of San Juan de Dios.

1598—A Chinese Hospital was established.

1618—Hospitals built; one in Cavite for sick sailors, one in Los Baños, one in Cagayan and one in Cebu.

1806—Royal Decree passed establishing Hospicio de San Jose.

1883—First laboratory established.

1900—Merging of old Spanish Laboratory and the old serum institute with a biological and chemical laboratory.

1901—Bureau of Government Laboratories established; Civil Hospital established.

1904—Admission of insane at San Lazaro Hospital first made.
1910—Philippine General Hospital established, assumed function of old Civil Hospital.
1911—San Juan del Monte Tuberculosis Sanatorium established; later transferred and became Santol Sanatorium in 1918.
1912—Law enacted providing for confinement of insane in government hospital; Law creating funds to aid charity institutions passed.
1923—Insular aid law passed to enable establishment of provincial hospitals.
1924—Free laboratory diagnostic service instituted.
1930—Insular Psychophatic Hospital opened at Mandaluyong.

CHILD AND MATERNAL HYGIENE

1879—Midwifery service created in Manila.
1903—Campaign against infant mortality started.
1904—School medical inspection started.
1905—First free dental clinics established in different parts of Manila.
1906—First school physician appointed; Gota de Leche founded.
1907—Compulsory vaccination of school children provided for.
1910—Preliminary studies on infant mortality announced.
1912—Committee to study infant mortality created by Act No. 2116. (Work of Committee extended by virtue of Act No. 2246 passed in 1913).
1913—First school health clinic opened.
1914—Manufacture and free distribution of tiki-tiki.
1915—First "Health Bay Contest" held.
1921—First "Health Center" established.
1922—Act passed providing for health examination of all school children; Red Cross extended cooperation to the Government in school health work.
1923—Act No. 3071—The Woman and Child Labor Law, regulating the employment of women and children, passed.
1930—First study made on how many infants a nurse can adequately render public health nursing service to under rural and urban conditions.
1932—First "Child Health Day" observed.
1933—First "Social Health Center" organized.

PUBLIC HEALTH ORGANIZATION AND ADMINISTRATION

1813—First Board of Health established. Abolished in 1834.
1851—Appointment of visitors to attend to sick indigents and give advice on health.
1870—Provincial and municipal boards of health created in organized communities.
1876—Royal Decree created office of "medicos titulares" (Health Officers) two in each province.
1877—Nurses employed for first time.
1882—By Royal Order of October 7, Superior Board of Health was established—(a consultative body on matters of public health and general sanitation) parish priests acting as presidents of local boards.

1888—By Royal Decree of September 10, medical inspection of health and charity for the Philippines created.

1892—Royal edict of March 20 created "medicos forenses."

1898—Provincial Board of Health for Manila established by Military Order.

1899—Colegio Medico-Farmaceutico de Filipinas founded.

1901—Board of Health for the Philippine Islands created by an Act of the Philippine Commission; this Board reorganized by Act of October 20, 1905 into the "Bureau of Health", veterinary service transferred to the Bureau of Agriculture and the Quarantine Service to United States Marine and Hospital Service.

1902—Manila Medical Society organized.

1903—Philippine Islands Medical Association organized (has a committee on public health).

1906—Law passed creating sanitary districts to facilitate health supervision of rural communities.

1910—Anti-Tuberculosis Society to cooperate with Government in tuberculosis work organized; First Congress of Far Eastern Association of Tropical Medicine held where matters of public health interest and importance were taken up.

1912—Act providing for creation of sanitary divisions and health fund to finance health work in provincial towns passed; "Primera Asamblea Regional de Medicos y Farmaceuticos", held February 8, 1912.

1915—Bureau of Health becomes the Philippine Health Service and a Council of Hygiene is created; Law passed creating the Public Welfare Board to coordinate work of private organizations engaged in health and social welfare activities; Public health nursing service introduced.

1921—Office of Public Welfare Commisisoner created from the old Public Welfare Board; Rockefeller Foundation International Health Board extended cooperation to Philippine Government in the development of hygiene and public health.

1926—First Tuberculosis Congress held; First Health Officers' General Assembly held.

1930—Act 3743 passed creating Tuberculosis Commission.

1932—Philippine Public Health Association organized, conjoint meeting with Philippine Islands Medical Association held 1933.

1933—Reorganization Act passed consolidating all public health activities under a Commissioner of Health and Welfare.

This outline of events gives but a panoramic view of the development of public health work in the Philippines. This had to be so, for to give a complete historical account of the evolution of this branch of science in this country is a task far beyond the limits of a brief report. The subject is full of interest, however, and its comprehensive treatment remains the duty of future medical historians.

Anent the practice of preventive medicine in the Islands prior to Spanish occupation, scattered pieces of evidence seem to indicate that the value of isolation and variolation was then understood. There is, however, no definite information regarding the origin of the practice of this branch of knowledge here in prehistoric times. But if we accept the doctrine of "unity or solidarity of folk-ways," it may be assumed that the first inhabitants of this Archipelago must have employed some sort of prevention against sickness in the light of their understanding then of disease causation. We may further assume that the early Malay invaders of the Philippines and the Chinese traders of pre-Hispanic periods must have brought along with them and introduced here some of their favorite notions of disease prevention.

And when Spain came to introduce to this country occidental civilization and culture she had withal had to make use of the type of hygiene and preventive medicine then understood and practiced in the Iberian peninsula, consisting mostly of empiric application by the government of very limited and inadequate method of disease prevention and amelioration. Why this was is not hard to comprehend if one considers the fact that hygiene and preventive medicine as a science is but a product of the 18th century.

The establishment of American sovereignty marked the beginning of the new era of public health progress in this country. During the three decades since 1898 several incapacitating and fatal diseases were studied and scientific methods of preventing and controlling them instituted. But however great may have been the accomplishment of hygiene and preventive medicine in the past, the problems still remaining for solution are greater; for, according to an eminent sanitarian, "the hope of the future lies in the continued and increasing growth of scientific knowledge which can be applied to the relief of human suffering and the saving of human lives."

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DEVELOPMENT OF SURGERY IN THE PHILIPPINES

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> While Science, true enough, knows neither frontier nor breed, which is generous, Science excuses no breed or frontier that fails to contribute to her progress, * * *, which is but fair. LIGHTENING THE WHITE MAN'S BURDEN.—Presidential Address, P. I. M. A. 1926.

OLD ERA

As might be expected, the Philippines participated in the development of surgery in the world, if not as an active contributor, and always abreast of its progress, at least as more than a blind, unquestioning follower, in the effort of her men to modify certain phases of its practice and adapt it to local conditions.

It being true, to a great extent, that hospitals and their facilities and the practices followed in them furnish an index to the development of surgery in a given community, it is but natural to make repeated references to them in the course of this brief historical statement. Good surgical work is difficult to accomplish in the absence of proper equipment and surroundings, and this only a good hospital can offer.

The first hospital in the Philippines after Spain came, of which there is notice, was founded late in the year 1575, and had a very short-lived existence. Its name did not come down to us. San Juan de Dios Hospital, by far the oldest general hospital in the country since, was founded, according to some, as early as March 22, 1565, and according to others, in 1596. Incidentally, the first local medical school under Spanish auspices was authorized in 1681, but was not definitely established until February 5, 1872. In the words of Don Jose de Arrieta: "It was the officials of the Government who would rise up against the idea, fearing insurgents who would graduate from the University."

ANESTHESIA

News of the benefits from the independent discoveries of inhalation of ether anesthesia March 30, 1842, and October 16, 1846, and of chloroform anesthesia about a year later, November 4, 1847, were not long in reaching the Philippines, but their routine administration was never and is not now entrusted to professional medical anesthetists, much as this is to be desired. Before that time, of course, operations everywhere had to be performed largely with patients writhing in pain and restrained by force during the ordeal. During Spanish times, chloroform was the anesthetic of choice in the only hospital in the Islands where any considerable operative work after the manner of the day was being done. There was so much dread of its depressing effect, however, that complete anesthesia was hardly ever aimed at, and surgical shock was always laid at its door.

Almost every conceivable form and method of annihilating pain during operation is resorted to at present, to suit the indications, namely, local, regional, splanchnic, spinal and sacral anesthesia. But rectal and intravenous anesthesia have found no wide acceptance locally.

ANTISEPSIS AND ASEPSIS

The life-saving legacies of Pasteur and Lister—antisepsis and asepsis—which saw their crystallization and practical application in the later seventies, could not but shed their blessings on the Philippines also, and by the late eighties, or about a decade later, the principles of antisepsis were introduced into the Islands, first by the use of boiled water during operations and dressings, and of the alcohol flame in the sterilization of surgical instruments. Queerly enough, gauze, sponges and bandages were to remain unsterilized or undisinfected for some time yet, the facilities for that purpose being acquired later. The fallacy of such practice is apparent, but it can be excused on the ground that everything possible was being done. Previous to that time, antisepsis and asepsis were completely unknown in the Islands, as elsewhere for that matter. The antiseptics of today were unheard of things. A local chronicler tells us that it was the usual thing in the operating room of those days to see the man in charge of the surgical instruments—usually some important-looking person—"disinfecting" the blood-stained or otherwise soiled instruments by wiping them with a piece of rag *ad hoc*, or with the tail of his own apron, the cleanliness of which can be imagined, and nonchalantly placing them back on the operating table, in readiness for the surgeon's use. Later on a little forward step in disinfection was made by dipping the instruments in diverse antiseptic solutions; later on still they were subjected to the intense heat of the alcohol flame, until now we have come to the modern boiling apparatuses, and autoclaves, and sterilization against bacteria and spores is under rigorous scientific control.

Dressings and tampons and drainage materials were made out of old blankets or rags. The sorting of the materials for the latter two was done with the patient's own combs, many of the former being inveterately long-queued Chinamen of prerepublican days, all of which materials thus prepared were used in dressing wounds, without any sterilization or disinfection or semblance of it. What a contrast between these questionable dressing sources, and the modern manufactured gauze from which dressings are now prepared, to say nothing of the rigid sterilization which they must go through before they are allowed to be used!

BIZARRE CONCEPTS AND PRACTICES

After all, such flagrant departures from sound surgical principles as we conceive them today were not at all out of tune with some of the bizarre concepts and practices of the times. There prevailed then the "good, laudable pus" idea of the fathers, who hailed or actually provoked its appearance in a healing wound as a very favorable sign. In all of this the Philippines could not be an exception. Thus we read, not without astonishment, that free pus formation was often encouraged, for which purpose a formidable assortment of ointments of more or less proved pus-forming value was always on hand, ready to be dubbed on a healing wound. Of these, an ointment with yolk of eggs was a favorite, sure to reward the surgeon with abundant free pus. Just why healing by second intention seemed to be a desideratum among the old surgeons is a mystery to the writer, unless it were that between hospital gangrene, the nightmare of pre-Listerian surgeons, and free pus, the latter was the lesser evil. What modern surgeon would not now bitterly reproach himself if he failed to bring about the healing of a surgical wound by first intention, and with an almost invisible scar?

No less bizarre than these practices, which read as if out of some sorceress' tale, were some of the operating room rituals of those days. We are not told how things went locally, but Cullen tells us in 1916, that as recently as only fifty years ago (1866), in America:

> Some surgeons would think nothing of putting their hands into the wound and then, after handling the sheets or blankets around the patient, of placidly continuing the operation. What need of worry? They were totally ignorant of the possibility of contamination * * * I have heard another surgeon specifically warn his students against the danger of contaminating the clean wound. He would then wash up carefully and, while admonishing his students, would walk around the amphitheater with his hands in his pockets. The next minute these hands went directly from his pockets into the wound. * * * I have seen another surgeon of excellent repute place the handle of his knife in his mouth for safe keeping, while he was busy tying ligatures.

As to the operating room apparel, he tells us further that:

> Some operators would appear in full dress suits or full black coats. The sleeves of these coats have been ingeniously split up at the sides so that the surgeon could readily hold them back until his arms were freed to the elbows.

The operating table in those days held a motley assortment of paraphernalia. There were, in addition to the instruments themselves, the dressings, tampons, drains, bandages, and the indispensable assortment of ointments which formed part of the armamentarium in order to provoke pus and everything else that might be needed for the operation. Flies seemed to feel at home and were chased away only with an imprecation from the instrument man, but no more. The screen idea had not yet dawned upon the minds of surgeons or assistants.

The quiet yet impressive atmosphere and spotless appearance of the modern operating room, its elaborate ritual, approaching a liturgy in some ways, with the surgeon and his assistants moving noiselessly about in their immaculately white gowns, caps, masks and impermeable gloves, whom one dares not touch or come too close to for the time being, the orderly separation of instruments, dressings and other paraphernalia, and the solicitude with which the operating room is guarded, lest it be desecrated by some winged intruder or ungowned mortal, all with a view to establishing and maintaining the most strict asepsis, are too well known to require mention.

IMPROVISED OPERATING ROOMS

Conditions in hospitals in those days were generally such as to make their atmosphere a most uninviting one, and their reputation generally bad, so that only poor patients went to them, and reluctantly. Most well-to-do patients preferred to be cared for and operated upon in their private homes, some suitable nooks in them being improvised into miniature surgical amphitheaters. This was true here as elsewhere. The old dread of hospitals for which the hospital-shy Filipinos were sharply criticized in the early days, was not confined to them.

OPERATING ROOM ILLUMINATION

We have gone a long way from the old operating room lighting "system" with its vacillating, flickering wax candles, through more or less dependable petroleum lamps to the present incandescent electric light which floods the whole operating room with light, to say nothing of the wealth of powerful and shadowless reflectors which every modern, self-respecting operating room is equipped with.

SCOPE OF OPERATIONS

While many operations were performed even before the advent of antisepsis or asepsis, or even of anesthesia, for tumors in the neck, mouth, throat (sic), breast and testis, amputations and resections, perineal cystotomies or lithotrities, and a little later suprapubic lithotomies, hardly any laparotomy appears to have been attempted locally until the year 1885. So dire were the results of entering the peritoneal cavity in those preantiseptic days that the boldest stood in mortal dread of it and no one ventured to risk his reputation. For a long time the abdomen remained a forbidden land. In America a much similar condition prevailed a little before that same period. At present, there is hardly any part of the human body which is not laid open to the surgeon's inquiry, either for relief or for cure.

FILIPINO OR REVOLUTIONARY ERA

During this short and trying period, from 1896 to 1900, such surgical work as had to be performed was necessarily confined for the most part of the repair of war injuries, such as amputations, reductions of fractures and dislocations, care of gunshot and other wounds, most of which at emergency military hospitals, and under most difficult circumstances.

NEW ERA

The year 1898 marked the beginning of the new era of medicine in the Philippines, largely influenced by American thought and methods. The opening of an American military hospital in Manila in 1899, now the Sternberg General Hospital, gave an opportunity to the older group of Filipino surgeons, who were really the pioneers, to have an insight into more modern surgical methods, practices, organization and equipment. Credit must go to this small group, perhaps not so much for their surgical skill, as for their inspiring and yeoman determination to qualify themselves, which they did splendidly, improvising animal operating rooms wherein to make themselves proficient, applying themselves diligently to the work and sparing no expense to equip themselves with the necessary armamentarium, which their then impecunious hospital could not offer them. They had the zeal and the searching inquisitiveness of the true scientist in them, and probably realized that thenceforth they were to cease to be passive spectators and become actors in the surgical drama. They were to come into their own as they never could before. The late Dr. Juan Miciano was one of them.

These men and their predecessors, in common with surgeons elsewhere at the time, often had to operate at the private homes of patients, and personally attend to the hundred and one details attendant upon a major surgical operation.

To us moderns who have been brought up in the comfort, safety and freedom from irksome personal attention to operating room details, such frequent extramural undertakings must appear as an ordeal, which far from reflecting on our surgical forebears, cannot but excite our admiration for their courage and patience. How many of us moderns would venture to perform a major operation in the best appointed private home today, unless it were absolutely necessary and as a last resort?

Competent work is being done now by an able group of younger Filipino surgeons, most of whom have received their medical education in the two excellent local medical colleges, in the United States, and in European clinics as graduate students, and had their surgical training chiefly in the Philippine General Hospital and in the old but splendidly remodeled San Juan de Dios Hospital, in Manila. Brilliant work was done by the late lamented P. C. Guazon, one of this younger group, and first Filipino Professor of Surgery and Head of the Department of Surgery in the University of the Philippines. A tireless worker, he brought about his untimely death by his unsparing industry, dying at the early age of 42, like a loved one of the Gods. While these men lay no claim to any outstanding originality or contribution, either in the fundamentals or in the technique of surgery, yet in the fields they have had opportunity to cover so far, it is felt that, on the whole, their work need not suffer much by comparison with that of others. Work on the neck, including the thyroid; on the abdominal viscera, notably the stomach, intestines, colon and rectum, liver and gall-bladder; on the genito-urinary organs, notably the kidneys, ureters and prostate, on bones and joints, that is, for fractures, dislocations, ankylosis, deformities and the like, is being done right along. The field of local anesthesia, chiefly with novocaine, has been considerably extended, and its technique carried to a point that in appendectomies, herniotomies, thyroidectomies and a few other major procedures, the use of a general anesthetic has become exceptional. In certain fields, there is assuredly more operative work done locally under local anesthesia than was the writer's privilege to see in many European clinics on his second visit not so long ago. Blood transfusion has been so simplified that in proper cases its use has become a life-saving routine, and nothing but the question of cost prevents its wider employment. A local fiber, abaca (Musa textilis), has been introduced as a suitable suture substitute for horse hair and silkworm gut and metal clips.

Needless to say, in their work, the latest contributions and most reliable tests from the laboratory, particularly pathology, bacteriology, and biochemistry, and the X-rays, are made use of, either for diagnostic or therapeutic purposes, or for bringing poor surgical risks within safe operative margin. Perhaps in no other domain of surgery has the X-ray proved its positive diagnostic value more than in genito-urinary work. The invention of the cystoscope, the revelations of the X-ray in connection with opaque solutions which may now be introduced either ureterally, in itself a beautiful little procedure, or intravenously, and the discovery of the various efficient functional kidney tests, give the work a precision that is unsurpassed anywhere.

The discovery of radium has, of course, given a new impetus and a new hope in the treatment of cancer, which is turning out to be as frequent in the Philippines as in other countries. Considerable immediate improvement and even apparent cures are of record.

WHERE FURTHER DEVELOPMENT LIES

Aside from work in connection with injuries, however, or for diagnostic purposes, there has been little opportunity as yet in surgery of the other ductless glands, and in cerebrospinal, cardiovascular and pulmonary surgery. Plastic, reconstructive, and industrial surgery, including systematic bone grafting, also need to be developed. The treatment of septic conditions still leaves much to be desired.

There should be more facilities for building up good surgical museums, follow-up, medical photography and microphotography, and research work. A surgical guild and an exclusive publication would go a long way towards stimulating sustained original work on a high plane, and what is not less important by any means, the cultivation of the ideal of service and the preservation of those intangible qualities which make one's life work so much more worth doing.

It is a far cry from those days of restraint "anesthesia" when the poor patient writhed hopelessly in pain during the excruciating ordeal, through the days of shaky chloroform narcosis to the present mastery of all forms and methods of noninhalation anesthesia; from the days of crude attempts at asepsis, or of no asepsis at all, to its present refinement, scientific precision and control; from the days of flickering candle or petroleum lamp operating room illumination to the present flood of incandescent light and dazzling reflectors; from the days when flies felt at home in the dingy operating room to the present scrupulously guarded and immaculately clean surgical amphitheater, where the presence of a stray fly is sure to bring a calling down for somebody; it is a far cry from those days of incongruous full dress suits or full black coats to the spotlessly white surgeon's garb of today, with its equally white cap and mask and rubber glove appurtenances; we have emerged from the days of "good, laudable pus" of the fathers to the present ideal of healing wounds by first intention; and gone are the days when the abdominal and other cavities were *terra incognita vel pro-*

hibita and too sacred for the knife, to the present day when, in the words of Deaver, uttered without levity, the abdomen and pelvis have become almost the "playground" of surgeons.

The Filipinos have been beneficiaries of all these advances, whose detailed account would read like a saga. It would be a sad reflection on their capabilities and self-respect if, in the years to come, Filipino surgeons should fail to return something of the gift they have received and will continue to receive from medicine from across the seas, given to them without measure and without stint.

Progress does not necessarily mean a supine willingness and an infinite capacity for absorbing others' ideas; a more positive and aggressive form of it is by having ideas of one's own and, in the commercialized language of the day, selling them to others. *Borrowing dulls the edge of husbandry.* Light must come from within as well; it bespeaks a pathetic intellectual penury and a dismal sense of defeatism always to expect it to creep in from without. The flow of the current must not be suffered always to be centripetal; it must veer centrifugally once in a great while, for is it not true that it is better to give than receive?

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GYNECOLOGY IN THE PHILIPPINES

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Gynecology is one of the youngest branches of medical science in the Philippines. It began only under the American administration and as a subdivision of surgery. Those who first practiced it, as for instance Drs. Singian, Miciano, Guazon, McDill, Gilman, and Lopez, were general surgeons. Others, like Drs. Perez, Zamora, B. Roxas and F. Calderon, were primarily obstetricians. A few well-known medical practitioners, among them Drs. Luna and Barcelona, practiced medical gynecology.

The College of Medicine and Surgery had no separate chair of gynecology until 1922 when, on the motion of the then Regent Calderon, a department of gynecology was created by the Board of Regents, which appointed Dr. Calderon as its head. The personnel of the department consists of Drs. Calderon, Tolentino, and Acosta-Sison from the obstetrical staff and Drs. C. Reyes, A. Mandanas, and C. Franco from the surgical division. Of these, only Drs. Calderon and Tolentino give their full time to gynecology. The rest keep up their dual role as obstetrician and gynecologist or as surgeon and gynecologist.

The gynecologic department gives medical students didactic lectures and clinical instruction in the dispensary, at the bedside and in the operating room. It conducts a daily clinic in the dispensary for diagnosis and medical treatments, and a weekly operative clinic for those needing surgical intervention. Its ward of 14 beds is too small to accommodate its increasing number of operative cases. On account of lack of space it has no beds for gynecologic patients who need medical treatment.

Endometritis, perineal repairs, and prolapsus uteri—all obstetrical complications, and adnexal inflammations due to gonococcus form a great bulk of the cases treated. These point the way of preventive gynecology. The early treatment of cancer from the viewpoint of its radical cure has a wide field of activity. But either the patients come too late or the diagnosis is not made in the incipient or early stage.

The use of the quartz lamp, radium, and X-Ray, the Wertheim technique of operable cases of uterine cancer, the interposition operation for procidentia uteri, the Alfieri method of righting a retroverted uterus, the Rubin and lipiodal test for determining the patency of the Fallopian tubes and the use of artificial impregnation are known to the modern Filipino gynecologist.

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THE PROGRESS OF OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY IN THE PHILIPPINE ISLANDS

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There is to be observed at present among our medical men a more determined resolve and concerted effort to extend the boundaries of our knowledge in all branches of medical science. This intense yearning to advance should receive our heartiest welcome and our most enthusiastic encouragement and fullest support.

At this time when plans are being carefully studied to promote the progress of medical science in our country, it is advisable to pause for a moment and ponder how far we have traveled, how much of the foundation we have already built solidly for the superstructure of the system of medical research which is being devised.

In this brief paper an attempt is made to record in meager outline the progress in this country of two branches of medical science: namely, Ophthalmology and Otorhinolaryngology.

In the Philippines, Ophthalmology as a separate branch of medicine, is comparatively new, and particularly so is its sister science Otorhinolaryngology. In tracing their growth it is meet to follow their progress during the following periods: The first period begins with the Spanish occupation and extends to 1876; the second comprises the period from 1876 to the beginning of American occupation in 1898; the third covers the years from then to 1909; and from that date to the present time is the fourth period.

First Period.—The knowledge of the people regarding medicine during the early part of the Spanish occupation was very primitive. There were "herb doctors" or quacks, whose medical practices and beliefs revealed the influence of contact which the natives had with other peoples, like the Chinese, the Borneans, and other Malayans, the Hindus, and the Japanese who used to trade with them even before the coming of the Spaniards. One of the great handicaps which our medical men have to contend with even at this time is the strong hold which the quacks have on the ignorant masses; particularly, in the remote municipalities and barrios. In the later part of this period, through the initiative and encouragement of the government and the church, Spanish doctors came here, and in their practice of general medicine undoubtedly also treated diseases affecting the eyes, ears, nose and throat.

Second Period.—With the establishment in 1871 of the San José Medical College, (the Medical Department of the University of Santo Tomas) began an important era in the history of medicine in this country. In 1876 this college turned out its first group of graduates (*Licenciados*), and from that time on this university began trying to meet the need for doctors in the Islands, with its graduates, who as general practitioners made use, as far as possible, of their scanty knowledge of Ophthalmology and Otolaryngology gained at that time.

During the later part of this period Ophthalmology was making rapid progress in modern countries of Europe and in America. It was also at about this time that Rizal (Ubaldo, 1924), after obtaining his licenciate degree in 1884 at the Universidad Central de Madrid, decided to specialize in Ophthalmology because of his mother's failing vision. His training in this branch of medicine was obtaned under famous oculists of Europe, like De Wecker of Paris, Fuchs of Vienna and others of Germany and other countries. In 1887 he returned to the Philippines and successfully performed, in their house in Calamba, the cataract extraction from the left eye of his mother, probably the first cataract extraction done in this country. News of his success rapidly spread throughout the Islands and neighboring countries. He was also known to have performed enucleation, strabismus correction, removal of pterygium, and undoubtedly he performed several other eye operations but authentic reports on these are not available. It is a matter for legitimate pride in our profession that the greatest man our country has produced was a physician and the first Filipino Ophthalmologist. Soon after, Spanish oculists like Drs. Biada and M. G. Tornell (Ortigas, 1924), and probably a few others came here to practise this specialty, and they were later followed by Filipinos who had taken post-graduate courses in Europe, among them being Dr. Simeon Villa.

Third Period.—In the early years of American occupation the government established the Bureau of Health and the Quarantine Service which have been instrumental in minimizing the havoc of epidemics. Smallpox, which previously was responsible not only for many cases of death but also for permanent blindness, was soon suppressed. Rigid rules enforced by the Quarantine Service eliminated, to a great extent, the danger of introducing contagious diseases, particularly trachoma and diphtheria, from neighboring Oriental ports. Physicians connected with the Army and Navy, who had some training in the specialties, began to practise here, more actively soon after the establishment of their respective general hospitals at Fort Wm. McKinley and at Cañacao. When the Government Civil Hospital was established, general surgeons or general practitioners took up also eye, ear, nose and throat work. Church and mission hospitals were also established in the later part of this period, and employed doctors some of whom had had some training in the treatment of eye, ear, nose and throat diseases.

Dr. Severino B. Alberto (Ortigas, 1924), who graduated in 1903 from the University of Santo Tomas, went to Europe to take up post-graduate courses in Opthalmology. Upon his return to the Philippines he practised this specialty extensively. He was appointed professor of Ophthalmology in Santo Tomas University and attending oculist of the San Juan de Dios Hospital. He made several trips to Europe. At present he is the head of the Section of Ophthalmology and Otorhinolaryngology of Santo Tomas.

Fourth Period.—This period has undoubtedly seen the greatest progress in the development of Ophthalmology and Otorhinolaryngology in this country. This was largely brought about by the establishment of the Philippine Medical School in 1907, in which, according to its organization, there was provided a separate department of Ophthalmology and Otorhinolaryngology; and by the foundation of the Philippine General Hospital, which opened its doors to the public in 1910, and also had a separate Department of Eye, Ear, Nose and Throat.

The progress of these specialties may be traced under the following headings:

1. Progress in instruction.
2. Progress in practise.
3. Progress in scientific or clinical investigations.

1. *Progress in the Instruction.*—In May, 1911, Dr. Reinhart Rembe, a German, but a naturalized American, was appointed associate professor and head of the Department of Ophthalmology and Otorhinolaryngology and Dr. Aristeo R. Ubaldo, a nephew of Rizal, as assistant. The course was then given in the fifth year, consisting mainly of lectures and practical demonstrations and was allotted 204 hours. In 1912 the rotation interneship service in the Philippine General Hospital requiring six months stay was started in the Hospital, one month of which was to be spent in the Department of Eye, Ear, Nose and Throat. Dr. Rembe left the Islands in 1914 and Dr. Ubaldo took his place. He was made full professor July 1, 1920. In 1919-1920 a clinical clerkship was inaugurated in the College of Medicine, University of the Philippines, and the students of the fifth year were then assigned in groups of two or more working for one month in the department during the mornings only. In 1923 a change in the curriculum of this College was made; the total hours alloted becoming 162. Instruction now begins in the second semester of the third year; in the fourth year the students are taught dispensary practise, given practical demonstrations and attend clinical conferences. In the fifth year they serve as internes in the hospital and are detailed for one month in the department where they receive practical instructions and are permitted to assist in minor operations. This total of 162 hours is more than the average number of hours allotted in American Medical Schools, which according to Dr. W. D. Reid, constitute 110 hours (Ophthalmology, 52 and Otorhinolaryngology, 58).

The curriculum of the Faculty of Medicine of the University of Santo Tomas has also been revised from time to time to comply with the requirements of the Government and to follow closely the trend of recent advances in the teaching of the specialties.

In regard to the residentship in the Philippine General Hospital and the San Juan de Dios Hospital, both of which are attached to their respective medical colleges, there also have been effected some changes: the term has been limited to 5 years in the former and 3 in the latter. The object is to give other graduates opportunities for hospital training preparatory to private practice or for assignment in provincial hospitals.

2. *Progress in the practice of these specialties.*—There is a group of specialists who have acquired their knowledge of the

art and science of Ophthalmology and of Otorhinolaryngology abroad, and although they have not engaged in the teaching of these subjects nor published the results of their investigations or experiences they have nevertheless contributed much to the progress in the practice of these branches of medicine here. To this group belong Drs. Victor Sevilla and Ramon Ongsiako. The wide practice and the high reputation attained by Sevilla attest his great ability as a specialist.

Up to about fifteen years ago correction of refractive errors was almost exclusively in the hands of opticians but today more and more of those who practice Ophthalmology take up refraction work.

3. *Progress in scientific or clinical investigations.*—In describing the march of progress in scientific investigations, we may cite here references to articles that have been read or published in local or foreign medical journals during this period. Incidentally, the designation in 1922 of the writer as a correspondent for Manila in the American Journal of Ophthalmology (Fernando, 1922) has enabled him to request publication in that journal of articles written by local oculists.

In 1913 Dr. Ubaldo (Ubaldo, 1913) advocated a modified technic of the Kronlein operation in large retrobulbar tumors. In 1914 he first called attention to a certain form of amblyopia observed in parturient women (Ubardo, 1914). This symptom was also studied by Dr. Ayuyao, who in 1933, made a report of the corneal findings regarding these cases (Ayuyao, 1933). Trachoma has since the beginning of this period, attracted the attention of the local oculists. Dr. S. B. Alberto wrote in 1912 and 1914 on the treatment and prophylaxis of this disease. Major Theodore Lyster (1911) of the U. S. Army, who was detailed to the Philippine General Hospital before Rembe came, called attention in 1911 to a comparatively frequent eye disease here—follicular conjunctivitis. Recently, the writer (1914) called attention to the frequency of mistaking follicular conjunctivitis for trachoma and subscribed to the theory of Dr. Harvey J. Howard that there seems to be an intimate relationship between the amount of pigment of the skin of the patient to the severity of this disease; the lighter the complexion the more severe the disease. In 1917, Dr. Velarde (1917) reported on two cases of conjunctivitis vernalis.

Dr. Ubaldo visited famous clinics in Europe and the United States in 1921, and when he returned to the Philippines he introduced many new procedures, among which may be mentioned cataract extraction with the erisiphake (Barraquer's method). In 1923 he reported the results of his experience with this technic (Ubaldo, 1923).

In 1922 a clinical survey of eye, ear, nose and throat cases in the free dispensary of the Philippine General Hospital was made with a view to determining the relative frequency of the commoner diseases affecting these organs (Fernando, 1922, 1923). A study of the causes of blindness among Filipinos was also made and reported in that year (1923). Dr. Fernando in 1923, and Dr. Elpidio Dizon in 1930, understook studies of the eye, ear, nose and throat lesions in leprosy. Eye complications resulting from disease due to deficiencies of vitamins A and B have been carefully studied by local oculists as well as by others (Fernando, 1923, Gamboa, 1930). In 1920, Guerrero and Concepcion (1930) made experimental study on xerophthalmia in fowls fed on polished rice.

A very important event in the history of Ophthalmology in this country and one that gave a new impetus to the study of this specialty was the visit of Professor E. Fuchs of Vienna, the most eminent ophthalmologist in the world in his time. He was appointed visiting professor by the University of the Philippines and gave a series of most interesting lectures on the pathology of important diseases of the eye from January 8 to January 19, 1923.

In December, 1921, Drs. Fernando and Nicolas (1922) first tried here milk injections in the treatment of acute inflammations of the eye and obtained satisfactory results. In 1922, Dr. Nicolas made a detailed report of three cases of tuberculosis of the conjunctiva.

Progress in Rhino-Laryngology has also been notable. W. P. Chamberlain in 1910 and Drs. Gomez, Kapunan and Gavino in 1920, made studies on diphtheria in the Philippines. Dr. V. Sevilla reported in 1914 his experience in the diagnosis and treatment of inflammation of the accessory sinuses of the nose. In 1924, Dr. Velarde reported on 5 cases of fibroma of the nasopharynx. Dr. Nicolas in 1924 and Dr. Ayuyao in 1927, described the tertiary manifestations of yaws in the nose and throat. Fernando in 1924 made known his findings that hoarseness as a symptom of beriberi was due to paralysis of one or both vocal cords, more frequently the left, as he had observed by means of laryngoscopic examination. This paralysis or paresis was attributed to neuritis of the laryngeal nerves.

Regarding the progress in the field of radium therapy, we may mention here that Fernandez (Ricardo) reported, in 1922, promising results in radium therapy in eye, ear, nose and throat work. Recently Drs. Singian and Gonzalez (1934) wrote a paper describing satisfactory results with their special technic in radium applications on several cases of malignant new growth of the nose, pharynx and larynx.

Medical science has progressed so much in the last fifty years that it is impossible for one man to keep *au courant* with its progress in all its branches. As a natural reaction, and to be able to render more effective medical service, medical education and medical practice have encouraged specialization. In line with this Dr. A. R. Ubaldo has happily initiated the policy of giving the older members of his staff ample opportunities to make original studies and undertake investigations in the particular subjects assigned to them to teach.

In 1927-1928, Dr. V. C. Alcantara took a post-graduate course in Peroral Endoscopy in the clinics of Dr. Chevalier Jackson, and on his return, was assigned to do the eosophagoscopic and bronchoscopic work in the department. Foreign bodies in the eosophagus, especially coins, which formerly were removed with the coin catcher as reported by Dr. Velarde in 1917, are now extracted by the Jackson technic. In December, 1932, Alcantara read a paper on his four years' experience in peroral endoscopy work, and in 1933, on cases of foreign bodies in the trachea and bronchus which he successfully removed.

At this juncture it is of interest to mention that upon his return here from his trip to Europe and America in 1921, Dr. Ubaldo started using suspension laryngoscopy, which gave him satisfactory results. With this method he succeeded in removing a papillomatous growth in the larynx of a child 3 years old complaining of hoarseness and difficulty in breathing. In another instance he used this apparatus in introducing a Jackson's tube into the eosophagus of an old woman with a suspected tumor of that organ. He removed a piece for diagnosis, and the pathologist's report confirmed the suspicion. He also introduced the bronchoscopic tube into the trachea for purposes of examination.

On August 20, 1927, Dr. Ubaldo (Ubaldo and Ayuyao, 1928), assisted by members of his staff, extirpated the larynx of a woman 60 years old with a malignant new growth in the larynx. The patient completely recovered, and was taught to use the speaking apparatus. This was the first successful laryngectomy operation ever performed in the Islands.

There has also been marked progress in Otology. Dr. Ramon Ongsiako reported in 1914 his experience in the treatment of otosclerosis. In 1918 Drs. Velarde and Farrales made a clinical study of 85 cases of mastoiditis. Dr. Ubaldo (Ubaldo and Alcantara, 1927) performed a labyrinthectomy in 1927. In 1931, the writer (Fernando, 1934) read and published a paper in which he mentioned some of the recent advances in this specialty in other countries and called the attention of the general practitioners to the need of recognizing some of the important early symptoms of intracranial complications of ear suppuration. In 1929, the writer, assisted by Dr. Ayuyao, opened the lateral sinus and ligated the jugular vein in a case of advanced infective sinus thrombophlebitis of otitic origin. But this intervention proved of no avail, the patient soon died of septico-pyemia and meningitis. On November, 1931, a case of subdural abscess of otitic origin was also operated on by the same surgeons (Fernando and Ayuyao, 1933) and the patient recovered. On July 30, 1934, they also performed ligation of the right jugular vein in the case of a boy, 5 years of age, having suppurative mastoiditis and with complicating severe infective lateral sinus phlebitis. This patient, who was also given two blood transfusions, recovered.

In conclusion it can be seen from the foregoing that the local specialists have done their utmost, in spite of paucity of experience and the limited resources at their command, to advance the frontiers of their knowledge in Ophthalmology and Otolaryngology. But when we compare our accomplishments with those of similar workers in other advanced countries we have to admit that we have but started. The surface has been barely reconnoitered and a vast field remains yet to be thoroughly explored. It is considered imperative that the Government should continue sending experienced and promising men to famous clinics abroad, not only to study recent advances but also to familiarize themselves with methods of research, so that when they come back, they can greatly help to initiate and formulate comprehensive and effective plans for the search for new knowledge and for the dissemination of this knowledge of these specialties to the other members of the medical profession for the welfare and benefit of our people. If the plan of the Philippine General Hospital to build a separate pavilion for Eye, Ear, Nose and Throat is materialized, this will be the logical place for the center of this future expansion.

In conclusion the writer would say that errors of omission or commission may have crept in; certain work or investigations may not have been properly credited, emphasized, or may have been entirely omitted from this article; and that for this he seeks the reader's indulgence. He would ask that it be remembered that in a brief account like this, one cannot write all that one wants to say.

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BIOLOGICAL PRODUCTS MANUFACTURED BY THE GOVERNMENT

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The preparation of sera and vaccines for the use of the Government health service in its campaigns against infectious diseases was, at the beginning of Filipino-American relations, entrusted to the Serum Laboratory, one of the principal divisions of the then Bureau of Government Laboratories which was created in 1901 by the Philippine Commission under Act No. 156. In 1905 the name of this Bureau was changed to the Bureau of Science, which explains why the latter is now engaged in the manufacture of biological products. The Serum Laboratory was formerly located on the grounds of the San Lazaro Hospital, but was transferred in 1906 to the grounds of the Bureau of Science. Due to lack of adequate space in Manila, especially for the housing of large animals that are employed in the preparation of certain kinds of sera and vaccines, it was moved in 1921 to its present location in Alabang, Rizal. Compared with the modest laboratory of 1901, it is now a well-equipped institution that is capable of putting out large quantities of products sufficient even during times of emergency.

When the Serum Laboratory was first established the prevailing diseases which took a heavy toll in human lives and caused heavy losses among work animals were smallpox and bubonic plague and rinderpest, respectively. For this reason the first biologics that were prepared on a large scale were smallpox vaccine, plague vaccine, antiplague serum and antirinderpest serum. Mallein and tetanus antitoxin were also handled in small quantities and a few years later tuberculin, antidiphtheric and other immune sera, rabies vaccine, cholera, typhoid, dysentery and other bacterial vaccines and antivenom serum were added to the list. The manufacture of a number of these products has been discontinued, due either to a very limited demand or to the fact that equally reliable imported preparations are available at much cheaper prices. The kinds of sera and vaccines that are now being prepared are shown in Table 1, in which the quantities given are those pertaining to the year 1933. As heretofore the large volume of these products is supplied to the various branches of the Government, but mostly to the Bureau of Health.

After its more than thirty years of existence, it may now be asked if the Serum Laboratory has been fulfilling its mission in the safeguarding of the public health. This question is best answered by inquiring into the occurrence of those diseases which before and during the early days of American Occupation harassed the medical authorities and decimated the population. According to the most recent reports of the Bureau of Health, smallpox is now practically unknown in the Islands and the incidence of cholera, dysentery and typhoid fever has been very much reduced. Formerly the bite of a mad dog used to throw the people into a panic due to a helpless despondency over the dread of contracting hydrophobia. Now every person has the consolation of knowing that the Government has always on hand a supply of rabies vaccine, which, as a prophylactic agent against one of the most dreadful of diseases, has proved its worth. To the attainment of these and other health improvements, the biological products manufactured by the Government have contributed not a little and for this reason the Vaccine and Serum Laboratory of the Bureau of Science deserves the confidence and continued support of the public.

TABLE 1.—*Biological products prepared by the Bureau of Science during the year 1933*

	Amount
Sera:	
Antidysenteric serum	121,310 cc
Normal horse serum	8,680 cc
Anticholera serum	181 cc
Antityphoid serum	93 cc
Vaccines:	
Cholera	3,480,453 cc
Dysentery (polyvalent, sensitized)	158,500 cc
Typhoid	434,160 cc
Cholera and dysentery	7,112,870 cc
Cholera and typhoid	1,086,480 cc
Cholera, typhoid and paratyphoid A	1,172,850 cc
Typhoid and paratyphoid A	219,750 cc
Gonococcus	744 cc
Gonococcus (combined)	118 cc

Staphylococcus aureus	465	cc
Staphylococcus aureus and albus	350	cc
Streptococcus	298	cc
Streptococcus, Staphylococcus albus and aureus	190	cc
Autogenous bacterial vaccines	838	(1-2 cc ampules)
Rabies vaccine (human)	292,695	cc
Rabies vaccine (veterinary)	20,720	cc
Smallpox vaccine (dried)	1,318,550	units
Smallpox vaccine (glycerinated)	1,864,981	doses

DEVELOPMENT OF PHARMACOLOGY IN THE PHILIPPINES

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Pharmacology is relatively new in the Philippines. It embraces an extensive field, overlapping with many other branches of science. It has been confused with pharmacy, botany, the chemistry of drugs, materia medica, therapeutics, and toxicology. As the term is clearly explained in standard modern textbooks of Pharmacology, it will not be defined here.

Pharmacology was formerly learned by the medical student as a by-product of his instruction in the other branches of medicine. Its appearance as an independent course in the medical curriculum was rather recent and until 1907 it was taught in this country exclusively by lecture. Under the leadership of Paul C. Freer (1907) the Philippine Medical School, now the College of Medicine of the University of the Philippines, inaugurated a course in pharmacology, the principal novelty of which was the introduction of the teaching and learning of pharmacology by experimental methods, i.e., the student himself undertakes experimental work and participates actively in his own training. The chief aim was the substitution of actual observation, independent reasoning and a spirit of criticism for authoritative statement. This method is particularly useful in medicine, for the physician is never merely a technician and the problems which his profession place before him can rarely be settled by reference to authorities, but must be approached by methods essentially similar to those employed by the experimental investigator. He must therefore be trained as an independent observer and thinker. Hans Aron [1] and Alfred Ogle Shaklee (1910), in particular, were the first to conduct courses of this kind. This method of teaching was ably continued by their Filipino successors.

Trinidad H. Pardo de Tavera (1901) published his well known book, The Philippine Medicinal Plants. Although many

[1] According to Dr. Isabelo Concepcion, one of his pupils.

of the therapeutic claims are not supported with complete data, this book has served as an important reference for investigators of the native medicinal plants. The preface of the book reveals the difficulties under which the author had to work. He intended to begin the study of the chemical composition of the local medicinal plants, but due presumably to lack of facilities and trained personnel, he planned to carry out the work in the laboratories of Paris under the direction of the eminent men who had been his medical teachers. This was the status of Philippine pharmacology at the beginning of the present century.

The work of R. F. Bacon (1906) on the physiologically active constituents of Philippine plants, and his joint work with H. T. Marshall (1906) on the toxic action of saponin, mark the beginning of experimental pharmacology in the Philippines. The former is a model of research work on the isolation of active principles of plants, while the latter is an example of investigation on the analysis of the effect of drugs. Bacon and Marshall thus set a standard by which the works of their contemporaries and later investigators in the Philippines will be judged.

Leon M. Guerrero (1910), Manuel Zamora (1912), Conrado Potenciano (1912), H. C. Brill (Brill and Wells, 1917), A. H. Wells (1919), Patrocinio Valenzuela (1921 and 1926), Jose E. Jimenez (1929), Joaquin Marañon (1927) and 1929), and Alfredo C. Santos (1931) are among those who carried out Tavera's intention and continued Bacon's work. Their works have increased our knowledge of the chemical compositions of the Philippine medicinal plants. Alfredo C. Santos and his collaborators have extended the work on the isolation of the active principles of the native plants to the study of the chemical constitutions of alkaloids. The synthesis of nicotinic acid and its derivatives by R. R. Williams (1916) awakened the idea of making new drugs; the synthesis of new compounds for leprosy by G. A. Perkins (1925) followed; the studies on the relation of action to chemical constitution by Otto Schobl (1923) and Patrocinio Valenzuela (1925) (in press) are a natural consequence of this new idea. A. G. Du Mez (1913 and 1915) combined emetine with alkaloidal reagents with the view of lessening its irritant action in the stomach and enhancing its amebacidal action in the intestine; his work gave emetine bismuth iodide to therapeutics; his study on the detection of adulterations of oleoresin of aspidium covers another aspect of pharmacology.

Bacon and Marshall were followed by many workers undertaking different studies on the action of drugs; in less than three decades they have opened practically all lines of investigation in Philippine pharmacodynamics. E. B. Vedder (1911), investigated the action of emetine on ameba; R. P. Strong (1910), the effect of Arsphenamine on yaws; W. P. Chamberlain and E. B. Vedder (1912), continuing the brilliant work of the early beriberi investigators, established the efficacy of administering tiki-tiki extract directly to the little patient instead of the mother. These are three outstanding contributions of Philippine Pharmacology to the world. Manuel S. Guerrero (1911) studied the action of beriberi milk on frog heart. He was the first to employ pharmacological methods in the elucidation of clinical phenomena in the Philippines. He excelled his local contemporaries in clinical medicine in resourcefulness. A. W. Sellard (1910) worked out the use of alkalies in Asiatic cholera; with A. J. Mc Laughlin (1910) he also studied the use of salt solution in the same disease. Alfred Ogle Shaklee (1917) continued here his study on the treatment of strychnine poisoning with chloroform which he began in America. His intention to study the influence of drugs on the effect of the heat of the tropical sun with the view of controlling this force of nature through pharmacology is a creative idea. Daniel de la Paz and Faustino Garcia's (1916) experimental study with reference to the use of emetics to remove foreign bodies from the respiratory passages is the beginning of the critical attitude in this country towards the therapeutic uses of drugs; the former (1921) investigated the alleged anthelmintic property of *Quisqualis indica*, employing among other methods the use of dog stomach and intestine as living beaker and test tube. Roman Montenegro (1918) followed up the side-effects of emetine; F. A. Fidelino and P. A. Pañgan (1927) investigated the mechanism of the absorption of drugs from intrahepatic administration; these are contributions by undergraduate students in the University of the Philippines. Faustino Garcia, Guevara and others (1918, 1921 and 1922) have been the principal contributors to the studies on the action of the Philippine medicinal plants; their studies on bioassay are pioneer works in the Philippines and have brought out the urgent necessity of establishing our official standards. Valenzuela, Guevara and Salud Garcia (1930) applied the statistical method to the treatment of their experimental data; their idea shows the increasing critical attitude in Philippine pharmacology. Otto Schobl's (1917) experiment on the treatment of experimentally induced cholera-carriers is an ingenious work, showing a new approach of experimental therapeutics. His work on germicides (1929) is classical; it points out the pitfalls one should avoid in transferring the results of laboratory experiments to the practice of medicine. José N. Rodriguez and Fidel C. Plantilla (1931) used histamine in the diagnosis of leprosy. Sellards and Lamberto Leiva (1923) re-investigated the treatment of experimental amebaiasis and continued their work at the bedside. Other contributions to the study of pharmacology at the clinics were made by Lara and others at Culion (Lara, 1923; Velasco et al., 1929; Delgado and Nicolas, 1926; Wade 1924 and 1925); F. G. Haughwout et al., (1920), Leach et al., (1923), Luis Guerrero et al. (1928), Agerico B. M. Sison and P. Ignacio (1926), Aniceto Mandanas (1926), Manuel Quisumbing (in press) and many others. Quisumbing, a private practitioner, carrying out his studies in the province, handicapped by lack of facilities and forced to support some of his patients as subjects of his experiments, deserves special mention. The happy thought of parenteral administration of chaulmoogra oil in leprosy is apparently Eliodoro Mercado's (1915); he injected his well known formula intramuscularly in 1906. Using this method with Ethyl ester the Culion Investigators, under the leadership of H. W. Wade, have obtained, from their systematic, painstaking works, results that are outstanding contributions in experimental therapeutics.

It is difficult to integrate in this short account the work on the botany of the Philippine medicinal plants and to express adequately the debt which Philippine pharmacology owes to the illustrious men mentioned by Tavera in the "Philippine Medicinal Plants." Leon M. Guerrero (1918), E. D. Merrill (1916), W. H. Brown (1921) and Jose K. Santos (1925, 1929) are worthy successors. Were they living to-day they would be happy to contemplate the brilliant works of these later men and would encourage them to go on.

Experimental pharmacology has created the spirit of research. The works in pharmacology, old and new, and the claims of the marvelous cures of drugs, still prevalent in the Philippines, will be judged critically in the future; the wonderful tales about new drugs and fraudulent patent medicines related by the laymen and propagated by the uneducated physicians will lose their former charm; prejudice, theory and emotional impression will no longer convince, but will be replaced by the systematic demand for complete data and critical interpretations. Destructive and critical pharmacology has dawned in the Philippines; our appalling numbers of alleged medicinal remedies, many of them having no more reason to exist than commercial interest, will be subjected to a rigorous sifting process on the principle of "Prove all things, hold fast to that which is good." When the work of destruction is completed and constructive pharmacology reigns no one can estimate the benefits which this evolution in pharmacology will give to the people of the Philippines.

The Philippine medicinal plants are a fertile field for pharmacological investigation. They constitute a vast national resource, the progressive unlocking of which is bound to lead to discovery of new remedies, industries and trade. The Philippine Government's experiment at Culion has shown the significance of systematic, coordinated experimental work and enables us to visualize what can be accomplished by an organization composed of botanists, chemists, physiologists, pharmacologists, pathologists and clinicians such as José K. Santos, Valenzuela, Alfredo C. Santos, Emilio Bulatao, Guevara, Faustino Garcia, José O. Nolasco, Liborio Gomez, Juan Z. Sta. Cruz, Benjamin R. Barrera, Casimiro B. Lara, Manuel Quisumbing, Wenceslao Vitug, Agerico B. M. Sison, Patricio Ignacio, Jose N. Rodriguez and the brilliant Antonio G. Sison. The combined genius of these men can make this country a leader among nations instead of trailing in the rear. It is hoped that the beginning that has been made will be extended systematically and intensively to discover more and more of the unknown that lies beyond.

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PROGRESS OF MEDICINE IN THE PHILIPPINES WITH SPECIAL REFERENCE TO DIAGNOSIS

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The first medical school in the Philippines was opened in the University of Sto. Tomas in 1871. From that time the teaching was practically theoretical, especially in the fundamental sciences like anatomy, physiology and bacteriology. These subjects were taught then mostly by means of conferences and lectures in which the medical student jotted down his notes and studied them with the aid of his textbooks. In the teaching, however, of the different clinical subjects, the clinical material available in the San Juan de Dios Hospital, which was founded in 1596, was used to some extent; although it must be admitted that even in Europe and America, until the latter part of the nineteenth century the method of practical teaching in clinical subjects was not extensively developed. Lectures and conferences were still the main part of medical teaching. It was only at the beginning of the twentieth century that radical changes were made in the teaching of clinical subjects, progressively giving fewer lectures and more practical work to the students.

In the Philippines what may be properly called scientific teaching of medicine was started only at the time of the American occupation, when the Philippine Medical School was established and opened on June 10, 1907, by the Philippine Government. This was the first time that the fundamental medical subjects were taught in a practical way, with the use of laboratories, thus giving the medical student a chance to learn anatomy, physiology, bacteriology and pharmacodynamics by laboratory methods. The logical inference is that the earlier physicians in the Philippines who studied in the Medical School of the University of Sto. Tomas previous to American occupation were deficient, through no fault of their own, in the necessary knowledge and mastery of the fundamental subjects enabling them to become expert clinicians. This is why the few Filipino physicians of that time who were trained abroad were the most prominent in the country.

As clinic is purely the practical application of the fundamental knowledge acquired in anatomy, physiology and bacteriology, it is therefore easy to explain why very little clinical observation was recorded during the Spanish regime and why the pioneer Filipino physicians were not duly prepared to master scientific clinical diagnosis.

The establishment of the Government Medical School was really the beginning of the scientific teaching of clinical diagnosis. It was only when the medical student had received a thorough and practical knowledge of the fundamental subjects that he was in a position to study properly physical and clinical diagnosis by the use of the different methods—physical, biological and chemical—in the examination of the patients who were assigned to him for study. With this improvement in diagnostic methods the student was placed in a better position to make good his knowledge at the bedside and in the consultation room for the benefit of the patient. He did not have to depend much upon the old hit-and-miss procedure as was the practice when the teaching methods were mostly theoretical. This marked a new era in the history of medicine in the Philippines.

Pioneering work in the most prevalent diseases was undertaken and more accurate methods of diagnosis were adopted. A distinct advance was made in the laboratory methods of diagnosis which had formerly been practically unknown or totally ignored for lack of facilities. Monographs, case reports, clinical studies were made of beriberi, malaria, smallpox, tuberculosis, dysentery, typhoid, cholera and other diseases. The *Bulletin of the Manila Medical Society* was started in 1909 and later became the *Journal of the Philippine Islands Medical Association*, the *Revista Filipina de Medicina y Farmacia* and the *Philippine Journal of Science* contributed a great deal towards the progress of scientific investigation in the different branches of medicine. It was through these different publications that some of the work done in the Philippines by Filipinos and foreigners in the line of medical sciences, became known abroad. Later on the *Bulletin of the San Juan de Dios Hospital of Ma-*

nila appeared in the field and it served first to stimulate the spirit of research among the students and members of the staff of the San Juan de Dios Hospital. It is safe to state without fear of successful contradiction that these publications have contributed the most valuable articles on some aspects of the cancer problem in the Philippines.

Another phase of the contribution to the teaching of medicine in the Philippines by the establishment of the College of Medicine and Surgery was the stimulus furnished by the School to the University of Sto. Tomas. It gave rise to the introduction of important reforms of the methods of teaching of medicine in the said university by the establishment of laboratories where the fundamental subjects of medicine could be properly taught to the medical student, and at the same time practical teaching came more and more in vogue.

The inauguration of the clinical pathological conferences in the College of Medicine, University of the Philippines, in its early years, together with the facilities offered by the Philippine General Hospital and the opportunities of post-mortem examination, gave the clinicians a chance to improve their methods of study of the patients and at the same time, it furnished a chance to check up the reliability and accuracy of the ante-mortem diagnoses made by them; because the post-mortem examinations either confirmed their diagnoses or showed their mistakes. These clinical pathological conferences were so conducted that previous to the demonstration of the finding of the autopsy a thorough discussion was given of the clinical manifestations observed during life, with interpretations from different viewpoints, and then the full discussion of the pathological finding was taken up. The result of such studies based on the comparison of the clinical and pathological findings in a large series of cases, is of far-reaching importance in the study of diagnosis. The following editorial of California and Western Medicine, Volume XXIII, No. 1, January, 1925, will give the reader an idea of the progress that the Filipino physicians have made in the matter of diagnosis:

CHECKING UP ON DIAGNOSES

It is good for all of us to occasionally have a check-up on the reliability and accuracy of our diagnoses. This is best done by comparing clinical diagnoses with autopsy diagnoses in a large series of cases.

The best, most complete and most significant study of this kind yet made is that recently reported in the Journal of the Philippine Islands' Medical Association. Conditions were particularly favorable for the study. The medical college, hospital research laboratories, and city morgue are all upon the same campus. They are all operated under one administrative authority. The records of the college and hospital are unusually complete, well co-ordinated, and the faculty of the school is ex-officio the staff of the hospital, both administered by a dean and director. A far-reaching weekly clinico-pathological conference was instituted many years ago and has continued to function. Practically all patients who die in the large hospital go directly and promptly to the department of pathology and the complete sealed clinical record goes with the body. Autopsy is carefully done and tissues and cultures promptly worked up. The findings and such specimens as are significant are preserved until the next weekly meeting of the clinico-pathological conference.

At the conference a brief clinical report is made, followed by the report, with demonstration of specimens by the pathologist. The results are always interesting, often stimulating, and sometimes depressing. All physicians are invited to attend these conferences and many accept. All medical students, interns and house officers are required to attend, and many members of the faculty are always present. It was from material handled in this way for years that the Sisons were able to compile their report.

Of the more than 10,000 complete clinical and post-mortem records available, the authors selected only the medical cases. As has long been the custom in that splendid service, each diagnosis is entered. The average patient having from two to ten clinical diagnoses just as they have several anatomical diagnoses. In Sison's medical cases, there were 2282 clinical diagnoses and 3046 anatomical diagnoses in the same bodies.

THE FINDINGS

In the series of 3260 diagnoses there were 526 errors of commission; in the clinical diagnoses, 848 errors of omission; 1886 correct diagnoses.

Divided somewhat by systems, the percentages of error were as follows: Errors of commission, 16 per cent; errors of omission, 25 per cent; correct diagnosis, 58 per cent.

Further appreciation of the value of this work is made by including comparable figures from Cabot's report of the Massachusetts General Hospital cases some fourteen years ago along the same lines:

	Massachusetts General Hospital Per cent	*Philippine General Hospital Per cent*
Circulatory diseases	34	35
Respiratory diseases	45	38
Urinary system	53.3	54

Digestive system	43.6	36
Nervous system	31	58
Miscellaneous	6.5	33

The striking differences in the findings in the two series under headings of "miscellaneous" and "nervous system" are explained in the article. The reasons are not of a kind that reflect unfavorably upon anyone's work.

Clinical studies were also made on pneumonia, typhoid, and encephalitis, with the special aim of showing the different manifestations of these diseases in Filipinos. Most of these papers have been published in the *Journal of the Philippine Islands Medical Association.*

There is no question that in the last twenty-five years the art and science of medicine in the Philippines have progressed with marvelous rapidity. Such modern diagnostic procedures as the clinical laboratory, biochemical, histo-pathological, X-ray examinations, and electrocardiography, which were entirely unknown in pre-American times are now commonplaces in the Islands; but the most significant contribution of the new era is the facilities that enable the carrying out of post-mortem examination, for this is the only reliable way in which a clinical diagnosis can be fully checked.

BIOLOGIC PRODUCTS OF PRIVATE LABORATORIES

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The private manufacture of biologic products in the Philippines is of recent date, and is even now being pursued on a very limited scale. One of the reasons for this is that most of the vaccines and serums needed by the public health service are prepared by the Philippine government itself through the Bureau of Science. Non-governmental entities and private medical practitioners generally use imported biologic products. Also the Bureau of Science is selling to the public whatever surplus products it has. There is, therefore, very little opportunity for private laboratories to undertake with any reasonable expectation of success the manufacture of biologic products on a commercial scale. Such laboratories have to put up the initial capital and shoulder running expenses and compete, first with the products of the Bureau of Science, which are distributed free, and second, with foreign products, which can be made at lower cost. However, since the present policy of the Philippine government is to encourage industrial development private laboratories will now have the opportunity to prepare products for sale without encountering competition from government entities.

The phrases "Biologic Products" or "Biological Products" are applicable to viruses, serums, toxins, antitoxins, and analogous products for use on men and animals. Act No. 3073 of the Philippine Legislature, approved March 16, 1923, regulates the preparation for sale of biologic products for the prevention and cure of disease. It creates a board, the "Biologic Products Board" composed of the Secretary of Public Instruction as Chairman, the Director of Health and the Director of Science as members, with authority to promulgate from time to time such rules and regulations as may in its judgment be necessary to carry out the purposes of the Act. Such regulations have been published in the Official Gazette on Oct. 27, 1925, XXIII, 129, page 2211 and revised and published in the Official Gazette on April 9, 1929, XXVII, No. 43.

As far as can be determined the first biologic product to be manufactured in the Philippine Islands was autogenous vaccine, which was made by the clinical laboratory of Dr. Proceso Gabriel about 1915. This laboratory was established in 1909. The late Dr. Lorenzo Ordoñes established his clinical laboratory in 1910; Dr. Jose S. Hilario, in 1918. These two and other laboratories also prepare autogenous vaccine.

After the passage of Act No. 3073 and the publication of the regulations, it became necessary for the existing laboratories to meet certain requirements, among which are the inspection of premises, equipment and technical personnel, and testing of products. In 1934, four local laboratories and eighteen foreign laboratories possessed licenses under this Act. The first local laboratory to undertake the preparation of biologic products on a commercial scale was the Laboratorio Arguelles, licensed in 1926.

Act No. 3103, approved March 16, 1923, authorizes the Director of Agriculture (now Director of the Bureau of Animal Industry) subject to the approval of the Secretary of Agriculture and Natural Resources to promulgate regulations for the preparation, sale, traffic in, shipment, and importation of viruses, serums, toxins and analogous products issued for the treatment of domestic animals. The first laboratory established to manufacture veterinary biological products was the Buencamino Laboratories, Inc., which was licensed in 1927. Among its preparations were anti-anthrax serum, anti-hog cholera serum, anti-tetanic serum, and aggressin for hemorrhagic septicemia. This laboratory ceased to operate in 1934.

Neither medical nor veterinary laboratories have made much progress so far because of the heavy competition of the government. Furthermore, the public has been so accustomed to use imported products that local manufacturers are handicapped at the start.

Private laboratories have played an important part in other countries, especially those which are industrially advanced. Some of them were founded by public subscription, others by the governments through direct subsidy. As their business progressed and they became self-supporting, the respective governments were very careful not to compete with them. During emergencies of war or public calamity these laboratories have cooperated with the governments by furnishing large quantities of serums and vaccines needed by army, navy, or civil population, with a rapidity that could not possibly be equalled by government institutions. Some of the outstanding discoveries in biotherapy have been made in private laboratories, and these have been advertised to the public by the propaganda that can be properly done by private laboratories. Scientists working in university or government laboratories have received material aid and compensation from private laboratories which thus encourage their research. They have also indentified themselves with the promotion of public health. While they cannot be classified as other than industrial or commercial, their contributions to public health constitute intangible assets which can hardly be measured in material terms.

EARLY HISTORY OF VETERINARY SCIENCE IN THE PHILIPPINE ISLANDS

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The early history of the veterinary profession in the Philippine Islands is discussed in this paper from the time this profession was first mentioned in Government records to the establishment of the College of Veterinary Science of the University of the Philippines.

It appears in official records that a position for a veterinarian was for the first time provided for in the Philippines during the Spanish domination by the Royal Decree of May 31, 1828, upon the organization of a regiment of cavalry known as the dragons of Luzon. This one position was by a subsequent decree increased to two in 1843. The incumbents were known as *mariscales*. They were not college graduates but qualified before an examining board created about the year 1492 in Spain. The first veterinary college was opened in Spain in 1792 and by the Royal Decree of August 19, 1847, the veterinary course was revised and the practice of veterinary medicine prohibited to non-graduates. Those who were already practising the profession were given three years, up to 1850, within which to qualify. As a consequence of this reorganization of veterinary education in Spain, by the year 1854 veterinarians in the Army were no longer called *mariscales* but *profesores de veterinaria or veterinarios*. The employment of this class of professionals in the Spanish Army in the Philippines in the cavalry and mountain artillery continued until the end of the Spanish domination.

In order to give an idea of the preparation of these early veterinarians here the subjects studied in the course as revised in 1847, are listed.

First year. Anatomy—General, descriptive of all domestic animals—Exterior.

Second year. Physiology. Hygiene.

Third year. Pathology, General and Special, Pharmacology, Prescription Writing, Therapeutics, Sanitary Police and Medical Clinics.

Fourth year. Pathological, Surgery, Operations, Veterinary Law, Commercial and legal. Art of forging and shoeing. Surgical clinics. Critical history of these subjects.

Fifth year. Physics, Chemistry, such Natural History as may be applicable to veterinary science, Zootecnics and applied agriculture.

The fifth-year course, which was given only in the veterinary school established in Madrid, was optional for those who aspired to the title of *profesor de veterinaria de primera clase.* Those that took the four-year course received the title of *profesor de veterinaria de segunda clase.* The *profesores de primera clase* were preferred in dealing with contagious diseases, sanitary police, examination of pastures, and in appointments to Government positions—civil and military. It is interesting to note that veterinarians in the Spanish Army had rank even during those early days, when we consider that in the U. S. Army, veterinarians were given rank only in 1916.

Laboratory or practical exercises were provided for throughout the course and consisted of dissections, vivisections, clinics, forging, and shoeing.

Besides their regular duties in the Army in the Philippines some of them were detailed to meat inspection in the matadero of the City of Manila. By the Royal Order of May 14, 1882, the salary of the veterinary inspector of the matadero of Manila was raised from twenty-five pesos to fifty pesos per month on account of the increase in the amount of work and closer personal supervision of the ante-mortem and post-mortem examination of slaughtered animals which became necessary because of the discovery of trichina in pork offered for sale in the market. The Royal Order mentions trichina but whether or not the case was really trichina or *Cysticercus cellulosae,* we have not been able, so far, to verify from any records. Up to the last day of the Spanish régime the meat inspection work in the Manila matadero was done by an Army veterinarian.

Because of the lack of qualified veterinarians in the colonies overseas, Army veterinarians were allowed to engage in private practice (Royal Decree of October 13, 1885).

The duties of the veterinary corps were to preserve the health of the animals in the service of the Army, cure their ailments, do meat inspection and serve as sanitary police where there were no private practitioners. Those assigned to equitation instruction looked after the training of cavalry mounts.

In 1886, rinderpest was introduced into the Philippine Islands from China. The great loss of cattle and carabaos from it in that year and the subsequent ones, undoubtedly aroused such a country-wide concern that the Government deemed it necessary to take extraordinary measures. A commission was appointed to study the disease with a view to finding means of stopping its ravages. Here again we find Army veterinarians appointed members of the commission, the most prominent of whom appears to have been Don Gines Geis Gotzenz. We are indebted to him for the first account of the contagious animal diseases then prevailing in the Philippine Islands. This was the report of the veterinarian members of the commission.

In his dedicatory remarks on this monograph, he gives us an inkling of the inadequate training of the members of the profession in Spain at that time in biological science, which is essential in dealing with contagious diseases.

It ran as follows:

> El desamparo en que se encuentra la clase veterinaria española impide que á las ciencias biologicas aparte el respetable contingente de conocimientos conque sus analogos de Francia, Alemania, y otras naciones las han enriquecido y es de esperar, que mientras una mano generosa no despierte sus dormidas energias, resulte deficiente y esteril el concurso que pueda prestar á la Economia rural, orgine de toda prosperidad y manantial inagotable de solida riqueza de los estados: uno de sus individuos, el ultimo solicita respectuoso su asentimiento para dedicarle su primera producción.

When we consider that biological science as applied to veterinary medicine was then in its infancy, we can imagine the state of that science in Spain at that time. This being the case we could then expect no adequately trained men to meet the big problem that had just commenced in the Philippines, and which continuously drained our Government of its resources and handicapped agriculture for nearly thirty years before it could be put under complete control.

The last number of the Guia Official de Filipinas, issued in 1898, contains a list of professionals practising in Manila and among these five veterinarians are listed, and that of 1890 gives the same list and the same veterinarians with the exception of one. Whether or not these were graduate veterinarians has not yet been determined. One of those so listed is Gines Geis, who may have been the Army veterinarian afore mentioned. Upon the creation of the veterinary examining board in 1913, none of the names listed in this directory appeared in the records of the board, nor in that of the Bureau of Internal Revenue.

At the inauguration of the new régime a veterinary department was organized on April 22, 1899, in the Board of Health of the provisional government under the provost-marshall general. Its duties were to inspect all cattle arriving in Manila, do the meat inspection in the City of Matadero, attend to the care and treatment of Government animals and the inspection of public and private stables as to their sanitary condition and the health of the animals. There were also veterinarians in the American Army with their cavalry and quartermaster. During this time there were one or two American veterinary practitioners in Manila. In July, 1903, the Philippine Commission authorized a veterinary division in the Board of Health for the purpose of investigating and suppressing diseases of carabaos, cattle, horses and other animals in the Archipelago, such as rinderpest, surra, glanders and other contagious diseases. This work was not actually started until another resolution was passed increasing the number of the personnel on January 27, 1904, to take effect April 1, 1904.

During the latter part of 1902 the control of rinderpest by the prophylactic methods that were then being used in countries where rinderpest was prevalent was attempted. This consisted of using glycerinated bile and anti-rinderpest serum, simultaneously at first, and then both simultaneously and by the serum alone method, and lastly serum alone combined with quarantines. The period from 1902 to 1910 saw these methods of immunization being tried here under different modifications, and their true value in the control of rinderpest being ascertained where the aim was complete eradication. It was soon realized that these various methods were inadequate, and continued efforts led to the discovery of a more adequate biologic such as the one we now have, the rinderpest vaccine. The control and eradication of rinderpest was pursued energetically, and upon it all the efforts of the veterinary force of the Government were concentrated. Because of rinderpest the profession in this country has acquired an importance that it never before enjoyed here.

On October 19, 1905 the Veterinary Division was transferred from the Bureau of Health to the Bureau of Agriculture, where for a time it was united with the Animal Industry Division.

In order that the Philippine Government might adequately cope with the animal disease situation at that time it was found necessary to have men trained in accordance with modern requirements, and to get these it was felt that local talent had to be developed, for outside help proved expensive and not always available. A school of veterinary science was therefore established in the University of the Philippines. It was authorized by an Act of the Philippine Legislature on June 18, 1908, and the first session was opened in June, 1910. It will be recalled that the first veterinary school in Europe was founded in France in 1761, precisely for the same reason that prompted the Philippine Government to establish the local veterinary college, namely: the control and possible eradication of rinderpest.

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THE DEVELOPMENT OF VETERINARY MEDICINE IN THE PHILIPPINES

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The development of Veterinary Medicine in the Philippines may be chronicled under three headings, namely; (1) Education, (2) Practise and (3) Research.

I. EDUCATION

Veterinary education in the Philippines began to receive the serious attention it deserves from our people twenty-five years ago. Due to the ravages of rinderpest and other epizootics among our animal population, it was keenly felt that the example of certain European nations of establishing veterinary schools with government aid should be followed here. The First Philippine Legislature displayed foresight when, in founding the University of the Philippines by Act No. 1870, passed June 8, 1908, it provided for the creation of a College of Veterinary Science. This College, however, was not organized and opened until June, 1910, in buildings and on grounds adjoining the Quarantine Station of the former Bureau of Agriculture, in Pandacan. In 1912 it was transferred to the San Lazaro Hospital grounds because of the abundant clinical material available for instruction in this section of the City, and housed in buildings formerly used by an immunizing station of the Bureau of Agriculture. In 1919 the College of Veterinary Science was moved to Los Baños, Laguna, and placed in close association with the College of Agriculture but in May, 1933, it was transferred back to Pandacan, its original location, and is now partly fused with the recently organized Bureau of Animal Industry.

The curriculum of the College of Veterinary Science in 1910 consisted of a four year gradated course. The basic courses in histology, embryology, pathology, bacteriology, pharmacology and materia medica were then given in the College of Medicine, while chemistry and the cultural subjects were taken in the College of Liberal Arts. The strictly veterinary subjects were given in the College of Veterinary Science. After the first year this curriculum was changed to a five-year course and October 30, 1924, the Board of Regents of the University decided to shorten it to four years again.

The faculty, which formerly consisted of American professors, are now all Filipinos, the majority of whom are alumni of the College who have taken graduate work in American universities.

Thus, it will be seen veterinary education in these Islands has undergone a series of changes to suit varying prevailing conditions and policies. And it is to the credit of those who have been entrusted with the teaching in the College of Veterinary Science that, notwithstanding these sudden changes, there has not been a marked lowering of the standard of instruction, which is comparable with that of the best American or European institutions of its kind. It is hoped, too, that a definite and permanent plan is now being developed.

II. PRACTISE

In the field of practise, veterinarians in the Philippines may be grouped into (a) those who are employed by the Government in the campaign against animal diseases, (b) those who are employed in sugar centrals, ranches, dairies, etc. and (c) those who are engaged in the private practise of their profession.

To the first group belongs the great bulk of our veterinarians. Before the creation of the College of Veterinary Science in 1910, American veterinarians were imported, as there were no Filipino graduates in veterinary medicine at that time. Since then, the graduates of this college, who now number 170, have gradually replaced the American veterinarians, who returned to their homeland at the expiration of their contract. Today the personnel of the Bureau of Animal Industry is completely Filipinized. The Filipino field veterinarian has done well in his fight against rinderpest and other epizootics, and he should be given credit for this.

Under the second group only a small number are employed in sugar centrals, ranches and dairy farms, as there are but few of these concerns in the Philippines at the present time.

The field of private practise in veterinary medicine is undeveloped. There are less than six practitioners in the City of

Manila. The most prominent among these are Dr. Victor Buencamino, Dr. Sixto Carlos and Dr. Faustino F. Turla, each of whom has a well-equipped veterinary hospital, in which up-to-date and scientific methods of treating animal ailments are practised.

Dr. Victor Buencamino was the first Filipino graduate veterinarian, having received his degree from Cornell University in 1911. After his graduation, he traveled through Europe, visiting the important veterinary institutions of Spain, France, Germany, Holland, and Italy. Upon his return to the Philippines he accepted an appointment as field veterinarian in the former Bureau of Agriculture. In 1912, he joined the faculty of the College of Veterinary Science where he taught surgery and clinical diagnostics. In 1916 he bought the veterinary practice of Dr. W. W. Richards, a retired Army veterinarian who successfully built up an extensive practice in the City. This hospital is located at 1026 Felix Huertas and is now almost exclusively under the charge of Dr. Aniano Estorres, an alumnus of the College of Veterinary Science.

Dr. Sixto Carlos is another of our successful veterinary practitioners. He graduated from the San Francisco Veterinary College in 1916. On his return to the Philippines, he accepted employment in the Bureau of Agriculture for one year and later served as assistant in the Buencamino Veterinary Hospital for a period of almost eleven years. His establishment, which was opened in 1927, is located at 185 Marquez de Comillas. He maintains a well-equipped hospital for small animals.

Dr. Faustino F. Turla is an alumnus of the College of Veterinary Science. Upon his graduation in 1922, he served as assistant to Dr. E. S. D. Merchant, a former professor of medicine in the College of Veterinary Science who also built up a good practise with a hospital at the Rotonda, Manila, since 1919. In 1924, after receiving a degree and qualifying for the practise of dentistry, Dr. Merchant sold his veterinary hospital to Dr. Turla, who is still conducting it.

III. RESEARCH

Research in Veterinary Medicine in the Philippines began when the Government Laboratories, which later became the Bureau of Science, were established in 1908. Investigation into the production of immune serum against rinderpest was at once started, because this disease was causing great havoc among our labor animals. The serum alone method was adopted in the early days of the campaign against rinderpest. This method, however, failed because it was soon found out that immuned serum did not confer a long period of immunity. Research work was also actively undertaken on such diseases as surra, strangles, glanders, foot-and-mouth disease, epizootic lymphangitis, anaplasmosis, hog cholera, etc., by a great number of research workers. Some of these early research workers were medical men, while the others were veterinarians employed in the former Bureau of Agriculture and in the U. S. Army. At the present time, veterinary research is carried on in the Bureau of Animal Industry and the College of Veterinary Science.

The most outstanding contribution of Veterinary Medicine in the field of research is the discovery of the rinderpest vaccine. By the extensive use of this vaccine, our 35 years of campaign against rinderpest is now being brought to a close and the final eradication of this epizootic from our shores is near at hand. This accomplishment goes far to insure the future rapid development of our animal industry and the realization of an extensive and varied program of animal improvement.

The results of research work in Veterinary Medicine in the Philippines have been published in the Journal of Science, Philippine Agricultural Review, Philippine Agriculturist, Bureau of Animal Industry Gazette, and the Journal of Animal Industry. Some of them have been presented in meetings of scientific organizations, such as the Philippine Scientific Society, Los Baños Biological Club, Society of Parasitology and the Philippine Veterinary Medical Association.

HISTORY OF ANIMAL PESTS AND DISEASES IN THE PHILIPPINES

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In a limited space it is impossible to present a complete list of animal pests and diseases prevalent in this country. Only those diseases which are important economically and in relation to public health have been assembled in this paper. They are being presented in the order in which they were first observed and described during the Spanish régime and the American occupation. An abridged synopsis of this kind would serve not only as general historical information on the subject, but also as a basis on which to gage the progress attained in the prevention and control of animal diseases and epizootics from year to year.

RINDERPEST, HEMORRHAGIC SEPTICEMIA AND ANTHRAX

In a popular publication entitled "La Epizootia, Cartilla para precaver á la ganaderia de algunas enfermedades comunes" Gotzens (1888) in his conclusion reminded the livestock owners that besides rinderpest there were other epizootics equally devastating, such as "Garotillo" or hemorrhagic septicemia and "Carbunco" or anthrax. His symptomatic descriptions of the last two diseases were typical of septicemia and anthrax and the preventive measures which he advocated to the live stock owners during an epidemic were convincingly indicative of these conditions. Gotzens (1888) was also the first to describe an epizootic of rinderpest in carabao which occurred in 1887. His report was published in 1888 entitled "Uno Epizootia en Filipinas", in which he complained of not having enough materials on which to base his observations. Evidently the epizootic wave was fast waning at the time he made his report. His description of the symptoms, course, pathological anatomy, prognosis, etc., were remarkably accurate for rinderpest as we recognize it today. He ascribed the disease to forage poisoning, miasms, worms or a typhoid-like infection of some kind. The true causative agent, however, was found to be a filterable virus. For the past half year there has been no report of this disease in this country, thanks to quarantine measures and the application of rinderpest vaccine. Indications are that it will soon be eradicated, while anthrax and septicemia will probably remain because both are soil-born infections. Further outbreaks of septicemia were later reported by Wolley and Jobling (1903) and by Boynton (1901).

PORK MEASLES (LEPRA O VIRUELA DEL CERDO)

Pork measles or cysticercosis (lepra ó viruela del cerdo) in the Philippines was first described by Dr. A. A. Maseras in 1894. His studies on the histo-pathology of the disease as found in Philippine pigs were complete. Even the structural description of the larva (*Cysticercus cellulosae*) was accurate. He also described the pathogenesis in man and the development of the larva into the adult tapeworm in the human intestines. Gotzens as member of the meat inspection commission prescribed regulations governing the condemnation of measly pork at the City abattoir. The consumption of infected meat was strictly forbidden. This disease is quite prevalent in hogs of certain provinces and its eradication depends on proper waste disposal.

RABIES

This dreadful disease of dogs was probably introduced into this country since the early Spanish expeditions and was known to army veterinarians. The first laboratory diagnosis, however, was conducted by Mr. Anacleto del Rosario only in 1894, as borne out by his biography written by Maseras. The studies of del Rosario would indicate that he was dealing with specimens from fresh cases in Manila. Destruction of stray dogs, muzzling and compulsory vaccination of all licensed dogs and several months quarantine of imported animals if put into practice would eradicate the disease in this country. Its communicability to man makes it an important public health problem.

TETANUS

No record is available of any description of actual cases in animals although it would seem logical to assume that being a soil-born infection it must have been recognized during the early Spanish régime. A series of articles by R. Moreno Rey appeared in the Boletin de Medicina de Manila in 1886 dealing with a description of various forms and methods of treatment. The method of handling tetanus in man and animals is too well known to merit further discussion.

SURRA

In 1901 Smith and Kinyoun published the first paper on trypanosomiasis in horses in the Islands but they were unable to identify the trypanosomes. In the same year an outbreak of a disease which killed 300 American horses in four months at the place of the *Quarter Master* in Manila offered an opportunity for Curry (1902) to study the disease. He found the same trypanosome previously described by Smith and Kinyoun and classified it as *Trypanosoma evansi.* The prevailing opinion at that time was that surra was brought to the Philippines by carabaos imported from Indo-China. Since there is no curative treatment, the identification of the intermediate host is the key to its control. In view of the economic importance of this disease to the Philippine horse industry there is pressing need for investigating this problem more extensively.

FOOT-AND-MOUTH DISEASE

Jobling identified and described an outbreak of this disease among cattle imported from China in 1901 for the manufacture of anti-rinderpest serum and smallpox vaccine. On account of its being transmissible to man the preparation of smallpox vaccine from infected calves had to be temporarily abandoned. Since then, it has become enzootic in the Islands. There is crying need for research work on this disease, concerning its biology, control and eradication.

HOG CHOLERA, LYMPHANGITIS AND GLANDERS

In 1902, the City Veterinarian reported to the Biological Laboratory of the Government Laboratories certain skin diseases of horses which turned out to be epizootic lymphangitis (Pseudo-farcy) and glanders (farcy). Several cases of certain infection of pigs were also submitted to the laboratory for identification which were found to be hog cholera. Though probably known during the Spanish time, printed accounts of equine glanders are not available. Several fatal cases in men have been recorded at the Philippine General Hospital. Being transmissible to man glanders should be eradicated wherever found. Hog cholera is the most important plague of swine in the Philippines at present. Better methods of prevention and control are necessary if its eradication is contemplated.

TUBERCULOSIS

This disease was probably not recognized in domestic animals during the Spanish régime. It was only in 1907 when the first organized meat inspection service was established in Manila that lesions of tuberculosis were identified in cattle and hogs. Eleven strains of tuberculosis isolated from pig lesions by Topacio (1933) were apparently from human origin. Tuberculosis organisms were also isolated by him from lesions of native cattle at the City abattoir. The infection is neglígible in native cattle. The heavy incidence in swine has become a public health problem and the solution lies in the proper disposal of human excreta.

AVIAN DISEASES

Fowl cholera and avian pest (Newcastle Disease) are the most important pests of chickens in this country. The first was reported by Gomez in 1925 and the latter was reported by Rodier (1928) and Farinas (1930) some years later. Avian pest is caused by a deadly virus which kills 98 to 100 per cent of the birds attacked. It is the most important problem of the poultry industry in the infected countries today. All over the world workers are engaged in trying to find an efficient and economic method of control.

PARASITIC DISEASES

External and internal animal parasites of various kinds are prevalent in this country. Among them, the nodular disease of ruminants, coccidiosis, ticks, kidney worms, liver flukes, are the most important. It is safe to say that parasitism contributes a large share in pests and diseases of our live stock. Each parasitic disease calls for a specific method of prevention and control.

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HISTORICAL DEVELOPMENT OF DENTISTRY THROUGH LEGISLATION

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Dentistry is one of the most important branches of medicine, and during the past fifty years its development and progress has been really remarkable. Its field has been broadened. At first dentistry confined its activity only to the mere extraction of a tooth; later, its efforts were focused on a single tooth and individual cavity; then upon the whole denture; and still later, through wider vision, it was disclosed that defective teeth may affect the entire dental apparatus. At the present time, competent medical authorities have no hesitation in asserting that many diseases from which mankind suffers can be traced directly or indirectly to mouth infection. From the crucible into which were poured the labors of pioneer dentists, their hardships, their hopes and their countless hours of unselfish devotion to duty and the pursuit of the ideal, emerges another era in the progress of dental science: Dental Prophylaxis and Oral Hygiene. Unquestionably the enactment of dental legislation has contributed a great deal to the advancement of dentistry, because the dentistry laws enacted have encouraged the members of the profession to proceed with their difficult task of solving dental problems. Therefore adequate laws are essential to protect and promote the best that the profession has to offer.

During the Spanish regime in the Philippines there were no laws regulating the practice of dentistry. The University of Santo Tomas, the highest institution of learning in the Philippines in those times, offered a two-year course for "Cirujano Ministrante." Little preliminary education was required for admission to this course; and the holder of this certificate was entitled to practice medicine in the remote towns where there were no licenciate physicians. Those "Cirujanos Ministrantes" who desired to become dentists, were given by the same University of Santo Tomas a four-month course in dental subjects, after which the certificate of "Cirujano Dentista" was issued to them.

After the Spanish-American war a new era of dental development took place in the Philippines. Dental practice was regulated, a Board of Dental Examiners was established, and several dental laws were passed.

Act No. 593—"Ley reglamentando el ejercicio de la Cirugía Dental en las Islas Filipinas", was the first dental law regulating the practice of dentistry in the Philippines, and was enacted by the Philippine Commission on January 10, 1903.

ART. 5 of this Act. No. 593 says:

> Es elícito el ejercicio de la cirugía dental en cualquiera de sus ramos, en las Islas Filipinas, despues de sesenta dias de la primera reunión de la Junta Examinadora de Cirujanos Dentistas de las Islas Filipinas, posterior á la aprobación de esta Ley, sin tener un certificado de registro de dicha Junta ó sin haber presentado al secretario-tesorero de la misma, con el objeto de obtener dicho certificado, una declaración jurada manifestando la fecha y lugar en que ha ejercido la profesión de dentista en las Islas Filipinas, con anterioridad á la aprobación de esta ley: *Entendiéndose*, Que á los dentistas que hayan sufrido exámenes satisfactorios ante una junta nombrada por el Preboste Mariscal General de la ciudad de Manila, de acuerdo con la autorización del Governador Militar de las Islas Filipinas, fecha dos de Agosto de mil ochocientos noventa y nueve, se les entregará por la Junta Examinadora de Cirujanos Dentistas, sin más examen, un certificado de registro, previo el pago del derecho correspondiente; *Entendiendose, tambien*, que nada de lo contenido en esta Ley se aplicará á los cirujanos dentistas del ejercito de los Estados Unidos de servicio en las Islas Filipinas, ni de ningun modo afectará ni será aplicable á los residentes en las Islas Filipinas que se dedicaban legalmente al ejercicio de la cirugia dental con anterioridad á la aprobación de esta Ley; *Y entendiéndose, ademas*, Que el que hubiere estudiado medicina en la Universidad de Santo Tomas de Manila durante un periodo que no baje de dos años y recibido el título de "Cirujano Ministrante" y haya estudiado cirugia dental durante los últimos cuatro meses de curso en la citada universidad, puede ser registrado como no graduado en cirugía dental, despues de sufrir un examen satisfactorio ante la Junta y una vez Registrado, estará autorizado para ejercer la cirugía dental en pueblos remotos donde no haya disponible ningún dentista calificado en regla. En el certificado de registro constará el nombre de los pueblos en que cada no graduado en cirugía dental esta autorizado para ejercer. El secretario-tesorero cobrará cinco dollars como derechos, por cada certificado de registro como no graduado en cirugía dental expedido por la Junta.

In the year 1913 there were three dental laws enacted by the Philippine Legislature, as follows:

Ley 2205—Aprobada por la Legislatura el 16 de enero de 1913 que concede á los dentistas derecho á recetar y administrar opio, cocacina, ó cualquiera de sus derivados, á sus pacientes.
Ley 2227—Aprobada el 7 de febrero de 1913 y que establece como impuesto de licencia anual para los dentistas ₱40.00.
Ley 2276—Aprobada el 18 de abril de 1913 que declara aplicable las leyes sobre cirugía dental á las tribus no cristianas.

Act No. 2381 was enacted by the Philippine Legislature on February 28, 1914. Article 9 provides:

> El articulo 9 de esta ley establece una pena de no menor de ₱300.00 ni mayor de ₱1000.00 ó prisión durante un periodo de seis meses ó con ambas penas, á los dentistas que prescriban opio á los pacientes que por su estado fisico no necesitan de su uso.

There was a bill passed by the Third Philippine Legislature known as "AN ACT PROVIDING NEW REGULATIONS FOR THE EXAMINATION OF DENTISTS AND THE PRACTICE OF DENTISTRY IN THE PHILIPPINE ISLANDS AND FOR OTHER PURPOSES", which became a law on February 5, 1915. This law is known as Act No. 2462 and its section 6 provides:

> Hereafter the Board of Dental Examiners shall admit to examination for the practice of dentistry in the Philippine Islands only those persons who have a diploma of doctor of dental medicine or of doctor of dental surgery from an institution duly accredited and legally constituted: Provided, however, That all students who at present are bona fide taking a course in dentistry in the University of Santo Tomas, Manila, and who will graduate as surgeon dentists from said institution in the academic courses terminating in March, nineteen hundred and fifteen, and in March, nineteen hundred and sixteen, shall be exempt from this requirement and may be admitted to examination provided they have the title of dental surgeon from said university and have all the other qualifications hereunder prescribed.

Read section 7 of this law.

On February 4, 1916, Act No. 2602, was enacted by the Third Philippine Legislature, amending Sections 1, 5 and 6 of Act No. 2462. It requires the candidates for examination to have the diploma of doctor of dental surgery or doctor of dental medicine granted by an institution duly accredited and legally constituted, in which the following branches are taught during three years in regular nine-month courses; anatomy, etc. . .

REVISED ADMINISTRATIVE CODE OF THE PHILIPPINE ISLANDS OF 1917

Act No. 2711. Approved March 10, 1917. The prerequisite qualifications for admission to examination to be given by the Board of Dental Examiners are just the same as required by the Act No. 2602. The important addition in the Revised Administrative Code is the definition of "duly accredited and legally constituted school, college or university."

Read Section 798, Act No. 2711.

AN ACT TO AMEND SECTION FIFTEEN HUNDRED AND SEVENTY SEVEN OF ACT NUMBERED TWENTY-SEVEN HUNDRED AND ELEVEN, RELATIVE TO THE RECORD TO BE KEPT BY PHYSICIANS, PHARMACISTS, DENTISTS AND VETERINARIANS." Approved, February 21, 1921.

Is hereby amended to read as follows:

Physicians, dentists, veterinarians, pharmacists, and second-class pharmacists shall keep true and correct records of all prohibited drugs received and dispensed or transferred by them, in such form and manner as may be prescribed in the regulations of the Bureau of Internal Revenue.

The Revised Administrative Code, Chapter 40, Bureau of Internal Revenue which clearly prescribes the right to the use and possession of prohibited drugs says:

Duly licensed physicians, dentists and veterinarians may, in the proper course of their professional practice only, prescribe and administer, or cause to be administered prohibited drugs as medicine or anesthetics and may receive and keep in their possession such drugs.

Act No. 3538 was enacted by the Philippine Legislature on November 13, 1929. It is an amendment to Sec. 798 of the Administrative Code, which requires the candidate for admission to the Dental Board to have finished a four-year high school course as prescribed by the Department of Public Instruction or its equivalent, preparatory to the study of dentistry; and to have received a diploma of doctor of dental surgery or doctor of dental medicine from an institution duly accredited and legally constituted, in which four years of regular nine-month courses are required. The enactment of this law marked another step in the progress of dental education in our country.

Acts Nos. 3680 and 3681, the two last dental laws enacted by the Philippine Legislature, are as follows:

Ley 3680—Aprobada el 15 de Octubre de 1930, que solo permite al extranjero examinarse cuando en su pais tambien se permite al filipino ejercer la dentisteria.

Ley 3681—Aprobada el 15 de Octubre de 1930, que exime á los cirujanos del Ejercito y la Armada de los Estados Unidos al registro mientras sirven como tales, á los dentistas extranjeros cuando fueran llamados en consulta.

The foregoing facts portray the beneficient influence of legislations in the development of dentistry in the Philippine Islands. It is clearly manifested that dental legislation plays an important role in the advancement of dentistry in our country; but no matter how good such laws may be, if the members of the dental profession are indifferent as to their enforcement, they become useless. The enactment of a law is one thing and its enforcement quite another. We cannot expect salutary effects of a law, if the members of the dental profession fail to realize that one of our most sacred duties is to help our Government to enforce the law at any cost.

SOME DENTAL PROBLEMS IN THE PHILIPPINES

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Dentistry in the Philippines during the Spanish regime was not recognized as a profession and so there was no organized dental college or school or any institution of learning where dentistry was taught as a science and art. However, after the coming of the Americans and after the implantation of a civil government, the University of Santo Tomas for the first time included the study of some dental subjects in the "Cirugia Ministrante" course and this formed the nucleus of organized dental education in the Philippine Islands. Then the Philippine Dental College, the first dental college established in this country, was organized and incorporated in 1913, and was recognized and authorized to confer the degree of Doctor of Dental Surgery (D.D.S.) by the Secretary of Public Instruction in 1916. Since then much improvement in the practise of dentistry has been noted in some quarters. This has been realized through the efforts of a few who contributed their skill and knowledge by teaching in dental colleges and by lectures and demonstrations in the scientific meetings of dental associations of the Philippine Islands.

Among the dental problems in the Philippines that require painstaking study are those involving the construction of full and partial denture, the placing of gold crowns and bridges, and the treatment of pyorrhea.

FULL AND PARTIAL DENTURE

The usual method of full denture construction is the taking of the impression with modeling compound or plaster of paris. The results of studies on the problem revealed that the method can be improved by providing individual impression trays with "truplastic material."

The practice of using partial denture with clasps was found preferrable.

GOLD CROWN VS. PORCELAIN RESTORATION

The placing of gold crowns in front is not infrequently practised. The filling with synthetic porcelain in case a cavity exists or a combination of this and gold inlay if the cavity involves the incisal angle were observed to be recommendable.

PYORRHEA ALVEOLARIS

Pyorrhea, which is characterized by the flow of pus around the teeth and the consequent loosening of the latter, often produces complications, such as rheumatism, headache, toxemia, pain in certain portions of the body, such as the back, etc. Deaths are reported due to these complications. The treatment of this disease is essentially surgical. The removal of calcific deposit, simple as it may seem, is by nature a surgical procedure. It is estimated that 25 per cent of the failures are due to the inadequate removal of these foreign bodies; 25 per cent due to the failure to remove completely the infected granulated tissue on the wall of the pocket; 25 per cent due to the inability of the protective forces of nature to increase resistance so as to get rid of these foreign bodies; 25 per cent is due to inefficiency of the operator to recognize other causative factors, and give the corresponding treatment.

As stated, the treatment is essentially surgical, and as such the patient as usual should undergo all the requirements for preoperative and postoperative surgical procedures, such as coagulation test, urinalysis, premedication and postmedication. Two methods are successfully used: gingivictomy and open-view operation. The former is indicated when the pocket is only one or two millimeters deep. If the pocket is deep and the destruction of the alveolar process is rather extensive it was found necessary to use the open-view operation, especially for the front teeth.

BLOODLESS SURGERY

Another method of eradicating pyorrhea is by the use of drugs that will have a selective and destructive effect upon the necrotic and infected tissue as well as the organism and purulent matter found in the pocket. Studies on the problem showed that a sulphonated derivative of hardwood distillation from which phenol has been removed is a useful therapeutic agent.

CLINICAL DENTISTRY IN THE PHILIPPINES

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Twenty years ago, many of us had very little idea of the importance of dental treatment to our health. But there were many true professional men practicing dentistry and there had developed in the minds of these men a recognition of certain primary requisites if progress was to be made and these were: (1) acquisition of a greater and wider knowledge; (2) a means for the dissemination of propaganda as to the importance of dentistry; (3) prohibition of the unqualified from practice of dentistry. A dental law was enacted to protect the public as well as to guide and protect the profession. Several dental colleges were founded for the education of future dentists and from these specialized institutions of learning, there came dentists who were trained to meet the problems of the dental profession. The public in the meantime became more and more conscious of the importance of dentistry. Among the recent developments in the dental science is the Theory of Focal Infection which has given the dentist an added burden of being responsible for the health conditions remote from the mouth so that whenever a dentist handles a patient, he seeks to improve the general health of this individual as well as to put his teeth in good shape.

At present there are several institutions where dental clinics are established. Among these are the dental colleges, where the dental students treat, make the necessary fillings and restorations under the close supervision of their respective faculty; the Bureau of Health, which maintains provincial dental clinics for the people of their respective provinces and dental clinics in provincial hospitals; the office of the Public Welfare Commissioner, where the dentists take care of adults and children in their correctional institutions and health centers; the Community Health Center, where the dentist gives the necessary treatments, makes extractions and inserts fillings for the indigent; the Philippine Chapter of the American Red Cross, where they maintain one or more dental clinics for each province solely for the dental care of all the school children; and the

Philippine General Hospital, where the dental clinic takes care of the dispensary and hospital patients. The work in these dental clinics is all done by modern methods and apparatus is available for use by the operators.

The clinical work performed by these different dental clinics is distinct in nature. The dental staff of the Philippine Chapter of the American Red Cross devote their time to preventive dentistry, that is, they give more attention to prophylactic treatment, to fillings of cavities, especially minute cavities, etc., while the temporary teeth that are not diseased are given much attention because of their influence on the future regularity and soundness of the permanent ones. The dental clinics maintained by the Bureau of Health and the Office of the Public Welfare Commissioner are doing their utmost for their patients both from a reparative and from a preventive point of view. In the Philippine General Hospital, all that is humanly possible is done for the removal of foci of infection in the hospital and dispensary patients. Those cases involving severe pain are referred at once to the dentists in the extracting clinic so that immediate treatment is given for the relief of the pain. If extraction is not regarded as necessary, the patients are referred to the dentists assigned for treatments. In patients where the removal of foci of infection is required, a thorough examination is given and all the necessary treatments as well as surgical operations are performed. In the surgical section, there are numerous cases of necrosis, impactions of third molars, unerupted teeth, cysts, etc. In ths hospital, there are several dental externes who are working in the different sections to acquire clinical ability. No restorations are made for the patients.

The dental professionals in the Philippine Islands realize that the future progress of dentistry depends largely on activities in research. However, there are comparatively few dental research activities here, due mainly to the lack of funds, especially for the establishment of a library where dental books, journals and other literature may be obtained for reference and where dentists, nurses, teachers and other public health workers may seek advice and assistance in developing talks and lectures pertaining to dentistry. There is a very wide field of dental and oral problems. We have an enormous amount of theoretical information, some of which appears to be of no practical value. But to make the results of scientific research useful to humanity, there must be a very close correlation of theoretical information with clinical observations. Some of the problems in clinical dentistry which need a thorough study are:

(1) The problem of nutrition. On proper nutrition depends the development of healthy teeth. This brings in vitamins A, C and D and many factors. Our research workers have found that vegetables, fruits, etc. produced here in the Philippines are good sources of all the different vitamins. But has there been any clinical study on the effect of each kind of these fruits or vegetables on the development of teeth of the Filipinos?

(2) The study of local factors in the etiology and arrest of dental caries especially among school children. A recent dental survey for three public schools conducted by the writer and by the Department of Epidemiology and Statistics of the School of Hygiene and Public Health, University of the Philippines, revealed that out of the 3,814 school children there are 3,303 with dental defects, mostly dental caries, or 86.6%. This disease is very common human disease and is rampant throughout the world. There has been a considerable amount of research work done in almost all the countries in the world in an effort to find a means of preventing it. Why can we not start studying the best means of preventing this disease?

(3) The study of focal infection as a factor in systemic disease. This work will require time and a considerable number of experimental animals, etc. This is one of the most important problems which should be scientifically studied by us but which line cannot now take up because of lack of funds.

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IV. DIVISION OF CHEMICAL AND PHARMACEUTICAL SCIENCES

CHEMISTRY IN THE PRE-AMERICAN REGIME

By M. V. DEL ROSARIO
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Chemistry in the Philippines during the pre-American epoch had a very limited field of activities. The University of Sto. Tomas was the only scientific institution of learning then in existence where chemistry was taught. In the later years of the previous century however, two Government offices, the Municipal Laboratory in 1888 and the Medico-Legal Laboratory in 1894, were established.

It may be stated that the sluggishness of the progress of science in the Philippines, chiefly of experimental science, was due: Firstly, to the general condition of the whole world wherein experimental science was just developing; secondly, to the preference given formerly to speculative science; and thirdly, to the enormous distance which separates this portion of Oceania from the rest of the world, mainly from the Occident.

The opening of the Suez Canal in 1868, had certainly an enormous influence on the development of this country in every respect. Shortly after this event, the establishment of the Faculties (Colleges) of Medicine and Pharmacy by the University of Sto. Tomas, in 1871, marked a step forward in the field of applied science.

Even before this event, however, it is of interest to note that "La Real Sociedad Economica de Amigos del Pais" was created far back in 1780 with the aim of promoting and protecting sciences, arts, industry and commerce and whose "Junta Directiva" was officially composed of the Governor-General and other high officials.

This Society began publishing in 1883 a "Boletin" wherein the following articles appeared: "Introduccion al Estudio de la Quimica", by Salvador Draper, on March 1st, 1884; "Teoria Fisico-racional de la vida organica y estructura especialmente de los vegetales", by Manuel Herrera, on May 1st, 1884.

There are some data which show that as early as 1830 there existed some drug stores in Manila and that certain remedies of native character were applied in the towns for the treatment of many ailments. In the Philippines and in most European countries most of the chemical work was performed by pharmacists.

Rev. Felix de Huerta in his book, "Estado Geografico, Topografico, Estadistico, Historico Religioso de la Santa y Apostolica Provincia de S. Gregorio Magno", published in 1865, cited that in the preceding century (1787) a French chemist made the analysis of the water of one river, San Juan del Monte, and one Spring, Bomboñgan in Pagsanhan, which was supposed to be medicinal. Also an analysis of the thermal spring at Los Baños, Laguna, was mentioned but without date.

On June 7, 1886, appeared the first professional monthly "Boletin de Medicina de Manila". Almost simultaneously a similar paper "Medicina y Farmacia" was published though only for a very short while. In the latter was published the article "Estudios acerca del Areca" by Tomas Torres y Perona who later on became Dean of the Faculty of Pharmacy. No copy of this publication is now available.

Rev. Dr. Marcos Laynes of the University of Sto. Tomas in his inaugural address spoke on "Combinación y compuesto quimico" (1886). This was a discussion of laws and facts which may be considered as one of the early dissertations read in the Philippines of physical chemistry.

In 1888 Anacleto del Rosario became, by competitive examination, Director of the Municipal Laboratory, a newly created position, and this meant a marked advance in Chemistry in the Philippines. In this Laboratory many analytical works were done by him such as the analysis of foods, drugs, etc.

On January 3, 1893, the "Revista Farmaceutica de Filipinas" was published by Messrs. Tomas Torres Perona, Anacleto del Rosario y Sales, Ulpiano Rodriguez, Leon Ma. Guerrero and Joaquin Garrido. Worthy contributions were made by A. del Rosario such as his "Contribución al estudio de Ilang-ilang", "Guano de Filipinas", "Inconvenientes del empleo del reactivo de Esbach", and several others. One of the most important among his works, because of its economic value, was the improvement of the industrial preparation of alcohol and its pasteurization. This discovery, however, was never patented.

Anacleto del Rosario, who was later made professor of the University of Sto. Tomas, published his most remarkable work in the report of the "Comision cientifica para el estudio de las aguas de la Isla de Luzon", created by the Spanish Government in 1885 in two books "Manantiales minero-medicinales de la Isla de Luzon" (1885) and "Estudio descriptivo de algunas Manantiales Minerales de Filipinas" (1890). The Spanish authorities at that time appreciated the value of the study of these natural sources, which required from five to eight years.

Some works found in the "Cronica de Ciencias Medicas" (1895-1898) are: "Perfumes" by Hugo Salazar, a "Case of poisoning produced by potassium cyanide," and "Importance of the ptomaines in toxicology" both by Sr. Ulpiano Rodriguez. Joaquin Garrido also wrote an article entitled "El alimento de los convalescientes" and of A. del Rosario's (posthumous) "Analysis de la leche de caravalla, la orina en el beriberi," etc.

Rev. Dr. Felix Oses, Professor of the University of Sto. Tomas in 1897, spoke at the opening exercises about his works on the "Metodo de Kjeldhal Modificado". It may be said that Oses was the first worker on the Kjeldhal method in the Philippines, and the result of his experiments was undoubtedly an improvement in its many applications to the different branches of chemistry.

"Ptomainas del cadaver humano" published in "Revista Farmaceutica de Filipinas" (1893) was a work of M. V. del Rosario.

In January 1894 the "Laboratorio Medico-Legal" was created and Ulpiano Rodriguez was appointed chemist. Mention has been made of his work.

In the same year Antonio Luna arrived and established a clinical laboratory where some original chemical works were done but not published; the majority of them were routinary.

In the University of Sto. Tomas, the Faculty (College) of Science in its three branches, natural, chemical, and mathematical, was opened about 1894 or 1895; unfortuately the wave of modernism abolished it and owing to the outbreak of the revolution the scientific activities were virtually paralyzed until the establishment of the Civil Government under the United States.

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GENERAL AND PHYSICAL CHEMISTRY IN THE PHILIPPINES

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Historical records show that by the Royal decree of January 28, 1867, the rule which required the teaching of elementary physics and chemistry in the secondary schools in the Islands was approved (Artigas, 1911). By virtue of the same decree the Royal College of Sto. Tomas was required to have a chemistry laboratory with the equipment and apparatus necessary for efficient instruction in chemistry. These steps marked the beginning of the development of general chemistry in the Philippines. The study of chemistry received further impetus when in 1871 the University of Sto. Tomas offered among others the Pharmacy Curriculum (Artigas, 1911) in which general chemistry was a required subject.

However, the first public recognition in the Islands of the practical application of chemistry was made on December 15, 1884, when Governor-General Joaquin Jovellar created a committee to study the mineral waters of Luzon and appointed Anacleto del Rosario as chemist (Vinzons, 1932). In his capacity as chemist del Rosario made some micro-chemical studies of the odors emanating from the Pasig River and published his results in 1886. Realizing, perhaps, the importance of the work done by this committee, the government established in 1887 the Municipal Laboratory of Manila. Anacleto del Rosario was appointed director of this Laboratory on June 17, 1888, as the result of a competitive examination (Vinzons, 1932). The investigations undertaken by del Rosario are recorded in his "Memoria descriptiva de los manantiales minero-medicinales de la Isla de Luzon" (1890); "El guano de Filipinas"; "Estudio descriptivo de algunos manantiales minerales de Filipinas" (1893); and "Analysis de las aguas ferriginosas de la Isla de Negros; Analysis de las aguas minero-medicinales de Filipinas" (1895).

It may be mentioned in passing that Antonio Luna also won in 1895 by competitive examination an appointment as Professor of Chemistry in the Municipal Laboratory of Manila (Zaide, 1932). Here he was assigned to analyze the waters of Sibul Springs in Bulacan.

Another important step towards the development of general chemistry in the Philippines was made in 1895 when a Royal decree authorized the University of Sto. Tomas to establish the Faculty of Physico-Chemical sciences. Unfortunately however, all prospects towards the advancement of scientific activities in the Islands were paralyzed during the Philippine Revolution which started in 1896.

After the Revolution those in charge of implanting the American form of government in the country did not fail to recognize the importance of chemistry. Hence in the organization of the civil government in the Islands they saw to it that a chemical laboratory was maintained in conjunction with various lines of government scientific work. An idea of the first chemistry laboratory in the Philippines under the American regime may be obtained from the following excerpt from the First Annual Report of the Superintendent of Government Laboratories, Dr. Paul C. Freer:

> The present laboratory is a makeshift, allowing only of the simpler kind of chemical work, and the lack of apparatus has materially increased the time necessary to reach results; the ingenuity and patience of the working force has been taxed to accomplish at all what under other circumstances would have been done with facility and rapidity. The hope of a new and suitable building in the near future has, however, made it easier to undertake work, and the entire laboratory force has endeavored to do what it could with the materials on hand.

In the same report Dr. Freer also recommended that the laboratory should have among its personnel a physical chemist, a chemist and investigator, an analytical chemist for mineral analysis and an analytical chemist, (1902-1903). According to the Second Annual Report (1903-1905) of the Superintendent of Laboratories:

> The chemical laboratory has been compelled to meet a continual call for work from other bureaus, many of the analyses being complex and taking a considerable amount of time. Its force has been limited chiefly because of the lack of room, and also for the reason that it has been difficult to obtain chemical workers from America.

> The range of work was varied. A number of analyses of suspected counterfeited silver coins for the custom-house and treasury were made; examinations for poisons, some of which were for chemico-legal purposes, and involved testimony in court, were undertaken, and investigations of stains, in cases of suspected murder, for the purpose of determining the presence or absence of blood have been asked in two instances. Analyses of mineral and other waters have been asked, and requests for reports on soils, coals, paints, alloys, etc., have been made.
>
> Unfortunately during the past year the limitation has been such that no one chemical worker has been able to devote his time to research work, and such investigations as have been accomplished have been undertaken at odd moments when for the time being no large pressure of analytical work was felt.

It is of interest to note that as early as 1903 the Superintendent of Government laboratories pointed out that *the advantages to the government of the chemical laboratory would consist in the systematic investigations of the resources of the archipelago, in the study of methods for improving manufacturing conditions then existing, and in demonstrating the value of products neglected at the time.* Those were the ideals of a true scientist, of a chemist! With those ideals to guide him he spared no efforts in the organization of the Bureau of Science to provide the chemical laboratories with all the equipment and library facilities needed not only for conducting routine analytical work, but also for undertaking chemical research. Much of the progress of general and physical chemistry in the country has been contributed by the personnel of the Bureau of Science as may be seen from the appended list of articles which appeared in the Philippine Journal of Science since 1906.

It must be kept in mind that the first members of the staff of the Department of Chemistry of the University of the Philippines were drafted from the personnel of the Bureau of Science. This fact explains why there has always been close cooperation between the two institutions as far as development of chemistry is concerned.

However, progress in the Department of Chemistry of the University of the Philippines was slow during the first decade after its establishment. There are two obvious reasons for this slowness: (a) lack of research facilities and laboratory space; and (b) limited scope of the activities of the Department, for then the Department was giving only elementary chemical instructions to students of preparatory medicine, pharmacy and engineering.

The establishment of the Chemistry curriculum in 1913 gave an incentive for some students to take the course. The enrollment of students in this course compelled the Department of Chemistry to offer advanced courses such as physical chemistry and technical analysis and gradually to reinforce its Faculty with additional members until it finally reached its present size. It then became possible to offer the more advanced courses of undergraduate and graduate nature required in the present chemistry curriculum and in the course leading to the degree of Master of Science major in Chemistry.

When in 1920 or thereabout, facilities for research work became available in both the Department of Chemistry in Manila and the Department of Agricultural Chemistry at Los Baños, studies which contributed to the progress of General and Physical chemistry were begun. The works done in the Department of Agricultural Chemistry are cited by (Santos, 1934) in his article "Agricultural Chemistry in the Service of the State". While the contributions of the Department of Chemistry of the University of the Philippines in Manila are listed below.

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ORGANIC CHEMISTRY IN THE PHILIPPINES

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It has been estimated that the virgin forests of the Philippines cover about 40,000 square miles and there are more than 2,500 species of trees. Various kinds of oils are obtained from the seeds, leaves, or flowers of these trees. Certain of the vegetable oils serve as raw materials for the manufacture of foods while others are useful for making paints, soaps and other products. The essential (flower) oils are employed in making perfumes.

A perusal of the numerous volumes of the Philippine Journal of Science shows how Philippine industries have been helped by organic chemical research. Publications on sugar, copra, coconut, lumbang, and ilang-ilang oils, tanning materials, industrial alcohol and other products have given valuable information for these industries. Moreover, there have been published useful basic data on numerous industries not yet established. Organic chemical researches on the composition and characteristics of Philippine vegetable and essential oils have been in progress in the Bureau of Science for a number of years.

Researches on Philippine lumbang oil (Aguilar, 1917-19, West et al, 1922-30) showed that oil has a composition quite similar to that of linseed oil and, like linseed oil, can be used for making paints and other products. These experimental results, which were published in the Philippine Journal of Science, led to the establishment of a Philippine paint industry. Paints of high quality are now manufactured in the Philippines from lumbang oil.

Experiments have shown that Philippine peanut, kapok, (Cruz and West, 1931) and rice oils (Cruz, West and Aragon, 1932) have a composition quite similar to that of cottonseed oil. These oils are suitable commercially for the manufacture of edible products and soaps and for other purposes for which cottonseed oil may be employed. The results of these investigations show the possibility of developing the Philippine edible-oil industries.

Formerly much of the copra produced in the Philippines was not a product of high quality. Investigations (Walker, 1906) on the drying of copra showed that copra which contains only about four per cent of moisture has very good keeping properties and produces a coconut oil of excellent quality.

The essential oils used in making perfumes and flavoring extracts are usually obtained by distilling the flowers, leaves, or other parts of plants. Ilang-ilang, champaca, lemongrass, vetiver, cinnamon, ginger and citrus oils have been investigated. (Bacon, Brooks, Gibbs, Agcaoili, Wells, Orosa, Tanduco, West, 1908-1933). Several of these oils are used in the perfume industry and others in the manufacture of nonalcoholic beverages. The results of this work should serve as a basis for Philippine essential oil industries.

Resins and gums are products obtained from the exudations of trees. These products may exude spontaneously but are more often secured by making incisions in the bark or trunk of the tree. Manila copal, Manila elemi, and various dipterocarp resins have been investigated and their properties and characteristics determined. (West and Brown, 1920.) Some of these resins are useful for making varnishes and other products.

Researches (Pratt, Marañon, Perez, Russel, West, 1915-1932) on medicinal plants have been carried out and some interesting glucosides and alkaloids have been isolated. Good yields of quinine have been extracted from cinchona bark grown by the Bureau of Forestry in Bukidnon. Philippine quinine could probably be developed into a profitable export product.

At present the mixed ethyl esters obtained from the acids of chaulmoogra oil are used in the treatment of leprosy. As this treatment is usually a rather slow process it is possible that some new chaulmoogra preparation may give quicker and better results. A number of new synthetic chaulmoogra preparations have been made.

Such investigations suggest the utilization of Philippine plants for medicinal purposes and give basic data for the preparation of a Philippine pharmacopoeia.

The tannin content (Bacon, Gana, Williams, Baens, Yenko, 1911-1934) of numerous Philippine tanbarks was determined recently. Tannin extracts were prepared from various species of tanbarks. Hides tanned with these extracts gave very good leathers of different shades of color. These results will be helpful in improving the quality of Philippine leather and also in developing an export trade for Philippine tanning extracts.

Investigations of by-products often lead to results of commercial importance. Rice bran (West and Cruz, 1933) is obtained as a by-product in the milling of rice. More than 111,000 tons of fine rice bran are produced annually in the Philippines. This by-product of the rice mills has been investigated rather thoroughly.

Rice bran is the most nutritious part of the rice grain for it contains fats, proteins and vitamins. For a number of years the Bureau of Science has been making an extract of rice bran (tikitiki extract) that contains vitamin B. This extract is widely used for curing or preventing beriberi.

When rice bran is stored the rice oil in the bran becomes rancid and the bran acquires a disagreeable taste. Deterioration of the bran may be prevented by heating it sufficiently to remove the moisture and then storing it in moisture-proof containers which prevent access of insects.

The Bureau of Science now prepares sterilized rice bran that is sold at the Bureau in moisture proof packages for two centavos each. Excellent bread, cakes and other bakery products may be made from this prepared rice bran. If this use of the bran as a food can be popularized among the poorer classes it will not be necessary for them to take extract of rice bran as a preventive or cure for beriberi.

In addition to the organic chemical researches to which we have referred there are many other kinds of Philippine raw materials that have been investigated in the Bureau of Science. The results of all of these researches have been published in the Philippine Journal of Science and the information is available to the public free of charge.

The prosperity of a country depends, in general, upon the growth of industries. The Philippines are rich in natural resources but comparatively few industries have been well established.

In order to establish new Philippine industries two things are usually necessary:

First—The acquisition of basic laboratory data to ascertain if the Philippine raw materials, or by-products, are suitable for commercial purposes.

Second—The actual establishment of factories, properly financed, for the production of commercial products from Philippine materials.

The second step is usually the most difficult to realize commercially because people seem reluctant to take up a new enterprise unless it is a line which has proven to be decidedly successful. Again, market prices and the cost of production are considerations that sometimes hinder the promotion of Philippine industries.

For an undeveloped country like the Philippines organic chemical research should really be a very important function of the government because it aims to establish industries and give employment to the people.

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THE DEVELOPMENT OF PHYTOCHEMICAL RESEARCH IN THE PHILIPPINES

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From the time when Wöhler in 1828 synthesized urea, thus showing that no "vital force" is necessary for the formation of organic compounds (Moore, 1918), the interpretation of the complex life processes in terms of the principles of physics and chemistry has been given considerable attention. Wöhler's discovery together with the brilliant researches of Scheele on the isolation and purification of organic plant acids (Rosenthaler, 1930), and the system of organic analysis perfected by von Liebig (Moore, 1918), have been greatly responsible for the birth of a new science known as the chemistry of plant life or phytochemistry.

The historical development of the phytochemical investigation in the Philippines may be conveniently divided into two periods. The first period covers the Spanish regime in the Islands, which lasted for more than three centuries. The second period represents the United States administration, commencing in 1898 and extending up to the present time.

THE SPANISH PERIOD

Of direct concern with the early phase of the phytochemical research in the Philippines is the account given by Father Ignacio de Mercado. In his work entitled "Libro de Medicinas de Esta Tierra" (Blanco, 1880) written before the close of the 17th century, he described a method followed by the Filipinos for the preparation of native wine from the ripe fruits of "guava" (*Psidium guajaba*). He also related the preparation of a thick oil, used for dying gray hair, from coconut shells by destructive distillation.

On April 24, 1827, experimental results for extracting the coloring matter from certain species of *Indigofera* (Blair and Robertson, 1907) were reported. In the following year, the analysis of the coloring matter was effected.

The ever-increasing demand for a government-owned scientific laboratory found its expression in the establishment of the "Laboratorio Municipal de la Ciudad de Manila" in 1887. Its first director, Anacleto del Rosario, had contributed a great deal on the problems concerning the purification of the native alcohol "nipa" palm and on the development of the distillery industry in the Islands. Besides, he had also worked on the alkaloid of St. Ignatius beans from the Philippines, and on the castor oil from "Palma Christi." Other prominent phytochemical investigations he had undertaken are the studies on the essential oil of "Ilang-ilang" and on the biochemical aspect of the nauseating odor in the Pasig river, originating from the decaying blue green Algae (Vinzons, 1932). This last problem is of historical interest as the present recurring algal nuisance in Manila and its vicinity is due to the same organism studied by del Rosario as early as 1886.

Of particular interest with regard to the biochemical aspects of the indigenous drugs is the work of Pardo de Tavera published in 1892 and entitled "Plantas Medicinales de Filipinas." This is an exposition of the therapeutic properties, methods of administration, chemical composition, and botanical description of Philippine medicinal plants.

THE AMERICAN PERIOD

As the technique of, and facilities for, research have developed and improved, many important chemical investigations on Philippine plants and their products have been undertaken during the present American administration. In this connection, the government Bureaus of Forestry, and Science, and the University of the Philippines have contributed their share for the advancement of phytochemical research in the Philippines.

As a whole, the varied phytochemical activities in this period can be more or less resolved into the following topics:

(a) Medicinal and poisonous plants
(b) Essential oils, gums, and resins
(c) Food plants and animal feeds
(d) Seeds yielding fixed oils
(e) Fibers and fibrous substances
(f) Tanbarks
(g) Natural dyes

The physiologically active constituents of a number of the local medicinal and poisonous plants have been isolated and their chemical properties studied. Some of these plants contain alkaloids, glucosides, volatile oils, and resins. Thus, "dita" (*Alstonia scholaris*), well known as a remedy for fevers and for chronic diarrhoea and dysentery, was found to contain the alkaloids, ditamine and echitamine. The saponin from the "gogo" bark (*Entada scandens*) was isolated as early as 1906 (Bacon, 1906).

A number of plants yielding essential oils, resins, and gums were reported (Brown, 1920; Tanchico-Santiago and West, 1933). Among these plants are the lemon grass (*Andropogon citratus*), "Moras" or vetiver (*Andropogon zizanioides*), "champaka" (*Michelia champaca*), "ilang-ilang" (*Canangium odoratum*), cinnamon (*Cinnamomum mercadoi*), "Colobot" (*Citrus hystrix* Dc. var. *torosa*). The chemical properties of almaciga or Manila copal, from *Agathis alba*, were studied. The resin is now exported in considerable quantities for the manufacture of high-grade varnish.

Due to the economic importance of seed-yielding fixed oils, extensive chemical studies on such seeds as the coconut, lumbang, kalumpang, and tuba were made (Brown and West, 1920). The results of these studies are now being applied in the utilization of these oils in industry.

Notable contributions have been made in the investigation of the Philippine food plants. Studies along this line include the proximate chemical composition, inorganic constituents and the vitamin contents of these plants.

Of importance to the leather industry in the Islands are extensive analyses of available tanning materials (Brown, 1920). This is of particular interest as the species of mangrove trees which are used commercially for tanning materials are found in the Philippines in large number. The Philippines can, therefore, well afford to compete with other tropical countries in the exportation of mangrove tanbarks, and of the bark extracts known as cutch.

The feasibility of using some Philippine forest products for paper making has been investigated and reported in a series of articles in the Philippine Journal of Science (Richmond, 1906-1910). Among the forest products examined which are found to be promising material for paper pulp are a bamboo (*Schizostachyum lumampao*), "Kogon" (*Imperata exaltata*) and "talahib" (*Saccharum spontaneum*).

In spite of the continually decreasing demand for natural dyes since the introduction of synthetic dyes in commerce, three Philippine plants were investigated with reference to their coloring matter. These are: "Dilau" (*Curcuma longa*), "sibukan" (*Caesalpinia sappan*), and the two species of indigo, (*Indigofera tinctoria* and *I. suffruticosa* (Brooks, 1910).

Such a brief historical sketch as is here presented would be all too fragmentary were we to fail to pay a tribute to all the pioneers who have contributed their best in the furtherance of phytochemical research in the Islands and thus have led the way for others.

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A REVIEW OF THE PROGRESS OF AGRICULTURAL CHEMISTRY IN THE PHILIPPINES

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Agricultural chemistry has been defined by Browne as that branch of science which treats of the chemical composition and mutual chemical relations of soils, crops and farm animals, in so far as they concern the production of the means of human subsistence and welfare. From this definition it can be seen at once that the field is almost limitless. The opportunities which are open to the agricultural chemists in the development of Philippine agriculture and in the utilization of products and by-products are unlimited.

In the Philippines, a notable achievement due to the science of agricultural chemistry is to be found in the present state of development of the sugar industry. The production of sugar cane varieties of high sucrose content, high yielding power and great adaptability to varying climatic conditions, by means of chemical selection, improved practices of fertilization and the replacement of old and obselete methods of manufacture with the more modern and up-to-date processes and efficient equipment, are in a large measure the results of agricultural chemical researches.

Greater production of raw agricultural products both for local consumption and for export and the complete and most economic utilization of agricultural products and by-products is a fertile field for research for agricultural chemists here. It has been sufficiently demonstrated here and elsewhere that greater returns are obtained from the sale of finished products than from raw products alone.

The heavy annual importations of manufactured goods and other agricultural products into the Philippines, can be replaced by local manufactures or through the cultivation of imported plant materials and turning them into locally required finished products. The introduction and propagation of new economic plants in places of the archipelago that are most suitable for these crops are temptingly great and for this reason agricultural government institutions are already sponsoring the campaigns for the cultivation of various economic crops in the different parts of the Islands.

FOOD INDUSTRIES

The average annual importation of food and food products into the Philippines reaches nearly ₱48,000,000. As we have and can grow a large variety of food plants which can be utilized for the manufacture of products that can in part or wholly take the place of most imported materials, it is possible that by proper development we may in time be able to materially decrease the importation of many food commodities. Possibly later, we may be able to export some of them.

Numerous kinds of imported products are manufactured from raw materials which have originated either here or from neighboring Oriental countries. If some of the needed materials are not yet grown here, the possibilities of cultivating and propagating them in many places of the archipelago most suitable for their culture are temptingly great.

It is therefore necessary that proper methods of utilizing and manufacturing plant products be studied in order to convert them into various forms of finished products which can be kept or shipped to distant places like imported kinds, thus making them available at all times, salable at moderate prices, and easily and readily transported to different places where they are not usually to be had.

Many of our fruits and vegetables are highly seasonal so that prices fluctuate very greatly. At the beginning and towards the end of the seasons, prices are too high and oftentimes prohibitive, but during the height of the season in which there is usually a large excess production, they are obtainable cheap if not practically thrown away as waste. It is during this period when they can be economically converted into finished products that canning or other forms of commercial utilization should be undertaken.

It is surprising that such a rich agricultural country as the Philippines must import millions of pesos of canned and other kinds of preserved fruits, especially canned pineapples, tomatoes, and other fruits and vegetables that can be grown and preserved right here. There is therefore need of showing the possibilities of utilizing our raw products profitably.

Mention of utilization will naturally bring us to a discussion of the different methods of preservation now in commercial use in many countries.

Man, since the earliest times, has sought ways of making available his needs for foods both in and out of season. He found, for instance, the value of drying and salting for preserving foods for a longer time than was otherwise possible.

Later on, in 1765, an Italian priest named Spallazani astounded his epoch by making the discovery of how to preserve foods by the application of heat.

CANNING

In 1795, after 14 years of experimentation, Nicholas Appert, a Frenchman, popularly known as the "Father of Canning" was awarded by the French Government a prize of 12,000 francs for his method of preserving food for army and navy stores.

In 1874, A. K. Shriver of Baltimore invented and patented the pressure cooker, which made it possible to increase the temperature in the sterilizing process.

The tin can, being light and non-breakable, very early became the container for commercial canning. The first tin cans were made by soldering the bodies and ends. The modern or sanitary can was developed by Charles M. Ams in the early nineties. He also invented the sealing compound that is applied on the covers to give the hermetic seal. With the invention of modern machinery for hermetically sealing the covers to the body, the sanitary or open can came into general use.

The present canning industry is now so well developed that where before a master workman could make only about 60 cans daily and the pack of what was then considered a well equipped cannery did not exceed 2,500 cans a day, now with the help of modern machinery, 300 cans a minute can be easily made and machines which can seal 120 cans a minute are used in large canneries. With the invention of other labor saving machinery the output was greatly increased and the cost of the products thereby reduced.

The Philippines can grow an unlimited supply of raw materials for canning different fruits and vegetables.

Pineapples and mangoes can be canned commercially. The Philippine Packing Corporation in Mindanao has up to recently been canning pineapples on a large scale.

While home and farm canning is recommended to utilize local surplus raw materials, there is need of erecting large canning plants which can economically utilize some of our fruits like the mango, pineapple and others. If canned properly and in large quantities, mangoes should have good local and foreign markets.

In commercial canning plants the supply of very cheap tin containers is most important. Cheap tin containers is a very important consideration and this applies to other industries which demand good and cheap containers such as glass, porcelains, paraffined papers, etc. An investigation into this problem is going to solve many problems of the food industries.

Government laboratories have demonstrated the variety of fruits and vegetables which give promise of being utilized commercially for canning purposes.

FRUIT TREATMENTS

The yearly importation of California and other foreign oranges, lemons, and other citrus fruits, not to mention other varieties of fruits, is a considerable import item.

It has been shown that most of these fruits or their appropriate substitutes can be grown satisfactorily in many places especially adapted to their culture. Besides these imported fruits, we have a large variety of our own which if subjected to the same treatments as the imported ones will be equally valuable.

PICKLING

Pickling is the preservation of food in brine or in vinegar either with or without bacterial fermentation.

We have a large variety of fruits and vegetables suitable for pickling purposes. The possibility of commercially pickling many Philippine fruits and vegetables has already been shown.

FERMENTATION

In the preparation of fermented and unfermented beverages, we have many kinds of fruits which can be used to produce nutritious, appetizing and specially flavored drinks. Fruits like the calamunding, duhat or lomboy, bignay, santol, pineapple, strawberry and different varieties of citrus fruits have been found to furnish excellent raw materials.

Studies have been conducted on the preparation of fruit juices and fruit wines and these have turned out just as good as the imported kinds.

When properly prepared many Philippine fruit juices that can supply the necessary vitamins and minerals and other health promoting accessories can be sold cheaper than imported kinds.

Basi, an alcoholic beverage from sugar cane juice, if scientifically prepared will be an important commercial product. There is need for improving the antiquated methods at present used if the industry is to be conducted on a sound commercial and competitive basis.

The preparation of vinegars from waste and otherwise unsalable fruits and the improvement of present methods of making palm sap vinegars are timely and important studies.

The preparation of nata, a mucilaginous fermentation product usually obtained from pineapples, when scientifically controlled, can be developed into an important industry which can very well take care of the surplus production of pineapples.

The method of fermentation of soybeans for the production of toyo or soy sauce, which is consumed in large quantities, is not well known. The soy sauce of commerce is either an imported product or manufactured by certain Chinese firms of the city. It is possible to develop industries for toyo making which will give products, if not better, at least comparable with the best in the market. The soy sauce prepared locally by Chinese is not usually of good or desirable quality.

FREEZING AND REFRIGERATION

Freezing and refrigeration storage takes care of about 80 per cent of the food supply of the United States which is in excess of ₱22,000,000,000, thus showing the importance of these two methods of preservation.

Commercial refrigeration, using varying degrees of coldness, has been used for storing many kinds of food products for a long time, but it has not given very satisfactory results for certain types of products. Many of these objectionable features of ordinary refrigeration storages were finally solved with the invention of quick freezing in 1930 by Mr. Clarence Birdseye of Boston who sold his patent to the Postum Company, now the General Foods Corporation, for ₱44,000,000.

Taking advantage of this invention and the work of investigations on the subject of freezing, studies have satisfactorily demonstrated the possibilities of preserving both the texture and flavor of mangoes, pineapples and many other Philippine fruits by processes that if commercially undertaken will open up promising industries.

If managed on a large scale, freezing preservation is bound to solve our fresh fruit and vegetable problems and the marketing of excess production. A large export business in Philippine perishable materials is bound to be developed by the use of the quick freezing method.

FLOUR AND STARCH

The Philippines up to a few years ago were importing nearly ₱10,000,000 worth of flour and starch yearly. This value, on account of lower prices of recent years, dropped to more than ₱6,000,000 annually—still a big sum indeed. Rice forms a very important part of the diet of our race. The preparation of native and other rice recipes is not so widely practiced on account of the inconvenience and time required to prepare the wet rice flour (commonly called in the Tagalog region "galapong.").

The results of investigation on rice flour and its possibilities is now public knowledge.

But there are other important problems connected with rice flour, one of which is to find other kinds of flour of Philippine origin that are high in the protein of wheat flour, which when added to rice flour will produce a product similar in nutritional and baking qualities to wheat flour.

The annual importation of corn and cassava starch into the Philippines amounts to more than ₱600,000. Cassava, scientifically known as *Manihot utilissima* Pohl., is called by different names. In the Philippines, it is commonly known as "balangay" or "kamoteng kahoy" in the Visayas, "bangala," in Lanao, "pangina" or "bingala" in Bukidnon, "kamote Moro" in the Ilocos, "pangina-kahoy" or "kamoteng-kahoy" in Sulu, "balinhoy" or "kamoteng kahoy" in the Tagalog provinces, "kamunte-kayo" in Zamboanga, "malaboanga" in Palawan, "padpadi" in Mountain Province.

In Malaya and in the Dutch East Indies, it is commonly known as tapioca, cassava, mandioca, and manioc. However, the term "tapioca" usually refers to different forms of cassava products. In Cuba it is known as "yuca", a name of Brazilian origin.

While cassava has been grown in the Philippines for a long time, the plant having been introduced by early Spanish colonists, its cultivation has not been as extensively carried on as in other tropical countries.

Cassava starch is commonly known in the Philippines as "gao-gao" and is used for laundering purposes. It is also used in sizing yarns and cloths, in the preparation of the so-called British gums, dextrins, and pastes, and in the manufacture of confectioner's glucose, of which increasing quantities are being used here. Of the last item alone more than 100,000 pesos worth is imported annually.

In the manufacture of food products, it is used in the preparation of custards, blanc mange, puddings, powder, macaroni, simolinas, and sauces, as a thickening agent in ice cream, and as fillers for various kinds of food products. It is also mixed with breakfast cereals. In the Philippines the cultivation of cassava as a raw material for the production of starch should prove a profitable enterprise.

While cassava has been grown in the Philippines for a long time, so far there are no plantations sufficiently large to supply the raw materials for a starch factory. There is need for starting plantations by using the varieties which are best adapted to the localities and at the same time of high yielding power, if the production of starch is ever to compete with the foreign manufacture. Herein lies a great field for agricultural chemists to solve some of the problems in starch manufacture.

While a number of starch factories have been started, for some reason or another, they have not yet given satisfactory results.

Probably following the example of Cuba, which passed a law making it obligatory for bakery establishments to mix cassava flour with wheat flour to the extent of not less than 10 per cent but not more than 40 per cent in the preparation of bakery products, might encourage the early development of the cassava industry. Some similar Government protection or encouragement has been adopted in Brazil and it seems that a similar procedure would be desirable to follow here.

INSECTICIDES

The annual destruction caused by insect pests in the United States to farm crops alone is estimated at 2,000,000,000 dollars, U. S. currency. In the Philippines, though no exact figures are available, the value of agricultural products annually destroyed by insect pests undoubtedly also amounts to a very large sum. In fighting locusts and coconut leaf miners along the annual expenditures of the Philippine Government, not counting those of individual planters and centrals, for the last few years, have exceeded 150,000 pesos a year. The fight to exterminate locusts and other major insect pests is one of the most serious agricultural problems in the Islands.

The insecticides in general use at present are chemicals; such as arsenates, nicotine, sulphate, hydrocyanic acid, and others more or less toxic to both man and animals. The use of arsenicals and powdered soap has been developed by the Bureau of Plant Industry and has proved quite satisfactory in its campaign to exterminate locusts. These, however, have encountered opposition on account of the arsenicals used. There is need therefore, of insecticides that will give maximum toxicity to insects but at the same time are harmless to man and beast. Of the latter species, scientists have found certain plants such as pyrethrum flowers from Japan and Yugoslavia. The derris roots, the active constituent of which is known as rotenone, for the manufacture of insecticides is pregnant with commercial possibilities.

Derris is the generic name of numerous leguminous climbing shrubs; some species are said to be trees. The plants are native to the tropics, and 12 of the 40 or more species are known in the Philippines, where these plants, which possess fish—and arrow poisoning properties, have various dialect names. Some of these names are "malasiag," "tibalan," "tibangalan," "tubli," "tuble," "tugli," "tugling pula" in Tagalog, "tubli" in Visayan and Bagobo, "upei" in Bontoc, "baot" in La Union, "lono" in Albay, "lagtang" in Samar, "tublitibauon" in Cebu, "baoet" in Zambales, and "toblelono" in Camarines Sur.

In the Dutch East Indies, where it has been cultivated for a long time, derris is also known as "tuba root." The average annual exportation of derris root from Malaya is more than 60,000 kilos.

Although many species of derris are known, *Derris elliptica* and *Derris malaccensis* seem to be the commercial species that are commonly grown in many tropical countries, particularly in the Federated Malay States and Borneo.

The determination of derris species of high rotenone content has been the subject of investigations by government chemists. The results of these studies will decide the best species to propagate for commercial planting.

At the present time the market demand for derris roots is very big and herein lies a big field for commercial undertaking.

AGRICULTURAL ANALYSES

As a prerequisite to nutrition studies, a handy reference on the composition of food materials has long been felt. Many physicians, particularly due to lack of local references, are using data of analyses of foreign materials obtained in the American and European laboratories. For the convenience of nutrition workers in the Philippines, therefore, a compilation of proximate analyses of Philippine food materials is necessary. Several analytical laboratories of the Government have cooperated in these analyses so that we now find rather voluminous compilations of this kind of work.

In addition to food materials, agricultural analyses of feeds, soils, fertilizers and many other kinds of agricultural products have been performed. Consideration of chemical analyses has been very important not only in the analyses of food and feed values but in the manufacturing industries, where it has been of special service in controlling the different processes.

SOILS AND FERTILIZERS

The determination of soil fertility, or the detection of mineral soil deficiencies, has been the subject of numerous investigations since very early times. As a result of these researches, several methods of determining soil fertility such as soil chemical analysis and the Neubauer and field plot tests, which are already well known, have been devised. A chemical soil analysis by using methods of extracting the mineral constituents of the soil that are far from duplicating the plant requirements, besides being laborious, and requiring a long time to perform, is expensive and is only valuable in determining excesses or deficiencies of certain mineral soil constituents. The prevalent notion among farmers that a soil analysis can determine the kind of crops that will grow best in a particular soil as well as the kind and amount of fertilizers to add is fallacious.

The Neubauer test is also expensive and time-consuming and is therefore impractical for the analysis of many field samples.

The soil plot test, which has been extensively used, is also not dependable, because results obtained thereby are not directly applicable to other fields. Besides, it requires a large tract of land and from 3 to 5 years to obtain useful information. There is therefore need of a method of determining soil fertility which will eliminate some if not all of the above mentioned objections.

Using the result of the researches of Winogradsky and Ziemiecka of the Pasteur Institute of Paris as a basis, Sackett and his collaborators of the Colorado Experiment Station, Fort Collins, Colorado, have perfected a bacteriological method of determining mineral soil deficiency by what they called the "soil plaque test." The principle involved in this method is based on the findings of Winogradsky and Ziemiecka, that the mineral food requirements of azotobacter (a group of nitrogen fixing organisms found in soils) and of farm crops are identical. Soils therefore that are particularly lacking in certain mineral constituents, such as phosphates, potash and calcium, will not produce notable growths of azotobacter colonies, while the beneficial effect of the addition of these so-called limited mineral constituents to those same soils will be indicated by the accelerated growth of azotobacter colonies.

They have found the soil plaque test to be a rapid and dependable method for determining phosphate and lime deficiencies and believe it may also prove equally valuable for potash.

Besides giving a very rapid qualitative test requiring only 72 hours for the detection of some mineral soil deficiencies as against about a month in the case of soil chemical analysis and the Neubauer test, or from 3 to 5 years for the field plot test, they also found the method to be sufficiently quantitative to serve as a practical guide for determining the amount of fertilizers to apply.

The amount of commercial fertilizers that has been used in the Philippines during the last few years has been considerable. It amply demonstrates the increasing realization of the value of conserving, or maintaining and restoring soil fertility. Not infrequently there are farmers who use too large amounts of fertilizers when this is not necessary while many should use commercial fertilizers to increase production but are unaware of this fact.

If a simple, rapid and inexpensive method of determining mineral soil deficiencies can be given Philippine farmers, a more judicious application of, and an economical way of using commercial fertilizers can be effected. An extensive survey of the value of this soil plaque method is now being conducted on Philippine soils.

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BIOLOGICAL CHEMISTRY IN PHILIPPINE AGRICULTURE AND FILIPINO NUTRITION

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The development of biological chemistry in the Philippines is intimately linked with the progress of four institutions, namely, the College of Agriculture, University of the Philippines, the College of Medicine, U. P., the Bureau of Science and the Bureau of Agriculture, all organized about a quarter of a century ago. The most important works of these institutions in this branch of chemistry were published in the Philippine Agriculture and Forester, now The Philippine Agriculturist, The Philippine Journal of Science and the Journal of the Philippine Islands Medical Association.

The biological chemist's earlier work centered on the chemical analysis of agricultural products such as foods and feeds. The data obtained and data from foreign laboratories which are of local application were compiled and published under the titles "The Proximate Chemical Analysis of Philippine Foods and Feeding Stuffs, I, II, III and IV," (Adriano, 1925, 1929; Adriano, Ramos and Ynalvez, 1932; Adriano and de Guzman, 1932). "The Chemical Composition of Philippine Food Materials," (Santos and Adriano, 1929) "Amount of Nutrients in Philippine Food Material" (Santos and Ascalon, 1931) and "Food Values," (Hermano, 1934). In these publications may be found the proximate proteins, fats, carbohydrates, minerals and water content of most of our foods, feeding stuffs and other agricultural products.

One of the important problems in agriculture is the selection of plant varieties rich in the specific foodstuffs desired. It has been shown that among the different varieties of sweet potatoes grown in the Philippines, Guinarosa 1070 and Leyte 1080 are the sweetest; while Tinogabong 1078 Sinamporado 1071, Leyte 1081 and Caigbao 1068 are the highest in starch, (Sabayen, 1914). Of the bananas, the varieties Pitogo, Butuan, Lacatan, Tiparot and Saba were found to be high in calcium;

Pitogo, Saba, Lacatan, Latundan and Tiparot in phosphorous, (Martinez, 1932). Of the rices the varieties Cruz, Bulandi, Susongsong, Inasinag, Piling Babay and Lumbang were found to be high in minerals, (Santos, 1934).

Nutrition studies in the Philippines indicate that the common dietary is deficient in calcium, (Roxas and Collado, 1922). Philippine cereals, tubers and bulbs were found to be poor in this nutrient. However, the following materials are high in it: Tinapa (smoked fish), tuyo (dried fish) clams, oysters, orange, mandarin, breadfruit, eggs, cheese, milk beans, endive, malungay leaves (*Moringa oleifera*, Lam.) and himbaba-o [*Allacanthus luzonicus* (Blanco) F.-Vill.] (Adriano and Tavanlar, 1925).

Cases of poisoning due to the eating of cassava are not infrequent in the Islands. Usually this is caused by the prussic acid in the cassava. Different varieties of cassava vary in their content of this poison. The varieties Aipin Valenca, Aipin Mangi, Mandioca Basiorao (new) Aipin Manteiga are low in this substance. However, the common Mandioca Basiarao is high, (Santos, 1934).

Cases of poisoning of man and of cattle due to eating of patani are also frequent. It has been found that both the wild and semi-wild varieties of patani contain dangerous amounts of prussic acid. So if the wild and semi-wild varieties must be eaten these should be boiled thoroughly in vinegar and the liquid thrown away; then boiled with lime water, and subsequently washed thoroughly in boiling water, (Serrano, 1923).

Analyses have shown that the yield of sugar per hectare from native cane varieties is not as high as from some foreign canes. Hence, farmers are replacing native canes with P.O.J. 2878 and H-109. The right time to harvest canes is determined by the use of biochemical methods. Close control of the chemical reactions during the process of clarification of the juice at the factory has resulted in greater sugar recovery.

Copra meal, an important by-product in the coconut oil industry, is extensively used as food. It has been found that it is rich in the amino-acids necessary for maintenance and growth, (Santos, 1920). However, it is poor in anti-scorbutic vitamin, (Derecho, 1921), and when forming from 75 to 85 per cent of the ration produces detrimental effect, irrespective of whether the oil content is high or low, (Sulit, 1926).

In the study of Filipino nutrition biological chemistry has contributed a great deal. That an average normal adult Filipino doing medium work needs 80 grams proteins, 40 grams fats, and 450 grams carbohydrates daily has been practically established, (Santos and Pidlaoan, 1933).

Many Filipinos believe that foreign food materials are better than those raised locally. Many also believe that balanced meals cannot be obtained without the use of imported food materials. Both these beliefs are, of course, unfounded. It has been found that native rice, corn, meat, fish, milk, oranges and other common food materials are as rich in nutrients as the imported ones, (Aron, 1910; Aron and Hocson, 1910; Kilbourne, 1910; Chamberlain, 1911; Chamberlain, Bloombergh and Kilbourne, 1911; Heiser, 1911; Chamberlain and Vedder, 1911; Chamberlain, Vedder and Williams, 1912; Strong and Crowell, 1912; Vedder, 1912; Vedder and Clark, 1912; Vedder and Williams, 1913; Gibson, 1913; Gibson and Concepcion, 1914. Therefore, there is no reason why the imported food articles should be preferred over those raised or produced locally.

Kandule (*Arius spp.*) is an inexpensive fish and is abundant in many Philippine waters. Partly due to its eating habit, some people are prejudiced against it, although it is no worse than a pig in this respect. The flesh of kandule contains a good amount of the amino-acids arginine, histidine and lysine, which are important materials for the building of muscles, (Galvez and Santos, 1932).

Gallan or palauan [*Cyrtosperma merkusii* (Hassk.) Schott] is a tuberous plant that grows in swampy places and in soils that are constantly moist and useless for producing important agricultural crops. It can be grown easily as it needs no special care. A number of food preparations are made from gallan such as jam, bibingka (hot cake), minokmok (powdered boiled gallan, mixed with grated coconut and sugar), suman (finely grated gallan mixed with sugar and grated coconut—wrapped with banana leaves and boiled), palitao or bilobilo (boiled dumpling), and maduya (fritter). It is sometimes used in place of sweet potato tubers in a Spanish viand called *puchero*. In time of famine it may be used as a substitute for rice. The young leaves and inflorescence may be eaten as vegetable and both are rich in growth promoting vitamin, (Gesmundo, 1932).

Latundan is the most popular banana in the Philippines. When compared with the other common varieties, it was found to be the easiest to digest. There is a general belief that *Saba* banana when uncooked is hard to digest. Studies have shown that when Saba is fully ripe it is easier to digest when raw than when cooked, (Santos, et al., 1933).

Seaweeds serve as a vegetable and are eaten in quantity, especially by people who live along the sea coast. They are a good source of the mineral, iodine. However when young animals (rats) were given plenty of seaweeds (70 per cent of the diet) growth was retarded, (Collado, 1926).

A great deal of important work on deficiency diseases has also been done, including pioneering studies on the etiology and cure of beriberi, (Santos and Adriano, 1929; Hermano, 1934). Since beriberi is prevalent in the country, it is natural that more interest should have been given by biological chemists in the Philippines to the anti-beriberi vitamin than to the others. Native fruits and vegetables have been found to contain plenty of vitamin B, but of those examined potato leaves and shoots appear to be the richest. Sprouted mongo or togi, the young leaves and flower of squash and libato (*Basella rubra*, Linn.) are also good sources of this vitamin, (Santos, 1922, 1934; Acuña, 1923; Santos and Santos, 1926; de Jesus, 1927; Santos and Collado, 1928; Hermano, 1930).

Of the fruits, *avocado* is one of the richest in the anti-beriberi vitamin, (Santos, 1922). Since tomato is rich not only in anti-beriberi but also in the anti-scorbutic vitamin, the increased use of it is advised. When eaten at least one raw tomato should be consumed. The popular fruit, lanzones, is poor both in anti-scorbutic, (Hermano and Sepulveda, 1934) and anti-beriberi vitamins, (Santos, 1934).

Beriberi is usually associated with the too exclusive use of polished rice. During the process of polishing, the bran which contains the vitamin is removed. So the eating of unpolished rice is advocated. However, not all unpolished rice is preventive of beriberi. Unpolished Gariñgan Tapucoy rice is poor in anti-beriberi vitamin. In Mindoro many people who used to eat Gariñgan Tapucoy contracted a disease called "lapnus," (Santos and Collado, 1932).

The above very brief review shows that Biological Chemistry in the Philippines was used more as a tool than as a science to be developed; and as such it has been most useful in the advancement both of Philippine agriculture and Filipino nutrition that has taken place during the last twenty five years.

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INDUSTRIES IN THE PHILIPPINES

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During the Spanish regime there were several industries already established in the Philippines. The manufacture of muscovado or concrete sugar, cast iron, lime, salt, leather and pottery were already carried on.

In the early days of the American regime, 1901, a Bureau of Government laboratories was established, which was later changed in 1905 to "Bureau of Science". One of the main objects of the Bureau was to promote the utilization of the commercial and industrial resources of the country and for the collection and dissemination of scientific, technical and commercial information relating to them.

Herbert S. Walker (1910) of the Bureau of Science, made an exhaustive investigation of the Sugar Industry in the Island of Negros during the years 1908 to 1909. The average cost of producing muscovado sugar in that island was given and compared with the cost of making centrifugal sugar. As a result of Walker's intimate knowledge of the local sugar industry he advocated the establishment of modern sugar centrals to produce centrifugal sugar. From 1913 a considerable number of modern sugar centrals were erected in the sugar districts of the Islands with the result that at the present time practically all of our raw sugar exports consist of centrifugal sugar.

In 1913, V. Q. Gana (1915) of the Bureau of Science, made an investigation of the local process of leather manufacture. The result of his investigations with the suggested improvements were published in the *Philippine Journal of Science,* Vol. X, Sec. A, No. 6 (1916).

As a result of Mr. Gana's investigation odorless sole leather is now locally manufactured, but the improvement has not reached the state of producing leather of the same quality as that produced in America. Very little has been done in the utilization of skins for use as upper leather. This phase of the leather industry should receive more attention in the future.

In 1914, Cox and Dar Juan (1915) of the Bureau of Science, made a comprehensive study of the various methods of salt-making as practiced in the Philippines. The method introduced by the Chinese, known locally as "iras inchic" appears to be a most economical process of making salt from sea water by solar evaporation. Cox and Dar Juan determined the proper relation that should exist between the various parts of the salt plant.

The lime manufacture in the Philippines previous to 1914, was made in intermitten kilns. In that year, a small continuous kiln of one ton capacity per day was constructed to supply a sugar central in Calatagan, Batangas. The kiln was constructed along the same lines as the experimental kiln constructed at the Bureau of Science by L. W. Thurlow (1916), modified as a result of the experience acquired in operating the experimental kiln at the Bureau. Since then, modern continuous kilns were introduced to supply the high quality of lime required by the sugar Industry. F. D. Reyes (1928) of the Bureau of Science, made a study of the relative efficiency of the various fuels available for lime burning.

J. C. Witt (1918) made an investigation of the status of the brick and pottery industry in the Islands. Witt suggested burning the bricks at a higher temperature to increase their crushing strength.

W. C. Reibling and F. D. Reyes (1912) made an investigation on the Chemical and Physical properties of cement. Exhaustive tests were also made on the suitability of cement raw materials from Naga, Cebu. As a result of this investigation the Philippine Government decided to establish a cement factory in that locality.

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PHARMACEUTICAL RESEARCH IN THE PHILIPPINES

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A review of the world history of pharmacy and chemistry unveils the wealth of research works undertaken by pharmacists, many of which have been the bases of fundamental discoveries in science. Although the beginnings of pharmacy in the Philippines date much later than in those countries that enjoyed the blessings of earlier civilization, the history of Philippine pharmacy reveals that a number of pioneering researches in pharmacy contributed to the development and progress of science in the Philippines, both during the Spanish period and during the American era.

RESEARCH WORKERS IN EARLY DRUG STORES IN THE PHILIPPINES

Insofar as written records are concerned, some of the foreign scientists, especially the German pharmacists who came to the Philippines to work in the first drug stores in Manila were among the first research workers in science in the Philippines whose studies led to the development of some of the Philippine industries. Friederick Steck, a German pharmacist who later became the owner of Botica Boie in 1835 and Botica de Sta. Cruz in 1865, was the first to work, in 1868, on the distillation of the oil of ilang-ilang (*Canangium odoratum*) on a commercial basis. He worked with his nephew Pablo Sartorius under whose name the ilang-ilang oil was marketed. The Sartorius ilang-ilang oil became commercially known throughout the world when it won the gold medal and highest awards at the expositions in Madrid in 1887 and St. Louis in 1904.[1]

Undoubtedly, the establishment of the Faculty of Pharmacy of the University of Sto. Tomas in 1871, offering a course comprising one preparatory year and a five-year curriculum of pharmacy leading to the degree of Licentiate in Pharmacy which ran parallel with the requirements for graduation in medicine,

[1] Centennial Memorial of Botica Boie Philippine American Drug Company, 1930, 104 p. Manila.

laid the foundation of Philippine pharmacy and chemistry and produced research workers such as Anacleto del Rosario, Leon Ma. Guerrero, Victoriano Luciano, Manuel Zamora, Mariano V. del Rosario, Primo Hizon, and a number of others. Many of the scientific investigations of these pioneer Filipino pharmacists were made in the laboratories of drug stores.

Victoriano Luciano y Simeona, one of the thirteen martyrs of Cavite who graduated from the University of Sto. Tomas on March 20, 1888, was among the first to experiment on the distillation of ilang-ilang and other volatile oils in the laboratory of his drug store. For his scientific works, Luciano was elected "miembro fundador con diploma de honor de la Academia Universal de Ciencias y Artes Industriales de Bruselas," in 1894.

In experimental work, however, the contributions of Anacleto del Rosario y Sales were unequalled by any pharmacist or chemist of the Philippines in his time.

PHARMACEUTICAL BOTANY

The first works in botany undertaken in the Philippines dealt largely with medicinal plants. A brief review of this subject is given by Merrill in his "Historical Sketch of Philippine Botany." [2] In the same volume there is a bibliography of Philippine botany with approximately 1,700 titles. This bibliography covers all available works from 1601 to 1925, and includes a large number of publications dealing with Philippine medicinal plants. Some works on medicinal plants remained unpublished. Elsewhere in this volume, Rodriguez and Bantug mention some of the known works in pharmaceutical botany. Of special interest in pharmacy is the work of Pardo de Tavera on "Plantas Medicinales de Filipinas" and Guerrero on "Medicinal uses of Philippine Plants" and "Notas sobre Plantas Medicinales de Filipinas."

PHARMACOGNOSY

This branch of science was taught under the title of "materia farmaceutica vegetal y animal," in the Faculty of Pharmacy of the University of Sto. Tomas, when the latter was the only existing pharmaceutical institution. Dr. Leon Ma. Guerre-

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[2] Merrill, E. D. 1926. Historical Sketch of Philippine Botany. *In* Enumeration of Philippine Flowering Plants, v. 4:43-56.

ro, who graduated from the tricentenarian university in 1877 as the first Filipino to receive the degree of Licentiate in Pharmacy, is the first Filipino research worker in pharmacognosy. He undertook at the request of the Court of first instance an investigation of over one thousand Chinese drugs of mineral, vegetable and animal origin imported into these Islands without any restriction many of them admittedly poisonous. Considering the facilities then at his command, one cannot but wonder at the manner in which he carried out his investigation "for even fossil mollusks of the first geological ages utilized in the Chinese materia medica have been classified." Unfortunately, for scientists the results of many of the early original scientific works of Dr. Guerrero have not been published, except those already cited, and numerous fragmentary contributions that were mostly printed anonymously in the *Cronicas de Ciencias Medicas de Filipinas*, the *Revista Farmaceutica de Filipinas*, the *Actas, Memorias y Comunicaciones de la Asamblea Regional de Medicos y Farmaceuticos de Filipinas*, the *Revista Filipina de Medicina y Farmacia* and the *Journal of the Philippine Pharmaceutical Association.* During the American era, the original works of Santos (J. K.) on *Chenopodium ambrosioides*, *Alstonia scholaris* R. Brown, *Datura alba* Nees and *D. fastuosa* Linnaeus, *Tinospora rumphii* Boerlage and *T. reticulata* Miers, *Artabotrys suaveolens* Blume, Philippine cinnamon enriched greatly the field of pharmacognostical investigations and constitute the outstanding contributions in Philippine pharmacognosy.

PHARMACY

The early practitioners of pharmacy in the Philippines during the first decades of the eighteenth century were the pioneers who investigated the problems on compounding of prescriptions; but the literature of Philippine pharmacy is silent on this matter owing to the lack of published reports. Zamora studied various galenical preparations, such as extracts, ampules, aromatic vinegars, granular products, household remedies and others. The most important, however, of all his works was the manufacture of extract of tikitiki which he successfully developed on a commercial scale, a work that earned for him the well-deserved name of "savior of children," because this extract cured effectively the young patients suffering from the dreaded diseases of beriberi. Again, the intensive research on rice grains and bran, the preparation and preservation of tikitiki extract, and related subjects, undertaken mainly in the laboratories of the Bureau of Science by a host of investigators solved many perplexing problems that confronted those whose lives have been dedicated to the study of reducing infant mortality in the Philippines.

It may not be amiss to mention at this juncture, that the value of the amazing results of the pharmaceutical, chemical, and biochemical investigations on tikitiki might have been overlooked, if they had not been enhanced by the work of Manuel L. Guerrero, Joaquin Quintos, Jose Albert and other Filipino physicians whose keen observation and spirit of research while in the clinics or at the bed-side decidedly demonstrated the therapeutic effects of tikitiki extract.

The early study on the manufacture of parenteral solutions of various kinds in the Philippines had been made by Hizon and Rodriguez and continued by Hizon (P.) and Hizon (R.). Studies on the widely used ampul preparations made by Feliciano (R.), Santos (A. C.), and Castro, are contributions in galenical pharmacy in the Philippines worth recording. The work of Du Mez on the compounds of emetine and his studies on galenical oleoresins were among the early experimental works in scientific pharmacy in the Philippines during the first two decades of the American era. Works on the preparation of oleoresins, resins, tinctures, fluidextracts, medicinal cigarettes from Philippine drugs, and other galenical products, were also contributed by Feliciano, Valenzuela and collaborators and Faustino Garcia.

One of the important branches of pharmaceutical knowledge is the subject of assaying, which is indispensable in the control of the therapeutic potency of pharmaceutical products. In this line, contributions were made by del Rosario, Marañon, Faustino Garcia, Guevara, Jimenez, Barcelon, Oliveros and others.

The assay of extract of tikitiki as a pharmaceutical problem which is badly needed owing to the existence in the Philippine market of several brands of extract of tikitiki is now approaching its solution. The work of Hemano on the biological assay of extract of tikitiki and the cytological studies of Jose K. Santos on rice, will undoubtedly be the basis of solution of this problem in Philippine pharmacy. Researches on phytochemistry and pharmacology will not be considered in detail in this writing, firstly, because the space is limited and secondly because the work on the two subjects have been reviewed by Marañon and de la Paz.

PHARMACEUTICAL CHEMISTRY

The aims of "iatrochemistry" as propounded by Paracelsus, who believed that the object of alchemy was not the conversion of the base metals into gold but the discovery of medicinal agents for the alleviation of suffering humanity, portray vividly the objects of pharmaceutical chemistry. It may deal with the preparation of inorganic and organic chemicals used in medicine, their properties, purity rubric, and methods of assay, or it may treat of the synthesis of medicinal agents or the isolation and purification of physiologically active constituents of plants or animals. However, all pharmaceutico-chemical investigations aim primarily to obtain the best chemical compounds for the treatment of human ailments. Research works along these lines were undertaken in the Philippines by Perkins and Cruz, who studied the compounds related to the constituents of the oil of chaulmoogra with the object of obtaining a derivative that may prove more valuable than the compounds already known and used. Similar studies were made by Herrera, Santiago and West and de Santos. As to the efforts in isolating and characterizing plant constituents, Bacon, Brill, Wells, Marañon, A. C. Santos, Uichanco (V. B.) and others are the investigators who made valuable additions to the knowledge of the constituents of Philippine plants. The work of A. C. Santos on the isolation of alkaloid and the study of their chemical constitution are the first of its kind ever accomplished in Philippine phytochemistry.

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V. DIVISION OF BIOLOGICAL SCIENCES

PLANT PHYSIOLOGY AND ECOLOGY

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Plant Physiology which deals with the functions of tissues, plant organs, and the behavior of individual plants, "occupies a somewhat uncommon position among the natural sciences". It has "many of the characteristics of a young science, although it is not really such". In several agricultural institutions in the United States it is only quite recently that it has been considered as a separate science. But the study of plant physiology at the College of Agriculture at Los Baños has been taken seriously ever since the establishment of that institution in 1909, the subject being considered as fundamental to agronomy.

The subject of plant physiology had been given little attention in the Philippines prior to American administration. If there had been any report on this phase of plant study it probably was in connection with the work of the Spanish Bureau of Forestry and only as casual observations, nothing based on well planned and carefully conducted experimental studies. For, most of the botanical studies made during the Spanish régime were on the classification and nomenclature of Philippine plants. Perhaps a few of the studies were on wood technology and on the economic value of certain plants. In April of 1902, Dr. Elmer D. Merrill started the establishment of a herbarium for the Philippine Government under the American sovereignty. Four years later, in 1906, Dr. Edwin Bingham Copeland published the results of his extensive experimental studies, "On the water relation of the coconut palm" (*Cocos nucifera*). Records show that this was the first experimental study of plant physiology made in the Islands but it was soon followed by other similar physiological studies. It was also Doctor Copeland, the founder and the first Dean of the College of Agriculture at Los Baños, who included plant physiology in the curricula of that College. In this connection he wrote the following:

> ...having a free hand in planning its course of study, I provided that every student not only could but must take one full year of

plant physiology, and that students taking the course regularly must have this year of plant physiology before being admitted to the study of agriculture itself.

It was thus an experiment and Doctor Copeland had several reasons for making it. Decidedly, the strongest reason, according to him, was the fact that "*the raising of crops is essentially nothing more or less than applied botany*". He strongly believes and he is right that "*the first essential in any scientific agriculture is the understanding of the ways of the plants*". Doctor Copeland's experiment proved a complete success. It withstood the test of time and has been copied by several agricultural institutions outside of the Philippines. His students of the pioneer days of the College are today the principal contributors to our knowledge of plant physiology in the Philippines. For these reasons, to give credit where credit belongs, it can be said that Doctor Copeland is the father of plant physiology in the Philippines.

Plant physiology not only is extensive in scope but of great practical value to agriculture. It deals with the study of absorption and excretion, metabolism, growth and reproduction, movement and irritability and death of plants. Its largest and most important branch is plant nutrition with both the physical and chemical aspects. In the words of Professor Burton E. Livingston, some of the topics dealt with in plant physiology are the following: "water requirements; nutrition by inorganic materials; nutrition by organic materials; the exchange of energy between the organism and its surroundings; the chlorophyll function; respiration, with and without free oxygen; enzymes, activators, hormones, and the general phenomena of catalysis; the control of growth and development, including reproduction; the physiology of movement and its control; and the physics and chemistry of protoplasm". The ultimate aim of plant physiology is to be able to interpret all the life processes occurring in plants in terms of the simple laws of physics and chemistry. However, because of the complexity of the protoplasm and what it can do, and the inadequacy of the present knowledge of physical and chemical laws, the ultimate goal of the efforts of plant physiologists has not yet been reached.

Extensive experimental studies have been made in the Philippines on the physiology of plants, especially crop plants and others of economic value. Most of these studies have been carried out in the College of Agriculture at Los Baños; in the Bureau of Plant Industry (formerly Bureau of Agriculture); in the Bureau of Science, and possibly some in the Bureau of Forestry. These studies, for the most part, have been on salt and fertilizer requirements of plants; also on their water requirements. But, extensive as they have been, such studies only indicate the enormous extent of the things still unknown. There is no dearth of subjects awaiting study. But the right trail is blazed, and with ample financial support, it is hoped that it will only be a matter of time before the goal is attained,—the practical application of the physiological findings to the development of agriculture and forestry in the Philippines.

The branch of botany known as plant ecology has not been experimentally studied in the Philippines as extensively as Plant Physiology. As Ecology deals with plants as influenced by their environment it overlaps plant physiology. Ecology, however, has a scope purely its own. The study of groups of plants, as a society, formation, or association and the study of dominance, invasion of species and other such phases are typically ecological in nature. Plant ecology is applied particularly in connection with the care and management of lawns, natural pastures, and forests. Knowledge of plant ecology is, therefore, especially useful to landscape gardeners, ranchers, and rangers and foresters.

Ecological studies made with forests or forest trees in the Philippines were due largely to the efforts of the Bureaus of Science and of Forestry. The very extensive studies of the vegetation of Philippine mountains and the relation between the environment and physical types at different altitudes made by Dr. William H. Brown, former Director of Science in the Philippines, are quite monumental. The vegetation on the Taal Volcano and in the thermal springs at Los Baños have also been studied. Weeds have been made the subject of careful ecological studies. Other similar studies could be mentioned but space does not permit their inclusion in this report.

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PLANT MORPHOLOGY IN THE PHILIPPINES

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Plant morphology in the Philippines as a branch of botany was practically unknown during the Spanish régime. It was true that in text books which were direct translations of French and German works and were used in private universities and colleges exclusively staffed by Spanish priests, a certain amount of morphological work of very general character was incorporated. Prior to 1900 we may say that practically no serious morphological work was done in the Islands. As is often the case, this period was mainly dominated by taxonomic work,[1] a fact not to be wondered at since the rich flora of the Islands offered a most tempting field to systematists.

During the Spanish-American war in 1898 and the insurrection against the American régime, conditions were not conducive to productive work. However, in the early part of the American occupation, there were some American botanists, who tried to inaugurate courses in cryptogamic and phanerogamic botany and morphology. With the establishment of public secondary and normal schools, and the University of the Philippines, formal courses in botany were made a reality. In those early days there were practically no trained Filipinos in morphology. Much credit is due those "pioneers," who with inadequate facilities, were able to inspire young Filipino students to become interested in this subject. These early foreign botanists were also instrumental in giving a great impetus to what may be called the biological side of botany as distinct from the purely taxonomic aspect of science.

The history of plant morphology in the Islands may be said to date from about the middle portion of the second decade

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[1] ROBINSON, C. B. 1905. The history of botany in the Philippine Islands. *Jour. New York Bot. Gard.* v. 7: 104-112.

of American occupation or even later.[2] The establishment of the Department of Botany in the University of the Philippines, Manila, and of the College of Agriculture at Los Baños, were events of no small importance, and the series of contributions on the morphology of phanerogamic plants which emanated from their laboratories bear witness to the value of their work. Histological studies of barks, leaves, fruits and seeds of Philippine medicinal phanerogamic plants have been the favorite theme, and in this province the influence of the Department of Botany, University of the Philippines at Manila, has been very great.

The study of the organography of the flowers as well as the structures of the embryo sacs, fruits and seeds of seed-plants have been begun in a modest way. A critical study of the stony layer in seeds of gymnosperms has been undertaken. Recently, particular interest is being shown in the solution of the probable causes of sterility and origin of polyembryony among fruit trees. Works on floral biology exclusively of important Philippine crop plants, as rice, sugar cane, and coconut, have also received attention to a considerable extent. The anatomical features of fibers of abaca, agaves, and dicotyledonous fiber plants have been studied also. In these phases of botanical inquiry, the College of Agriculture is the most productive.

Cytology as a specialized branch of botany has attracted very little attention locally, although its importance has long been recognized. This apparent neglect is partly due to inadequate facilities available in our laboratories, and consequently not much has been done on this phase of botany in the Philippines. Cytological work done up to the present time has dealt with the sex chromosomes in *Elodea*, chromosome counts in *Cocos* and *Saccharum* spp., and on the behavior of the chromosomes in triploid Oenotheras.

The morphology of the archegoniate plants, the mosses and ferns, and algae have been practically left untouched. Some

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[2] Copeland (1906) made some studies of the anatomy of the root and leaves of the coconut (*Philippine Journal of Science*, v. 1: 6-54) palm growing in San Ramon, but the writer believes that the first true contribution to the morphology of our plants was done in 1916, when Espino made studies of the structures of the fibers of abaca. (*The Philippine Agriculturist and Forester*, v. 4: 200-230).

work has been done on the fungi, but this has been for the most part taxonomic and on the economic side rather than from the side of pure morphology.

It may be safely said that there is plenty of work still to be done for the science of plant morphology, including cytology, in the Philippines, as this has been barely touched here and there. The problems of the morphologist are endless and range from gross structures to cell structures throughout the plant kingdom. The importance of these problems can not be overestimated, for on such researches, more than on any others, taxonomy has to lean in its attempt to trace the evolution of plants. The creditable showing of local morphologists for the last ten to fifteen years makes one hopeful that in years to come students of plant morphology and cytology in the Islands will not fall behind the record, however meager, they have made.

A RESUMÉ OF THE CONTRIBUTIONS TO THE KNOWLEDGE OF PHILIPPINE MARINE INVERTEBRATA

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"On a yellow carpet of calcareous polyps and sponges, groups of leatherlike stalks, finger-thick, lift themselves up like stems of vegetable growth; their upper ends thickly covered with polyps (*Sarcophyton pulmo* Esp.), which display their roses of tentacula wide open, and resplendent with the most beautifully varying colours, looking, in fact, like flowers in full bloom. Very large serpulites extend from their calcareous tubes, elegant red, blue, and yellow crowns of feelers, and, while little fishes of marvelously gorgeous colour dart about in this fairy garden, in their midst luxuriantly grow delicate, feathered plumulariae."

These words of F. Jagor in his Travels in the Philippines, (1875, p. 245) give a true and vivid picture of our rich marine fauna that can be seen by anyone who takes the trouble to visit the waters of our shores.

Although many early naturalists have visited the Philippines and have made collections of land mammals, birds, reptiles, insects and terrestrial shells, study on our marine invertebrates did not start till towards the end of the 19th century. Hugh Cuming, for example, the eminent English naturalist who lived in the Philippines from October, 1836 to November, 1839, gathered all kinds of animals, excepting fishes and marine invertebrates.

Our marine and terrestrial shells which have been the object of numerous trips and investigations of many early writers are treated elsewhere and will not be discussed in this short paper. Instead, a brief review of the work done in marine invertebrata outside the molluscs and the stony corals is made here to show how much has been done and how much is yet to be done on Philippine marine life.

In the year 1871, the British Government organized the "Challenger" Expedition to make scientific explorations of the physical, chemical, geological and biological conditions of the great ocean basins. The "Challenger" worked in the Philippines from October 20, 1874 to January 26, 1875, working at sixteen different stations. Besides obtaining numerous forms of diatoms, protozoa invertebrate and fishes on the surface and from shallow waters, the Challenger obtained over 860 deep-sea invertebrates and fishes belonging to 385 species in the Philippines. Of these 177 species and 42 genera are new to science and 127 species and 8 genera are not obtainable outside the Philippines. The collection of the Challenger was worked out by a number of famous European Zoologists, all authorities in their respective lines. (See appendix A). The "Challenger" collection, now in the British Museum, is probably the largest collection of Philippine deep-sea forms. Its collection of littoral forms, however, is far from being complete.

An extensive collection of Philippine animals was made by Dr. C. Semper, Prof. of Zoology in Würsburg from 1859 to 1864 in Manila, Bohol and Mindanao. The greatest bulk of this, however, was composed of marine and terrestrial shells. *Sipunculoids* and *nudibranchs* were also obtained and these were worked out by Emil Selenka (1883) and Rudolf Bergh (1897) respectively.

D. José Montero y Vidal in his "El Archipelago Filipino" (1886, pp. 120-136) listed a number of marine crustacea, annelids, tunicates, bryozoa, echinoderms, coelenterates, sponges and infusorians in addition to numerous molluscs. His classification, however, was carried only up to genera and not always reliable.

In 1887, D. Augusto G. de Linares wrote two articles on Philippine marine fauna in connection with the Exposicion de Filipinas in Madrid, the articles appearing in "El Globo". Good descriptions and illustrations of *Euplectella aspergillum, Farrea balaguerii, Semperella schultzei* and *Hyalonema lusitanicum* were given in one article and a detailed description of the arrangement of the spicules of Hexactinellida was given in the other.

The few alcyonarians brought back to Europe by Müller, Jagor and Sanderson were deposited in the Berlin Museum and formed a part of the materials worked out by Walter May (1898, pp. 44, 101, 169) in his revision of the Alcyonacea.

Under the auspices of the Smithsonian Institution, the U. S. Bureau of Fisheries Steamer "Albatross" made extensive collections of littoral, pelagic and bathypelagic marine forms in Philippine waters in 1907 to 1910. The "Albatross" expedition was very thorough and its collection forms the bulk of Philippine marine animals in the U. S. National Museum. The materials were assigned to various authorities for study and the results are published from time to time in the various volumes of Bulletin 100 of the U. S. National Museum as contributions to the biology of the Philippine Archipelago and adjacent regions. (See appendix B)

In 1912, Dr. Murray Bartlett, then President of the University of the Philippines, entered into an agreement with the then Acting Director of the Bureau of Science, Dr. R. P. Strong, to send a joint expedition which would undertake a marine biological survey of the Philippine waters. The University of the Philippines sent Dr. L. E. Griffin and Dr. R. P. Cowles, while the Bureau of Science sent Mr. Alvin Seale. The party collected shore and reef animals in such places as the Tawi-Tawi group and Taytay, Palawan, Albay, Calapan and Port Galera, Mindoro. The members of this expedition settled at the latter place and established there a temporary station for four months, from March 11 to June 18, 1912. The fish collection was given to the division of fisheries of the Bureau of Science while the invertebrates were housed with the Department of Zoology of the University of the Philippines. The alcyonarians and jellyfishes of this collection were worked on by Light (1913-1915) and the crustacea by Cowles (1915).

The greatest bulk of the alcyonarian collection was sent to Prof. Kükenthal, then at the University of Breslau. Small portions were worked on by J. Moser (1919), H. Luttschwager (1914-1922) and K. Kolonko (1926). After the death of Prof. Kükenthal, the part of the collection belonging to the family Nephthyidae was sent to the Zoologisches Museum of Berlin and was entrusted to Prof. J. Moser. When the writer was sent to Europe for alcyonarian study he had the opportunity to examine all these specimens, the types of previously described Philippine species and types from other parts of the world. The 1912 collection together with the materials gathered in recent years formed the basis of his two papers (Roxas, 1933) on Philippine Alcyonaria.

The establishment of the Puerto Galera (Mindoro) Marine Biological Station of the University of the Philippines in 1924 gave impetus to local workers to study our marine invertebrate fauna.

To work on our marine invertebrata here in the Philippines is of course difficult because of the fact that most of the types, if not all, are in foreign museums and institutions, mainly in the Smithsonian Institution at Washington, D. C., British Museum, London and Zoologisches Museum, Berlin. In spite of the handicap, however, a number of contributions on marine invertebrates were made by Roxas (1928) on Echinoidea, by Roxas and Estampador (1930) on Stomatopoda by Sivickis and Domantay (1928) and by Domantay (1931, 1933, 1934) on Holothurians.

Some Philippine marine polychaetes recently sent to the Naturhistoriches Museum at Vienna were worked on by Holy (1934).

With this good start, more attention should now be given to the more practical aspect of marine zoology. The works of Seale (1908-1917) on the sponges and other marine products and those of Talavera (1930) and Talavera and Faustino (1931) should serve as good starting points for the exploitation of our marine invertebrate resources.

APPENDIX A

Contributions to the "Challenger Reports" in which Philippine Marine Invertebrates are Described

Vol. I, ZOOLOGY (1880)

Part 1.—Brachiopoda. By THOMAS DAVIDSON.

Part 2.—Pennatulida. By Professor ALBERT V. KOLLIKER.

Part 3.—Ostracoda. By G. STEWARDSON BRADY.

Vol. II, (1881)

Part 7.—Certain Hydroid, Alcyonarian, and Madreporarian Corals. By Professor H. N. MOSELEY.

Vol. III, (1881)

Part 9.—Echinoidea. By ALEXANDER AGASSIZ.

Part 10.—Pycnogonida. By P. P. C. HOEK, Assist. Zool. Lab. (Leyden).

Vol. IV, (1882)

Part 12.—Deep-Sea Medusae. By Professor ERNST HAECKEL.

Part 13.—Holothurioidea. First Part.—The Elasipoda. By HJALMAR THÉEL.

Vol. V, (1882)

Part 14.—Ophiuroidea. By THEODORE LYMAN.

Vol. VI, (1882)

Part 15.—Actiniaria. By Professor RICHARD HERTWIG.

Part 17.—Tunicata. First Part.—Ascidiae Simplices. By Professor WILLIAM A. HERDMAN.

Vol. VII, (1883)

Part 19.—Pelagic Hemiptera. By F. BUCHANAN WHITE.

Part 20.—Hydroida. First Part.—Plumularidae. By Professor G. J. ALLMAN.

Vol. VIII, (1884)

Part 23—Copepoda. By G. STEWARDSON BRADY.

Part 24.—Calcarea. By N. POLEJAEFF of the University of Odessa.

Vol. IX, (1884)

Part 22.—Foraminifera. By HENRY BOWMAN BRADY.

Vol. X, (1884)

Part 26.—Nudibranchiata. By Dr. RUDOLF BERGH.

Part 28.—Cirripedia. Anatomical Part. By P. P. C. HOEK, Memb. Roy. Acad. Sci. (Netherlands).

Vol. XI, (1884)

Part 31.—Keratosa. By N. POLEJAEFF.

Part 32.—Crinoidea. First Part.—Stalked Crinoids. By P. H. CARPENTER.

Part 33.—Isopoda. First Part.—Genus Serolis. By FRANK EVERS BEDDARD.

Vol. XII, (1885)

Part 34.—Annelida Polychaeta. By Professor W. C. M'INTOSH.

Vol. XIII, (1885)

Part 35.—Lamellibranchiata. By EDGAR A. SMITH.

Part 36.—Gephyrea. By Professor EMIL SELENKA. (Erlangen).

Part 31.—Schizopoda. By Professor G. O. SARS.

Vol. XIV, (1886)

Part 38.—Tunicata. Second Part.—Ascidiae Compositatae. By WILLIAM A. HERDMAN.

Part 39.—Holothurioidea. Second Part.—By HJALMAR THÉEL.

Vol. XVI, (1886)

Part 45.—Stomatopoda. By Professor W. K. BROOKS.

Vol. XVII, (1886)

Part 48.—Isopoda. Second Part.—By FRANK EVERS BEDDARD.

Part 49.—Brachyura. By EDWARD J. MIERS.

Part 50.—Polyzoa. Second Part. Cyclostomata, Ctenostomata, and Pedicellinea. By GEORGE BUSK.

Vol. XVIII, (1887)

Part 40.—Radiolaria. By Professor ERNST HAECKEL.

Vol. XIX, (1887)
- Part 54.—Nemertea. By Professor A. A. W. HUBRECHT.
- Part 55.—Cumacea. By Professor G. O. SARS.
- Part 58.—Pteropoda. First Part. Gymnosomata. By PAUL PELSENEER. (Brussels).

Vol. XX, (1887)
- Part 59.—Monaxonida. By STUART O. RIDLEY and ARTHUR DENDY.
- Part 61.—Myzostomida (Supplement). By Professor L. von GRAFF.
- Part 62.—Cephalodiscus Dodecalophus. By Professor WILLIAM C. M'INTOSH.
  - Cephalodiscus Dodecalophus. By SIDNEY F. HARMER. Appendix to Part LXII.

Vol. XXIII, (1888)
- Part 72.—Heteropoda. By EDGAR A. SMITH.

Vol. XXIV, (1888)
- Part 52.—Crustacea Macrura. By C. SPENCE BATE. (One Vol. text and one Vol. plates).

Vol. XXV, (1888)
- Part 63.—Tetractinellida. By Professor W. J. SOLLAS.

Vol. XXVI, (1888)
- Part 60.—Crinoidea. Second Part. Comatulae. By P. HERBERT CARPENTER.
- Part 73.—Actiniaria (Supplement). By Professor RICHARD HERTWIG.

Vol. XXVII, (1888)
- Part 69.—Anomura. By Professor J. R. HENDERSON.
- Part 76.—Tunicata. Third Part. Pelagic Tunicates. By Professor WILLIAM A. HERDMAN.

Vol. XXIX, (1888)
- Part 67.—Amphipoda. By Rev. THOMAS R. R. STEBBING. (Two Vols. text and one Vol. plates).

Vol. XXX, (1889)
- Part 51.—Asteroidea. By W. PERCY SLADEN. (One Vol. text and one Vol. plates.)

Vol. XXXI, (1889)
- Part 64.—Alcyonaria. By Professor E. PERCEVAL WRIGHT and Professor TH. STUDER.

Vol. XXXII, (1889)
- Part 80.—Antipatharia. By GEORGE BROOK.
- Part 81.—Alcyonaria (Supplement). By Professor TH. STUDER.

APPENDIX B

Contributions to Bulletin 100, of the U. S. National Museum in which Philippine Invertebrates are Described

(Excluding molluscs and corals)

Vol. I.
- Part 3.—Scyphomedusae. By A. G. MAYER.
- Part 4.—Chaetognatha. By E. L. MICHAEL.
- Part 5.—Hydromedusae, siphonophores and ctenophores. By H. B. BIGELOW.

Part 6.—The relationships of the general calcarina, Tinoporus, and baculogypsina as indicated by recent Philippine material. By J. A. CUSHMAN.
Part 8.—Polychaetous annelids. By A. L. TREADWELL.
Part 10.—Polyclad turbellarians. By T. KABURAKI.

Vol. II.
Part 1.—The Salpidae. By MAYNARD M. METCAEF.
Part 2.—The Salpidae. By MAYNARD M. METCAEF.
Part 3.—Pyrosoma. By MAYNARD M. METCAEF and HOYT S. HOPKINS.
Part 4.—Silicious and Horny Sponges. By H. V. WILSON.

Vol. III.
Starfishes. By W. K. FISHER.

Vol. IV.
Foraminifera. By J. A. CUSHMAN.

Vol. V.
Ophiurans. By R. KOEHLER.

Vol. VI.
Part 2.—Additions to the Polychaetous annelids. By A. L. TREADWELL.
Part 3.—Hydroida. By C. C. NUTTING.
Part 4.—Echinoidea, Part 1. The Cidaridae. By TH. MORTENSEN.
Part 5.—Four new species of polychaetous annelids. By A. L. TREADWELL.

Vol. IX.
Bryozoa. By F. CANU and R. S. BASSLER.

APPENDIX C

List of Work on Philippine Marine Invertebrates
(Excluding molluscs and corals)

BERGH, RUD. 1870. Semper Reisen Philippinen. Die Nudibranchien.

COWLES, R. P. 1913. The Habits of Some Tropical Crustacea. *Philip. Jour. Sci.* v. 8D:119-124.

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LIGHT, S. F. 1914. Another Dangerous Jellyfish in Philippine Waters. *Philip. Jour. Sci.* v. 9B:291-295.

LIGHT, S. F. 1915. Notes on Philippine Alcyonaria. Part III: Two new species of Lithophytum Forskal from the Philippines. *Philip. Jour. Sci.* v. 10D:1-10.

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PROBLEMS IN PHILIPPINE FISHERIES INCLUDING ICHTHYOLOGY AND HERPETOLOGY

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Records show that the Philippine Government became interested in fishery work in 1907, when the Bureau of Science engaged the services of a fishery expert from the United States. This interest gained momentum with the detail of the S. S. "Albatross" of the United States Bureau of Fisheries to do exploration work on the marine fauna of our waters (1907-10). The first concrete government policy relative to the program of work to be pursued in the development of our aquatic resources was promulgated by the Bureau of Science in consultation with Dr. Hugh M. Smith and other fishery experts of the staff of the S. S. "Albatross".

This work was given further encouragement by the creation of a Division of Fisheries in 1921, and the enactment of Act No. 3307 in 1926 and Act No. 4003, in 1932. Act No. 3307 provided for the strengthening of the Division of Fisheries while Act No. 4003 set aside a sum not to exceed ₱100,000 a year from fees accruing under its provisions for the promotion of our fishing industry. Finally in 1933, a division of Fish and Game Administration was created in the Department of Agriculture and Commerce and was vested with the power of carrying out the provisions of Act No. 4003 (Fisheries Act) in addition to the function performed by the Division of Fisheries of the Bureau of Science.

FISHERIES

Fishery refers to the business of catching, marketing, and preserving fish and other forms of aquatic life. As trustee of these aquatic resources it is incumbent upon us to see that the sources of this wealth be protected and conserved. To this end, we need information on the following: (1) ichthyology; (2) animal biology such as (a) embryology, (b) development, (c) spawning and brooding habits, (d) age and rate of growth,

(e) sexual maturity, (f) feeding habits, (g) migratory habits and drift of the spawn; (3) statistics as to (a) catch per unit of effort or gear, (b) species, size-groups and percentage of young in the catch, (c) fish population in a given bank; (4) methods of catching; (5) water pollutions; (6) and condition of waters as to oxygen content, pH, etc.

Ichthyology.—Philippine ichthyology has not been neglected. To date no less than 1700 species of fish are known and recorded here and at least forty European, American, and Filipino ichthyologists and specialists contributed to the systematics of Philippine fishes.

Fish and fisheries biology.—This is the phase of fishery work that should be given serious consideration in order to promote the development of our fishery industries. It is only within the last few years that contributions on this subject began to appear, most of them dealing only with fresh-water fish and fisheries contributed by the College of Agriculture at Los Baños.

Studies in embryology and development should be pursued in order that the critical periods or stages in the life history of the animals might be discovered. The time to protect the fish can therefore be ascertained. Periods of spawning and brooding are necessary guides in the promulgation of closed seasons, regulations for purposes of protection, conservation, and rehabilitation of depleted fisheries. Age, rate of growth, and size at sexual maturity should give the bases for the standardization of mesh openings of nets or openings of other traps for the purpose of making possible the easy passage of young and immature individuals.

Studies on feeding habits are necessary information in fish cultivation. These studies may also help in the determination of migratory habits. Migratory habits will furnish the information as to where and when to protect spawning as well as the larval fishes. Information on the drift of the spawn will indicate if the spawning ground or area will have to be protected.

Another important problem connected with fishery work that has not received due attention in the Philippines is the gathering of statistics on catch per unit of effort or gear, percentage of young in the catch, size-groups present in the catch, and the passage of year classes in pelagic fishes. These data are important criteria in ascertaining whether or not a given fishery is under-going depletion. Such study was initiated in the Limnological Station of the College of Agriculture at Los Baños five years ago. The depleting condition of the kanduli (*Arius spp., Ariidae*) fisheries of Laguna de Bay was ascertained by these observations.

Methods of fishing.—In the last few years the Bureau of Science, the Fish and Game Administration and to a certain extent the College of Agriculture have been quite active in the study of fishing methods used in the different parts of the Philippines. This work should be continued but must be supplemented with the analytical examination of the composition of catches in order to make such studies useful. In this way it may be determined whether or not a fishing gear is destructive to a given fishery.

Fishing banks.—Only preliminary surveys have so far been done with our fishing banks. The extent of these fishing areas, the nature of their bottom, their depths, currents, and distribution of food supply and plankton organisms should be determined. This information is necessary to ascertain the type of gear suitable for each kind of fishing bank. It is also essential for the development of our fishery industries to map out both depleted and virgin fishing areas for such resources as commercial fishes, sharks, sponges, corals, oysters, seaweeds, trepang, crabs, shrimps and others. In order to accomplish this end, we should be provided with a suitable fishing boat equipped with fishing gears, and apparatus necessary for exploration work of this nature.

Water pollutions.—This is important in connection with fish culture and conservation of fish in rivers, ponds and lakes. The present laws to prevent industrial wastes and sewage disposals in reaching these bodies of water should be enforced. Laguna de Bay would perhaps produce a much larger bulk of fish than its present yield were it not for the highly polluted and disturbed condition of the Pasig River. If it were not for the absence of oxygen one meter or more below the surface many of our fresh-water lakes would accomodate an abundance of fish life.

Aquiculture and fish introduction.—The most important problem of our highly developed bañgos pond industry is the conservation of the bañgos fry. Natural nurseries of bañgos fry should be protected and the catching of spawning individuals should be regulated. Our Government should continue to establish and maintain model fish farms especially in places where the people are newly becoming interested in aquiculture.

The pond-raising of gourami, an imported fresh-water fish from Java should be encouraged. Marginal lowland rice paddies and abandoned "sacatal" should be turned into gourami fish-ponds.

Studies on the cultivation of mullets, oysters, window shell oysters, sponges, crabs, shrimps, seaweeds and other aquatic resources should be undertaken.

But fish introduction in the Philippines should be looked upon as an extremely delicate proposition. The carp introduction should serve as a good example, although it is hoped that this fish will still prove to be a valuable food here. The introduction of the black bass seems to be a failure since it fails to thrive in the lowlands. The American catfish which was recently brought here should be given a trial in our swampy regions such as the Candaba swamps of Pampanga, Bayambang, Pangasinan, and similar situations.

Preservation and utilization of fishery products.—One of our greatest needs is improvement in the native methods of fish preservation as well as the evolution of better ones. The establishment of fish preservation stations at Estancia, Iloilo and Catbalogan, Samar, is indeed in the right direction. More of such stations should be established at different fishing centers.

There is also need for developing the industry of utilizing the fish by-products in the manufacture of fish meal, fertilizer, varnishes, liver oil or emulsions, pearl essence, etc.

We should also improve the methods of refrigeration so that the supply of fresh fish may be continued during the entire year. Improvements should also be sought in preserving fish by smoking, salting, drying, pickling, marinating and fermenting.

Canning fish and other aquatic products also deserves serious consideration here.

HERPETOLOGY

The work in Philippine herpetology is more or less extensive as far as its systematics are concerned. In the monographs * published by E. H. Taylor, he gives a complete list of collectors and workers responsible for the present knowledge in the systematics of Philippine herpetology.

What is needed at present is to encourage investigations and studies on the biology of these animals so that those of economic value, either as food or predators of insect pests may be given due protection from the inroads of man. So far the only contributions on the biology and feeding habits of some Philippine frogs and lizards are papers by the writer and his students from the College of Agriculture.

As to economic herpetology, the Bureau of Science has undertaken some preliminary experiments on the production of anti-venom injections from Philippine cobra. This valuable experiment should be continued and other species of snakes may be used.

Recently, there had been great demand for skins of lizards, snakes, and crocodiles for the manufacture of articles of art and commerce. Steps should be taken to protect these animals from extermination.

From time immemorial our sea turtles have supplied our commerce with articles for the manufacture of high quality of tortoise shell products. These animals should also be amply protected in order to conserve the supply.

Frog legs are regarded as an excellent food in Filipino homes. Even our common frog, *Rana vittigera,* which is too small to yield good legs for the table are taken in large numbers for the market. The large frog, *Rana magna,* is not abundant enough to fill the demand. Recently (July 31, 1934) the Fish and Game Administration of the Department of Agriculture and Commerce brought here from the United States breeding stock of the American bullfrog, *Rana catesbiana* for purposes of propagation in our country.

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* Amphibians and turtles of the Philippine Islands. Bureau of Science Publication No. 15. Bureau of Printing, Manila, 1921; The snakes of the Philippine Islands. Bureau of Science Publication No. 16. Bureau of Printing, Manila, 1922; The lizards of the Philippine Islands. Bureau of Science Publication No. 17. Bureau of Printing, Manila, 1922.

FISHERY LAWS AND REGULATIONS

For lack of sufficient data on the biology of our food fishes and the absence of complete surveys of our fishing banks, our present regulations relative to the conservation of our fishery resources need revision from time to time as these data become available.

The present system in the administration of our municipal fisheries in which each municipality exercises direct control of municipal waters is conspicuous for the absence of protective measures, or if regulations are promulgated, they are defective and monopolistic. In this way these public resources become the exclusive properties of a select few who take advantage in dictating their own prices. The administration of the fisheries of Lake Taal and the Pansipit River in Batangas is a case in point. These fisheries which are worth at least ₱100,000 a year are sold to the highest bidder by the municipalities of Taal and Lemery every five years.

Moreover municipal fishery ordinances are not uniform so that they are by no means effective in protecting or conserving fishes in waters touching two or more towns. Centralizing the control and administration would remedy this defect.

The apparent lack of appreciation on the part of the public of the value of conservation constitutes the most serious obstacle to the enforcement of whatever good, constructive laws we have at present or that may be enacted in the future. This obstacle may be remedied by more extension work with the end in view of bringing about proper understanding between the Government and the fishermen.

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[1] Appendix to "Problems in Philippine Fisheries including ichthyology and herpetology" by Deogracias V. Villadolid.

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THE DEVELOPMENT OF MAMMALOGY IN THE PHILIPPINES

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Mammalogy is an undeveloped science in the Philippines. In spite of the work of such notable men as Cuming, Mearns, Whitehead, Steere, Hollister, and a few others, much still remains to be known along this line of study here.

The work on Philippine mammalogy has been confined mainly to collecting and systematic classification. Aside from these, very little is known here of this field. A review of the work that has been done will help enlighten those who are interested in this branch of Philippine Zoology.

PHILIPPINE MAMMALOGY DURING THE SPANISH REGIME

The history of Philippine mammalogy may properly be linked with the early voyages to the Philippines. The first known record of Philippine mammals, however, was that of William Dampier who remarked about the marked abundance of wild hogs in the woods of Mindanao which he visited in 1686.

A paper containing a list of Philippine animals was first published by Jacobo Petiver during the early part of the eighteenth century. The materials were supposed to be supplied by the Jesuit missionary, George Joseph Camel, who made what probably was one of the earliest, if not the earliest collection in the Philippines.

Petiver's publication was followed by many others which dealt with the enumeration of the Philippine mammals collected and the descriptions of new forms. These publications were based mainly on the collections made by such European collectors as Friederich Eschscholtz (1823-1826), Fortune Eydoux and Paul Gervais (1830-1832), Hugh Cuming (1836-1840), F. Jagor (1859-1861), A. H. Everett and J. Whitehead. Prof. J. B. Steere as early as 1887, also collected animals in various parts of the Philippines. Studies based on his collections were published chiefly by A. Gunther, D. G. Elliot, N. Hollister, G. M. Allen, and by Steere himself. The Menage Expedition to the Philippines was able to make a small collection.

Of the collections made during this era, two were most notable; those of Hugh Cuming and of John Whitehead.

European collectors and scientists were most active in the work on Philippine mammalogy during this period. With the change of sovereignty there was also a change of interest in the science.

PHILIPPINE MAMMALOGY DURING THE AMERICAN REGIME

Shortly after American occupation of the Philippines, Major Edgar A. Mearns, an experienced mammalogist, started his collection of what undoubtedly is the largest single collection of Philippine mammals. The collection totalled more than one thousand specimens containing 93 species and subspecies, 54 of which were made the types of new species and subspecies, and 8 as types of new genera. G. S. Miller, N. Hollister, and Mearns himself published the results of studies made from this collection.

Mearns collected from a very large number of localities and islands, the most important of which was Mt. Apo.

The most recent notable collection was brought together by Edward H. Taylor. Although approximating that of Mearns in size and number of species, his collection contained fewer new forms. Taylor himself published a monograph based largely on his collection. So far, this is the latest publication on Philippine mammals.

Aside from these two major collections, there are also recorded minor individual collections such as those of: George C. Lewis, Dr. C. Fox, D. B. Mackie, L. M. McCormick, Dr. P. Bartsch, Wm. D. Carpenter, and Dr. J. C. Hardy.

The Bureau of Science Collection mostly brought together by R. C. McGregor and A. Celestino consisted originally of about 98 specimens representing 26 species.

THE PRESENT STATE OF PHILIPPINE MAMMALOGY

The work that has been done on Philippine mammals is still very meager if one considers the extent of the territory that is not yet intensively worked out. Most of the collections were confined to only a few places, and, even in well known localities such as Mt. Data and Mt. Apo, a more intensive and thorough collecting will doubtless yield still other new forms. Many of the small islands do not have even a single record of a mammal.

The most fertile fields for collecting which will undoubtedly yield many new forms include the mountains along the eastern part of northern Luzon, in addition to several isolated islands. More careful and thorough collecting is needed before the answers to problems such as: the real mammalian distribution in the Philippines; faunal relationship between islands and island groups; faunal relationship between the Philippines and the surrounding land masses; and many other problems whose solutions are not as yet known until our knowledge of Philippine mammalogy is adequate.

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ORNITHOLOGY IN THE PHILIPPINES

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Ornithology has been defined as the science which deals with the study of birds. Like other branches of natural history, the intricate problems dealing with the studies of birds are grouped into two phases, viz., systematic and economic.

SYSTEMATIC ORNITHOLOGY: ITS HISTORY AND DEVELOPMENT

The history of Philippine ornithology may be traced back to the beginning of the eighteenth century when the collection of Philippine birds by the Moravian Jesuit, George Joseph Camel, supplied the materials for the earliest memoir on exotic birds that has come down to us. For nearly two centuries these islands had been nothing more than a veritable collecting ground for foreign naturalists. Travellers, members of the clergy, and crews of mercantile vessels picked up birds here and there and took them to Europe where they were identified. The novelties of Philippine birds aroused the interest of great European museums which later sent expedition here. Specimens of Philippine birds are now prized possessions of those institutions, which, moreover, were responsible for the early literature on Philippine birds. Sonnerat, Kittlitz, Lindsay, Eydoux, Jacquinot, Jagor, Layard and many others were the early explorers collecting birds in this archipelago, while such names as Gray, Martens, Sharpe, Walden, Salvadori, Marquis of Tweeddale and Everett are linked with the literature on Philippine ornithology.

The fame of the Philippines as a collecting ground crossed the Atlantic about the middle of the nineteenth century. In 1870 the first American collecting expedition was undertaken by Dr. Joseph B. Steere. This expedition was later responsible for the development here of an ornithological institution and for this reason the succeeding events will be described in a more detailed manner. Dr. Steere stayed here four years. Disregarding the obstacles he encountered during the first trip, Dr. Steere returned to the Philippines and was here with three assistants during the years 1887-1888. One of his assistants was Dean C. Worcester, then a student in zoology at the University of Michigan. It may be of interest to emphasize here that Steere's second expedition had in some way an influence over the present political make-up of this country. When this party returned to the United States, Worcester and Bourns, the latter another assistant of Steere on his second trip, looked for means to enable them to come again to the Philippines, and in the years 1890-1893, the two gentlemen were here on a private collecting party.

It is not intended to show that the collection of birds here during the last half of the last century was done exclusively by Americans. European naturalists like Everett, Marche, Guillemard, Chadenberg, Platen, Schmacher, Whitehead, among many others, also collected birds here.

The advent of American occupation marked a new era in Philippine ornithology. Based on Mr. Worcester's familiarity with Philippine conditions, he was appointed a member of the first commission. Under his direction, a section of ornithology was created in the organization of the new government. It was under the Philippine Government Laboratories, later called the Bureau of Science. Mr. Worcester continued his contributions to Philippine ornithology in addition to his vast duties as member of the commission. Mr. Richard C. McGregor was in charge of the section. Inasmuch as all ornithological work in the Philippines since the American occupation was done under the direction of Mr. McGregor, the description of the activities of his office would be tantamount to the enumeration of the activities in the science of Philippine ornithology.

In spite of the other duties assigned to him and despite lack of assistance, Mr. McGregor made a tremendous contribution to the knowledge of Philippine birds, particularly along sytematic lines. He built the finest collection of Philippine birds now in existence.

Mr. McGregor described birds from nearly all parts of the archipelago and made compilations of nearly all existing literature relating to Philippine ornithology. Jointly with Mr. Worcester, "A Handlist of the Birds of the Philippine Islands", was published in 1906. In 1909 the publication was enlarged with corrections and agenda into, "A Manual of Philippine Birds" was continued primarily by Americans stationed here for other duties and by foreign collectors. Some of them were those of Major Mearns of the U. S. Army, of Governors Forbes and Wood and of Marquis Hachisuka of Japan. Marquis Hachisuka's keen interest in Philippine ornithology was manifested by his publication of "Birds of the Philippine Islands," the first volume of which appeared in 1931-1932.

ECONOMIC ORNITHOLOGY

As in other zoological lines, studies along the field of economic ornithology, or "the study of birds from the standpoint of dollars and cents" follow those of systematic ornithology.

About 20 years ago, the Bureau of Science attempted to popularize the value of birds in the destruction of insect pests. That aroused public sentiment so that the Philippine Agricultural Congress in session voted its appreciation of the work done in that institution. Lack of financial aid, however, did not permit that Bureau to carry out its program.

Studies bearing on the relation of our wild birds to agriculture, horticulture, forestry and fisheries, are of paramount importance. Studies along this line are therefore being carried out. How much of the program can be covered cannot now be ascertained. However, despite lack of adequate assistance the birds frequenting rice fields have been studied. The economic value of two species of rice birds have been determined. It is generally accepted that the relation of birds depends mainly on the character of their food, and this is determined in several ways: (1) by field observation, (2) by experiments with newly captured birds, and, (3) by examination of stomach contents in the laboratory. The last is considered the method most satisfactory. During a period of nearly three years, about 5,000 stomachs have been examined and data are now available for determining the value of a few species of birds.

Game.—There are no data on hand, but it cannot be denied that with the development of our highways, and the advent of the improved methods of transportation and contrivances for killing birds, the number killed for game has increased tremendously within recent years. In view of this, the distribution, abundance and habits of the game birds are being studied in order to provide the sportsmen adequate sport without impairing the normal number of the birds.

The steps taken by a group of local sportsmen who, about twenty years ago introduced a number of game birds here, should be mentioned. At least three attempts are known to have been made in introducing game birds here from China. According to information, a number of pheasants, Chinese francolins, and Daurian quails were liberated in a few places near Manila, particularly in Balagbag, near Fort Wm. McKinley, Rizal Province. Observations made during the last two years indicated that the last two species are holding on, while no record is known of the pheasant.

Edible birds' nests and guano.—The harvesting and commercial utilization of bird products which at present is confined to the edible nests of certain species of birds await a working ornithologist to improve and develop in order to be a real source of income to the government.

Large breeding grounds of sea birds had been noted by early ornithologists as occurring in Palawan and in several isolated southern islands. Exploitation of those areas may prove beneficial to the country through their guano deposits.

Introduction of foreign birds.—There are a number of foreign non-game birds that have been introduced into the Philippines either intentionally or unintentionally principally through the traffic of caged-bird fanciers.

The earliest known record of an intentional introduction was that of the crested myra, *Aethiopsar cristatellus.* The birds were introduced by Spanish authorities in about the year 1850 with the object of combating the locust plagues which devastated local crops. Partial studies made within the last few years indicate that the species is fulfilling its mission and in addition to locust, it feeds on many other species of harmful insects.

Two species which are obviously destructive have, in recent years, been observed to establish themselves in the Islands. The agency of the introduction of the mountain sparrow *Passer montanus* is not known, while there is every reason to believe that the Indian red munia, in the market known as strawberry finch, *Amandava amandava,* was established here through the dealers of caged-birds.

SUMMARY

For about two centuries, ornithology in the Philippines was confined to the collecting of birds, mostly by European naturalists. Interests of American naturalists in Philippine birds commenced about the middle of the last century.

With the appointment of an American ornithologist to the first Philippine commission, who had charge of all scientific work under the government, a section of ornithology was created. Early achievements of that section were largely along lines of systematic ornithology.

When the systematic ornithology was thought to be on a solid foundation studies along the economic lines were begun. Investigations on the relation of birds to agriculture, horticulture, forestry and fisheries were started a few years ago. At present data on about 5000 stomachs of birds are available.

In addition to the examination of stomach contents observations should be made to determine the habits of birds including those of game birds, birds building edible nests, sea birds depositing guano, and caged-birds imported from time to time.

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HISTORY OF PLANT BREEDING IN THE PHILIPPINES

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INTRODUCTION

As generally understood, plant breeding is cross-breeding plants or plant hybridization. The term implies "improvement" or "amelioration" of plants. In its modern and broader aspect, plant breeding would cover all the phenomena of plants, including structure, habits, yields and other physical characteristics that are amenable to change and control by man. Therefore, in considering the achievement in plant breeding in the Philippines when it is a new phase in agricultural practice, it is well to remember that plant breeding as an agricultural practice should have a definite purpose in view in the production and development of new plant forms either by introduction of varieties, selection, crossing or any other means useful in improving the hereditary qualities of plants.

Scientific plant breeding is not so simple a practice as is generally supposed. It may be considered as a plain but serious business to be conducted by carefully trained persons in a painstaking and methodical way. It is a line of work which demands special training based on a previous study of the underlying principle of genetics. Plant genetics as a biological science developed rapidly only since the rediscovery of Mendel's law in 1900.

A knowledge of the fundamentals in genetics is essential if the student of crop or plant breeding is to pursue his work in the most logical manner. A study of genetics, therefore, should precede the practice of the art of breeding.

I. BEGINNING OF PLANT BREEDING IN THE PHILIPPINES

The inclusion of a course in plant genetics known as Agronomy V (Plant Breeding) in the curriculum of the College of Agriculture, University of the Philippines at Los Baños, in the academic year 1912-1913 under the charge of the late Dean Charles Fuller Baker marked the beginning of plant breeding instruction as well as investigation in the Philippines (Mendiola, 1920, 1921). In 1916 the College of Agriculture sent Doctor Mendiola as a pensionado of the Philippine Government to Cornell University to major in Plant Breeding. In 1918, upon Doctor Mendiola's return to the Philippines, he reorganized the courses of study in plant breeding and genetics. Two undergraduate courses, Elementary Genetics and Methods of Plant Breeding, and a graduate course, Elementary Biometry were then instituted. Although the courses were all elective, they proved to be popular among the students. At present the following courses on the fundamental principles and the practical applications of plant genetics are given in the College of Agriculture: For undergraduates, Principles of Breeding, Breeding Tropical Crops, and Advanced Sugar Cane Breeding. For graduate students, Advanced Genetics and Advanced Methods of Breeding Tropical Crops.

II. PLANT BREEDING RESEARCH AND INVESTIGATIONS IN THE PHILIPPINES

The instruction in genetics served as an avenue to the wide field of research and investigations on the improvement of Philippine crops. At about the time the course in plant genetics was opened in the College of Agriculture two senior students were assigned plant breeding research subjects, one on hybridization of tobacco and another on hybridization of corn. The tobacco hybrids (Tirona, 1914), and the corn hybrids (Mendiola, 1914) constitute the first results of the applied science of plant breeding in the Philippines. As the genetics courses became more elaborate and comprehensive, investigations and experimental studies along the lines of variation, heredity, mutation, Mendelian phenomena, crop biometrics, and pure line selection of different crop plants in the Philippines proceeded steadily, although slowly. The slowness was due partly to the fact that only two government institutions, the College of Agriculture and the Bureau of Agriculture, were engaged in plant breeding studies and also that the research funds granted were inadequate either for the proper prosecution of genetic projects or for the training of personnel.

But despite the infancy of plant breeding and genetic science in the Philippines, it may be said that what has so far been accomplished compares favorably with the achievements along similar lines in Java, India, and other tropical countries. The book entitled "A Manual of Plant Breeding for the Tropics", by Dr. N. B. Mendiola, which was published in 1926 by the

University of the Philippines, gives a condensed though comprehensive presentation of what had been achieved in the Philippines along plant improvement from 1914 up to 1925. Very recently Doctor Mendiola proposed a new and operative method of plant improvement. The method is of outstanding significance as a milestone in the development of plant genetics for it is based largely on Philippine-grown materials (Mendiola, 1932, 1933). In line with the most recent advances in breeding the writer has just begun a long range investigation on the relation of cytology to plant improvement. This angle of genetic research is concerned with the relation of chromosomes to sterility, fertility, vegetative luxuriance and other agronomic features of various varieties, mutants and hybrids of crop plants.

In the following paragraphs are recorded briefly the different crop breeding studies and investigations which have been completed in the Philippines.

1. RICE BREEDING

Rice, being the staple crop of the Philippines, has received major attention in breeding and genetic studies. Along selection studies are those of Jacobson (1914), Gutierrez (1918), Goco (1918), Romero (1918), Mendiola (1920, 1932), Montemayor (1924) and Rayos (1924). Correlation works on varieties were reported by Jacobson (1916), Peralta (1919), Vibar (1921), and Capinpin (1923). Variety tests were begun by Morada (1921). Pollination studies and artificial and natural crossing work were reported by Torres (1923, 1927, 1930), Rodrigo (1925), and Mendiola (1927). Some biological and genetic aspects of rice grains were observed by Jacobson (1914), Mendiola (1918, 1932), Unite (1921), Rodrigo (1926), and Reyes *et al.* (1933). The agronomic and plant breeding values of rice seedlings were investigated by Torres (1924) Rodrigo (1924) and Calvo (1927). A study on the improvement of rice by inbreeding and selection was conducted by Juachon (1933), and Juachon and Mercado (1933).

2. CORN BREEDING

The most outstanding contributions on corn have been by Mendiola (1914) and Marquez (1918) on hybridization; by Goco (1921) and Mendiola (1932) on selection; by Mendiola (1920, 1921) on breeding for disease resistance; by Mariano (1920) on correlation of characters; by Isidro (1934) on effect of detasseling on yield; by Macasaet (1918) and Bautista (1918) on agronomic and breeding values of distancing and intercropping; and by Morada (1921) on variety testing. The evolutionary value of the ear of local corn was studied by Mendiola (1920).

3. SUGAR CANE BREEDING

The Philippines probably ranks not far behind Java in the production of superior cane varieties by breeding and selection. Cane breeding in the Philippines was begun by Doctor Mendiola in 1918. The perfection of a system of recording pedigrees of cane seedlings, the development of crossing and nursery technique, the efficient methods of rapid propagation, and the production and introduction of novel and superior seedling cane varieties have been possible through the initiative and guidance of Doctor Mendiola. Later, the Bureau of Agriculture (since divided into the bureaus of Plant Industry and Animal Industry), the Philippine Sugar Association, and some sugar centrals established cane breeding stations. The greater part of the personnel conducting the work in these stations received their training in cane breeding in the College of Agriculture.

The different cane seedling types which have been bred in the Philippines have been described by Mendiola (1919, 1920, 1921, 1922, 1924, 1928), Roxas (1919, 1928) and Unite (1932). The biology of cane flowering was investigated by Paglinawan (1925) and Mercado (1926, 1929). Variation and selection in cane seedlings and hybrids were studied by Morales (1928) Florida (1929) and Legaspi (1932). The genetic and plant breeding values of wild types of other species of *Saccharum* were investigated by Perez (1933) and Creag (1933). A key for identifying canes was proposed by Mendiola (1922, 1930). The breeding from mosaic-free cane was first reported by Unite and Capinpin (1926).

The sugar cane bred in the College of Agriculture bears C. A. C. numbers; those bred by the Philippine Sugar Association, P. S. A. numbers and those produced by the Bureau of Agriculture, P. I. numbers.

4. TOBACCO BREEDING

Tobacco is considered one of the money or cash crops of the Philippines. Along with the development of cultural practices in growing this plant, steps for its genetic improvement have also been instituted. The hybridization of tobacco conducted by Tirona (1914) led to a new aspect of the tobacco industry (Mendiola, 1915). Introduction and tests of cigar wrapper and cigarette types were performed by Paguirigan (1916), Leaño (1916) and Gutierrez (1928). Other experiments on tobacco hybrids have been reported by Gutierrez (1924) and David (1926). The correlated characters in the tobacco plant were studied by David (1925). To economize and simplify the technique of pollination, a study of the efficiency of different materials for bagging tobacco flowers was conducted by De la Cruz (1929).

5. FRUIT BREEDING

In the study of methods for the improvement of fruits, hybridization and discovery of bud variation and mutation proved to be effective. The improvement of papaya through the isolation of hermaphroditic races was first reported by Baker (1914). The pineapple breeding conducted in the College of Agriculture may be considered a forward step in Philippine pomology. The native variety of pineapple was much improved by crossing with other forms of pine and exceptionally fine new pineapple seedling varieties were created by hybridizing the introduced varieties. Full accounts of pineapple breeding, probably the most outstanding in the tropics, are given in the papers of Mendiola (1924) Capinpin (1928) and Mendiola, Capinpin and Mercado (1934). On the lanzon, investigations on seedlessness through the occurrence of bud mutations or otherwise were conducted by Mendiola (1922). On the mabolo and pomelo similar studies were made by Capinpin (1933, 1934). Teratological forms and freaks and their inheritance have been reported on the banana by Capinpin (1926), Mendiola (1922, 1929) and Capinpin and Mercado (1931).

6. BREEDING OF PERMANENT CROPS

Because of the slow growing nature of coconut and abaca they are not good materials for genetic research, hence very few studies for their improvement have been conducted. Certain phases, however, of breeding and selection in coconut were made by Aldaba (1921) and Maceda (1933); and in abaca by Mendiola (1923). A beginning has been made on keeping a performance record of individual coconut trees (Mendiola, 1926). The variability of tensile strength of commercial fibers of abaca were reported by Tirona (1932).

7. BREEDING OF SOME OIL-BEARING PLANTS

The limited improvement by breeding in this class of plants has been attained by selection and seasonal tests on sesamum (Zulaybar, 1914), (Samonte (1919); and by variety tests of tañgan-tañgan (Carandang, 1921).

8. VEGETABLE BREEDING

Acclimatization tests, selection and variability studies on cowpeas, beans, mungo, peas, soybeans and other garden crops have been reported by Constantino (1916), Galang (1916), San Miguel (1916), Dacanay (1916), Layosa (1918), Maceda (1919), Rodrigo (1928), and Caguicla (1933). Crossbreeding of varieties in eggplant (Bayla, 1918) and in cowpeas (Capinpin, 1933) are the only reported studies on hybridization.

9. BREEDING ROOT, STARCH AND FORAGE CROPS

Of the root crops, the sweet potato breeding conducted by Mendiola (1921) constitutes another landmark in Philippine plant breeding. Cassava breeding was also initiated by the College of Agriculture. Variety tests and introduction of improved varieties are lines of work which have been accomplished in the improvement of cover crops (Mendiola, 1928) and on root crops by (Sison, 1921 and Roque, 1924).

10. BREEDING OF ORNAMENTAL PLANTS

Primarily ornamental plants have been used as materials for breeding to develop novel types, and secondarily to derive additional genetic facts from these groups of plants. Bud variation in Codiaeum by Mendiola and Magsino (1922); somatic segregation in hibiscus (Mendiola, 1931), hybridization of hibiscus (Mendiola, 1925); Mendelian inheritance and seminal variation in gardenias (Capinpin, 1925, 1927); inheritance of leaf lobes and sterility phenomena in hibiscus (Mendiola, 1926, 1927), are some investigations which revealed important genetical discoveries in these species. New types of seedling hibiscus were obtained by Mendiola and Capinpin (1923) and Mendiola and Unite (1924). Gladiolus hybrids have recently been produced by Capinpin and Dawis (1934).

11. BREEDING FOR DISEASE RESISTANCE

According to a paper by Mendiola and Ocfemia (1916), the work of breeding disease-resistant crop plants in the Philippines was initiated in the College of Agriculture. Some results have already been attained in breeding disease resistance in sugar cane as indicated by the studies of Mendiola (1923) and Unite and Capinpin (1926).

12. INTRODUCTION OF IMPROVED VARIETIES OF PLANTS

The introduction of crop varieties which may prove superior to the existing types in a given locality is a phase of the plant breeding program which was adopted by the College of Agriculture in its earliest days, and by other government institutions engaged in plant investigations. Among the species which have been successfully introduced in the College of Agriculture are Kawisari B coffee (Mendiola, 1931), Java selected Hevea clons (Mendiola, 1931), oil palm (Mendiola, 1931), quinine (Mendiola, 1927), Ramai rice (Aragon, 1930) and improved chico seedling (Gonzalez, 1932). Some coffee varieties introduced in the College lost resistance to coffee rust (David, 1928); some hybrid and seedling types of Irish potato (Capinpin, 1933) did not thrive well under conditions in Los Baños. The two most promising species of *Nephelium* introduced from Java (Mendiola, 1934) constitute valuable additions to choice fruits in the Philippines.

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C. CORN BREEDING
D. SUGAR CANE BREEDING
E. TOBACCO BREEDING
F. FRUIT BREEDING
G. BREEDING PERMANENT CROPS
H. BREEDING SOME OIL-BEARING PLANTS
I. BREEDING VEGETABLES
J. BREEDING ROOT, STARCH AND FORAGE CROPS
K. BREEDING OF ORNAMENTAL PLANTS
L. BREEDING FOR DISEASE RESISTANCE
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A HISTORICAL RÉSUMÉ OF PHILIPPINE ENTOMOLOGY

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On the island of Palawan, writes Antonio Pigafeta in *The First Voyage Around the World by Magellan* (Hakluyt Society), there "are found certain trees the leaves of which, when they are free, are animated and walk. They are like the leaves of the mulberry tree, but not so long; they have the leaf-stalk short and pointed, and near the leaf-stalk they have on each side two feet. If they are touched, they escape; but, if crushed, they do not give out blood. I kept one for nine days in a box. When I opened it, the leaf went around the box. I believe those leaves live on nothing but air." Pigafeta's account of Palawan leaf-insects as he saw them in 1521 is apparently the first recognizable written record of Philippine insects. Aside, however, from this and perhaps similar random accounts by casual travellers, no entomological work was undertaken in the Philippines until the nineteenth century.

The first entomological investigator in the Philippines appears to have been Johann Friedrich Eschscholtz, who, as physician and naturalist on the Russian ship *Rurik*, visited the Islands in 1816 (Essig, 1931, 617-622). More entomological collectors followed later, especially after 1830, the year of the opening of the port of Manila to the world's commerce, as then foreigners other than Spaniards became less subject to annoying restrictions. The results of the activities of these hitherto unwelcome aliens marked the opening and, in many cases, important fundamental chapters in Philippine entomology.

One of these pioneer foreign explorers was Hugh Cuming, the famous English conchologist. He visited the Islands, first in 1831 and again in 1840, and collected in the interior, not only of Luzon, but also of Mindanao and many of the smaller islands, which were then extremely difficult of access (Melvill, 1895). Although interested primarily in shells, Cuming amassed in addition a large quantity of Philippine insects. Some of the earliest known species of Philippine Hemiptera, reported on by Dallas (1851) were described from Cuming's material that found its way to the British Museum. Likewise, his specimens, together with those obtained in later years by Carl Semper, formed a large part of the basis for the first catalogue of Philippine Coleoptera by Baer (1886). One of Cuming's beetles which Baly (1858) named *Promecotheca cumingi*, in his honor, was to obtrude insistently on public attention a century after its discovery, as the notorious coconut-leaf miner.

Hemiptera Insularum Philippinarum (1870), by Carl Stal, the famous Swedish entomologist, who is generally considered as the father of modern hemipterology, and *Die Schmetterlinge der philippineschen Inseln: Rhopalocera* (1886-1892); *Heterocera* (1896-1902), by Georg Semper, a German zoologist, are both milestones in Philippine entomology for all future work on Hemiptera, Homoptera, and Lepidoptera. The material used in the preparation of these publications was collected by Carl Semper, a brother of Georg, during his travels in different Philippine localities from 1859 to 1865. Carl Semper was unquestionably the most successful of all entomological explorers in nineteenth-century Philippines; he must have gone into the work with exceptional vigor, combing for insect forms the least frequented wilderness even in the high mountains of Luzon, Palawan, Bohol, and Mindanao. His Hemiptera and Homoptera alone numbered 520 species, or nearly one-third of the total in this group that is known at the present date. Most of these species were then new to science.

In the Philippines at present, Lepidoptera is the best known order, with about 1,825 recorded species, according to Schultze's (1928) estimate. When we consider that in Carl Semper's collection his brother recognized 1,519 species (612 butterflies; 907 moths), we can appreciate the characteristic German thoroughness with which this collector worked. A considerable number of these had, of course, been previously recorded from the Philippines as a result of activities of other collectors, notably the German savant Hans Herman Behr in 1848, the adventurous French lawyer-naturalist Pierre Joseph Michael Lorquin in 1856 and in 1862, and the German lepidopterist Otto Staudinger. The last named sent collectors to the

Philippines and on the material gathered, published, in 1899, his *Lepidoptera von Palawan.*

Other groups of insects, likewise, received attention, as, for instance, on the part of the French Baron Edmond de Selys-Longchamps, leading world authority of his time on dragonflies and damselflies, who published a paper on *Odonates des Philippines* (1891). The same Stal who studied Semper's Hemiptera also worked up his orthopteran material and published a paper, *Orthoptera nova ex Insulis Philippinis* (1877).

The number of foreign collectors and the scientific reports that ensued gradually increased markedly. The Philippines was becoming better known entomologically in Europe and, to some extent, also in America. Resident workers during this period, however, appear to have been few and far between. Along faunistic lines, two publications of local production may be noted, namely, Ramon Jordana's *Bosquejo geográfico é historico-natural del Archipiélago Filipino* (1885), which was published in Madrid, and the Dominican Father Casto de Elera's *Catálogo sistemático de toda la fauna de Filipinas conocida hasta el presente,* 3 volumes (1895-1896), University of Santo Tomas Press, Manila. The latter work in particular represents an enormous undertaking. Volume 2, "Articulados," lists over four thousand species, most of them being supported by specimens then extant in the Santo Tomas Museum. Bibliographical citations are conveniently complete. In this volume, insects occupy the first 525 pages; Chilopoda, Diplopoda, Arachnida, Crustacea, Rotifera, Annelida, etc., the remaining 71 pages of the text; while 72 additional pages are devoted to index. Unfortunately, in spite of the book's limiting title, a number of extra-Philippine forms were included, so that, although the localities are specified in each case, a somewhat confused idea of the Philippine fauna results. This work was awarded a diploma of merit in the Philippine regional exposition, which was held at that time in Manila. Both Jordana and Elera were general zoologists, and not entomologists.

Toward the closing decades of the nineteenth century, resident collectors were beginning to appear, especially in the persons of Alexander Schadenberg, who was one of the German founders of Botica Boie, Regino Garcia and Father Francisco Sanchez, S.J., science professor at the Ateneo de Manila, and his illustrious former pupils, Dr. José Rizal (during his exile at Dapitan), and the Guerrero brothers (Doctors Leon and Luis). None of them published on their materials, but they placed these in the hands of European specialists.

Biological studies of insects, which are admittedly so essential in formulating control of injurious species and utilization of beneficial forms, were conspicuous by their almost total absence. Domingo Sanchez y Sanchez, an assistant zoölogist in the Government Forestry Service, published a paper on a coffee longhorned borer, entitled *Memoria sobre un insecto enemigo del cafeto* (1890). In the *Boletin Oficial Agricola de Filipinas,* issued monthly by the Agronomical Service during the years 1894, 1895, and 1896, is a general article on insects that are injurious and insects that are beneficial to the farmer, another on the cultivation of the mulberry and silk culture, two articles on white grubs, three on locust control, one on possibility of commercial utilization of locust fat, one on peanuts and one on Ilocos cotton, in which incidental mention is made of insect pests. The writers, with one or two exceptions, showed only an amateurish acquaintance with insects. They all were obviously field agronomists who had to take in insect control as a very minor incident in their work. One exception was Francisco Alcarraz (1895), who, although not an entomologist, proved himself a careful and accurate observer of insects. His report on migratory locusts, their natural control by heavy rains and wind, preference for the plains rather than higher mountain altitudes for oviposition, rate of march of migratory hoppers, relation of activity to sunshine, and similar characteristics, which, by the way, represented the earliest observation of this kind in the Philippines, has been confirmed by later workers. It might be pointed out at this juncture that locusts, above all other agricultural pests, have seriously engaged the attention of the Government since very early times. One cannot help but see, indeed, a striking revelation of the innate conservatism of human nature when he reads the startlingly modern note of the following paragraph in the "Ordinances of Good Government," which were originally promulgated by Governor-General Don Sebastian Hurtado de Corcuera in 1642 and revised by Governor-General Don Fausto Cruzat y Góngora in 1696 (Blair and Robertson 5: 211):

"The Indians, both men and women, must be made to destroy the locusts that do so great harm to the crops throughout the Islands, especially the young, called *locton,* which are so destructive and can be killed easily, as they have no wings. Each person shall be charged during certain days or weeks to kill so many gantas of this destructive pest, under penalties that shall be imposed for neglect. Neglect by the alcaldes-mayor and corregidors in this law shall mean deposition from office, and a change in their residencia."

Another writer in the *Boletin,* José Sanchez (1894), noted the preference of the cockchafer *Leucopholis irrorata* Chevrolat, which he misidentified with an European species as *Melolontha vulgaris*, for soil rich in humus for oviposition. Incidentally, not a single insect species in the *Boletin* bears a correct determination, despite all the taxonomic work previously done on Philippine insects by renowned European specialists, so that the pests referred to can be recognized only by the native names given in the articles.

The successful introduction of a starling, locally known as "martinez," *Aetheopsar cristatellus* Linnaeus, from southern China between the years 1849 and 1852, "in order to control the locusts" (Blair and Robertson 51: 127) proved of value in later years, inasmuch as this bird immigrant has been effectively utilized in controlling army worm infestation. This introduction represents the earliest attempt at biological control of insects in the Philippines.

The cochineal insect (introduced first in 1826 and again in 1861), mulberry, and silkworm were among other nineteenth-century importations of beneficial insects, which, however, met with failure. An illuminating account is given by Zuñiga in his *Estadismo,* Vol. 1, pp. 29-30 (Blair and Robertson 50: 48-51, footnotes) of an attempt at silk culture, through the impetus given by the Sociedad Economica de los Amigos del Pais in 1781: "As this tree grows as easily as a weed in this country, in a short time were seen around the [estate] house [in San Pedro Tunasan, Laguna] extensive and beautiful plantations of these trees which could produce an abundant harvest of excellent silk. Silkworms were imported from China and it was seen that they multiplied readily. Not only on this estate, but in all directions, the promotion of this industry was taken up with ardor. A considerable quantity of silk was made; but on selling it the owners found that they lost money in cultivating this article. When a calculation was made of what the land which the mulberry tree occupied could produce, it was found that even when it was planted with nothing more than camote it yielded them more than the silk did; add to this the care of the worms and the cost of manufacture and it will be found that those who devote themselves to its culture must inevitably lose. . . . . The rector of San José [College, owner of the estate,] alone continued to manufacture the silk that was yielded from the mulberry trees which he had planted, although at last he had to abandon the project."

Scientific work in economic entomology in the Philippines, as a major activity, was in reality an aftermath of American occupation. The earlier varied projects of the United States army research staff included entomology, of which one of the most important results was the discovery that the malaria mosquito can breed only in clear running water, and not in ponds and marshes, as in Europe or America. This valuable finding, however, remained unnoticed in army files until after its rediscovery by researchers of the Rockefeller Foundation stationed in the Philippines. Through military efforts, likewise, the common species of American bumblebee, *Bremus americanorum* (Febricius), was introduced into the Mountain Province, Luzon, for the purpose of fertilizing the clover which was raised for the army horses and mules. However, this species apparently did not become permanently established, although at least two indigenous forms of bumblebees are commonly caught on flowers in that locality.

To Charles S. Banks belongs the distinction of being the first Government entomologist in the Philippines, with his appointment in 1902 to organize an entomological section in the Bureau of Government Laboratories (later the Bureau of Science). At about the same time, two other very enthusiastic workers were engaged, as a sideline to their regular duties in the Manila Observatory, in carrying out observations on various plant pests, largely Lepidoptera and parasitic Hymenoptera. These were Father William A. Stanton, S. J., assistant director of the Weather Bureau, and Father Robert E. Brown, S. J. Their interesting notes were included in the monthly bulletins of the Weather Bureau in the years 1903, 1904, and 1905.

With the opening of the College of Agriculture at Los Baños, in 1909, and the organization of an entomological section in the Bureau of Agriculture, Manila, in 1910, entomological work in the Philippines received its much needed reënforcement. More problems relative to insects received their proportionate share of attention, including life histories and other biological peculiarities of various major insect pests as a basis for control, host relationships, insecticide tests, relation of environmental factors to insect outbreaks, plant quarantine, and scores of others. Some lucky breaks led to the discovery of new facts or new methods in economic entomology, such, for instance, as Mitzmain's (1913) proving that surra is transmitted by the common horsefly, *Tabanus striatus* Febricius, Mackie's (1917) development of a process for fumigating cigars in partial vacuum to destroy beetles, and Ocfemia's (1934) results on the sugar cane leaf-hopper, *Perkinsiella vastatrix* Breddin, as a specific vector of the Fiji disease in the Philippines. A review of the large number of entomological articles, mainly in *The Philippine Journal of Science, The Philippine Agriculturist,* and *The Philippine Agricultural Review* (since 1930 *The Philippine Journal of Agriculture*), from the pens of local workers cannot be undertaken with justice in a brief article of this nature. However, those interested may turn to the partial summaries given in the papers by Otanes (1925), by Merino, Teodoro, and Otanes (1925), by Teodoro and Otanes (1925), by Uichanco (1929, 1934), and by Lopez (1929-1932), and to the general indices of the *Philippine Journal of Science.*

Perhaps too much stress has been laid in the present paper on the systematic results of various investigators. However, it is plainly the first problem of an entomologist, in whichever branch he may be engaged, to acquire a fairly adequate knowledge of the local insect fauna as a setting for his work. To this end, Philippine economic entomologists have much to be grateful for in the fruitful results of the activities of collectors, who, by the way, did not pass out with the nineteenth century. Although there have been scores of recent collectors, Charles Fuller Baker, who was professor of agronomy and subsequently dean of the College of Agriculture from 1912 until his death in 1927, and his Cuban collector, Julian Valdez, whom he paid out of personal funds, did more than any other individual to augment our knowledge of Philippine insect fauna. With a total of 115 world authorities on various insect groups working on his material, whose reports were embodied in over 400 papers, the known number of insect species of the Philippines was increased to a hitherto unprecedented extent. But of paramount importance is the fact that his inspiration as a teacher and example as a tireless worker have exerted a profound influence on the training of the present corps of entomologists in the various government branches, nearly all of whom were his intellectual foster children.

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PHILIPPINE PALEONTOLOGY

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Philippine paleontology is essentially a study of invertebrate paleontology as up to this time very few vertebrate fossil remains have ever been encountered. As a matter of fact outside of lone specimens of *Stegodon* teeth from Mindanao, *Elephas* teeth from Pangasinan, shark's tooth from Mindoro, and some Mammalian teeth, probably of antelopes, from Pasig, Rizal, Philippine formations have so far yielded only invertebrate fossils.

The first mention of Philippine fossils was made by Baron Richthofen (1862) when he reported the finding of specimens of Foraminifera in Binangonan Peninsula, Rizal Province. Later Felix Karrer (1880) described some Foraminifera from the Zambales mountains. Still later Philippine fossil Foraminifera were described by Douvillé (1911) and by Yabe (1919, 1925, 1929).

Radiolarians, corals, echinoderms, and mollusca have been described by Smith (1906, 1913), Dickerson, (1921, 1922), and others in a few publications, but the most important work and the one which may be considered the foundation of Philippine paleontology was made by Karl Martin (1896) who on account of his work in the Dutch East Indies was able to recognize certain horizons in the Philippines by the presence of *Vicarya callosa* Jenkins and its associated fauna.

On account of the fact that in the Tropics during the tertiary period the climatic changes were slight, the evolution that has taken place has proceeded much more slowly and the changes have not been as well marked as compared with those in the Temperate regions. Philippine geologic and paleontologic history must be read with this difficulty and much comparative material both recent and fossil must be accumulated in order that sub-specific differences may be recognized. Thorough familiarity with recent fauna is, therefore, absolutely necessary and students of Philippine stratigraphy, paleontology, and geologic history must begin with the study of the existing marine fauna in and about the archipelago. Attention at this point may be called to Cushman's "Foraminifera of the Philippine and Adjacent Seas", Bartsch's studies on Philippine Mollusca, the writer's "Recent Madreporaria of the Philippine Islands" and his "Summary of Philippine Marine and Freshwater Mollusks."

Attention must be called to the fact that guide fossils are extremely rare and reference of Philippine Tertiary formations to standard divisions will have to be made after a careful notation of the percentage of living species present and this percentage will be very different from those recognized in Europe or America but will approximate the figures set by Karl Martin in Java and the other islands of the Dutch East Indies.

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ARCHAEOLOGY IN THE PHILIPPINES

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The term archaeology as applied to Philippine antiquities has reference primarily to the less perishable objects which were in use by the ancient Filipinos prior to and during the discovery and settlement of the islands. These objects occur over the greater portion of the islands and are principally of stone implements, burial jars and fragments of Chinese, Siamese and local pottery. In some parts of the islands, particularly in dry caves and cliffs, and in certain other protected places, wooden objects and like material have been recovered, usually in connection with burials.

The three principal sources furnishing archaeological remains are burial places, sites of ancient villages of greater or less extent, and quarry sites where the natives obtained flints, soapstone and other material for implements and ornaments. Some of the so-called surface finds were probably articles lost by the natives, but the great majority of the finer objects found in cultivated fields were undoubtedly plowed from shallow graves in which the skeletons had wholly disintegrated.

Real archaeological investigation and collection of archaeological objects have just been recently undertaken in the Philippines. In the beginning there was hardly any real archaeological investigation. Since the beginning of the seventeenth century foreign travellers have casually found some archaeological objects in some parts of the islands, particularly in Luzon, Bisayas and Mindanao. These objects were collected and used as their private collection. It was Professor H. Otley Beyer, Head of the Department of Anthropology, University of the Philippines, and a few other American scientists who really made an investigation and a collection of archaeological objects. He undertook the Rizal archaeological survey from 1926 to 1930. He has collected many stone implements and fragments of Chinese and Siamese porcelain and stonewares dating from the Sung, Yuan, Ming and Ching dynasties of China. Recently the National Museum of the Philippine Islands, with its limited funds has made some archaeological investigations and collections of archaeological objects from the provinces of Sorsogon and Batangas. With sufficient funds to finance its undertaking and trained men to do archaeological work the National Museum can carry out its plan of investigation and collection of archaeological objects extensively.

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THE TASK OF ETHNOGRAPHY IN THE PHILIPPINES

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The study of the races of man is always of great interest. This is especially true in the Philippines, where the most distinct people live representing the greater part of the races of the globe, in some instances pure, in others mixed since very remote times. Here man presents himself with the greatest variety of characteristics conceivable, as has been noted by eminent ethnologists. Beginning with the Negrito and ending with the Chinese and European mestizos, all the races are represented in these islands.

Our task is to impart a knowledge of the Philippine groups as we find them to-day throughout the Philippines. Formerly, owing to long established practice, no Philippine groups were considered with any attention, except those that were already Christianized or civilized. It is true that some foreigners have already made some casual observations on some of the ethnic groups in the Philippines, yet their opinions are far from complete and many times conflicting. It should be the duty of ethnography to apply itself more faithfully to the neglected or uncivilized ethnic groups of the Philippines. Its aim must be to take up this conception of humanity not in a merely superficial way but to trace actually among the lower ethnic groups the processes which have rendered possible the transition to the higher developments of to-day. We shall therefore bestow a thorough consideration upon the external surroundings of the various Philippine groups, and endeavor to trace the historical developments of circumstances in which we find them to-day. The geographical conception of their surroundings, and the historical consideration of their development, will thus go hand in hand. It is only from the combination of the two that a just estimate can be formed.

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MEDICAL AND VETERINARY PARASITOLOGY IN THE PHILIPPINES: SOLVED AND UNSOLVED PROBLEMS

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The investigation of parasitological problems in the Philippines started soon after the occupation of the Islands by the United States in 1898. Prior to that time, that is, during the Spanish régime, parasites were not seriously considered as health hazards even in the more enlightened countries of Europe so that it could hardly be expected that parasitology would have had its early local adherents.

There are then two plausible reasons why parasitological research should have been encouraged during the early days of American Occupation. One of them is the fact that the change in sovereignty occurred during that period in the history of medicine when epoch-making discoveries were being made in different parts of the world on the relation of animal parasites to disease. Before that time medical thought was dominated by bacteriology which was considered as the science which deals exclusively with living organisms as pathogenic agents. Another reason was the belief that the Philippines, because of its tropical climate and its primitive sanitary system, would be a rich field for parasitological investigations. When, therefore, the Bureau of Government Laboratories, which was the precursor of the Bureau of Science, was organized in 1901 for the purpose, among other things, of conducting investigations into the nature, prevention and treatment of prevailing infectious diseases, workers in parasitology formed a conspicuous group among the members of the new institution. It can be said of those early scientists that they laid down the foundation for parasitological research in the Philippines. They did very creditable work and their publications show that they were aware of nearly all of the important problems that needed to be solved. If they did not accomplish more than they reported, it was perhaps because no one else could have done better with the knowledge and facilities then available.

SOLVED PROBLEMS

Endamoebiasis histolytica.—This disease, which is due to infestation with *Endamoeba histolytica*, is even now often confused with bacillary dysentery. Due to its prevalence it was one of the first major problems to attract attention. Strong and Musgrave (1900) were the first to record its presence in the Islands and to distinguish it from bacillary dysentery. In 1904 and 1906 Musgrave and Clegg reported the cultivation *in vitro* of amoebae obtained from water and human faeces. These authors did not distinguish between the different types of amoebae and the conclusion to which they arrived that all amoebae are or may become pathogenic only served to add to the then already existing confusion regarding the identity of the amoeboid organisms found in the human intestine. Fortunately Walker (1911) and later Walker and Sellards (1913) reinvestigated the question of human endamoebiasis and their results helped to clear up the confusion. Quoting from Hegner and Taliaferro's Human Protozoology, "Walker (1911), besides conclusively demonstrating the existence of two species in man, definitely showed that the amoebae which Musgrave and Clegg cultured from faeces and which occur in the water supply of Manila were free-living amoebae, non-pathogenic to man, and furthermore that they could be cultured from faeces simply because their cysts had been ingested and had passed through the body unchanged. Walker and Sellards (1913) continued this work by carrying out a carefully planned series of infection experiments on human beings which showed how man acquired his infection and indicated the relation of man to the parasites (carriers of *E. histolytica*, etc.). In 1912 Vedder showed for the first time that the specific action of ipecac in amoebic dysentery is due to the alkaloid emetine. This was also a very important contribution, for it placed the treatment of human endamoebiasis on a strictly scientific basis. In 1924 Haughwout reported his observations on the differential diagnosis of tropical dysenteries based on the cytology of the stools. In 1923 Sellards and Leiva contributed to the pathology of the disease by observing the effect of stasis on the development of ulcers in the intestine of cats infected with *E. histolytica*.

Malaria.—A historical resumé of malarial investigations in the Philippines has recently been published by Russell (1934), for which reason the disease need not be included in this paper.

Schistosomiasis japonica.—This disease is caused by the blood fluke, *Schistosoma japonicum,* the occurrence of which in the Philippine Islands was first reported by Wooley (1907). In 1922 Mendoza-Guazon noted its prevalence in the islands of Samar and Leyte, where it constitutes a serious public health problem. For a long time the intermediate host of the parasite remained unknown, which probably explains why it had not received due attention from sanitarians. Recently Tubangui (1932) demonstrated that the intermediate host is a small, amphibious snail, *Blanfordia quadrasi.* With this knowledge it should now be possible to formulate concrete plans towards the control of the parasite.

Euparyphiasis ilocana.—This is due to the presence in the human intestine of the fluke known as *Euparyphium ilocanum.* It was discovered in the stools of a prisoner in Bilibid Prison and was named by Garrison (1908) as *Fascioletta ilocana.* As the name suggests and as confirmed by Hilario and Wharton (1917), the parasite is common among the inhabitants of Northwestern Luzon. In 1931 Tubangui encountered the fluke in wild rats in Manila, showing that it has a wider geographical distribution than was formerly believed. In 1933 Tubangui and Pasco worked out the life cycle and showed that the parasite utilizes two snail intermediary hosts. One of these snails is the ampullarid, *Pila luzonica,* commonly known as "cuhol" in Tagalog. This mollusk, which harbors the infective stage of the fluke, is often eaten raw or in an insufficiently cooked state by the people of Northwestern Luzon. This explains why the parasite is limited to a certain group of people.

UNSOLVED PROBLEMS

Of the many parasitological problems that remain to be solved, the following are considered among the most important.

Trypanosomiasis evansi (surra).—This disease affects horses, cattle and carabaos, but is especially fatal to the former. It is not known how long it has existed in the Philippines. The first authentic record of its occurrence is that by Smith and Kinyoun in 1901 when the epizootic appeared in and around Manila and killed large numbers of United States Army horses and mules as well as native ponies. It has since that time been the subject of inquiry by many investigators, but very little of practical value has been accomplished. The chemotherapeutic studies so well initiated by Strong and Teague (1910) should be continued and improved upon until a drug is found or a method of treatment discovered that will really cure the disease. Equally important from the strictly scientific point of view are further studies on the transmission of the causative agent, *Trypanosoma evansi*, from one host to another. It has only been established thus far (Mitzmain, 1913) that the infection is conveyed in a purely mechanical manner by blood-sucking parasites, especially by the horse-fly, *Tabanus striatus*. Attempts to find a true intermediary host, that is, one in which the trypanosome undergoes cyclical development, as in the case of the African trypanosomes in their relation to tsetse flies, have thus far failed. Kelser (1927) came to the conclusion that in equine trypanosomiasis, at least, the mode of transmission is purely mechanical, contending that if the infection were brought about by permanently infected insect vectors, the horse population of the Philippines would have been wiped out long ago. Only well-planned experiments, however, could show that such is really the case.

Human paragonimiasis.—The occurrence of the lung fluke, *Paragonimus westermani*, in the Philippines was first recorded by Musgrave in 1907. This is a dangerous parasite, producing in man symptoms very similar to those of tuberculosis. It does not seem to be confined in its distribution to any particular region but it appears to be especially prevalent in the Bicol region, Samar and Leyte. Its life cycle has been worked out in Japan and elsewhere, but in the Philippines its intermediate hosts have not yet been determined.

Fluke infestations in domesticated animals.—Cattle, carabaos and other ruminants in many parts of the Islands are often found infested with trematode worms, of which the following species are the most common: *Fasciola hepatica*, *F. gigantica*, *Paramphistomum explanatum* and *Fischoederius elongatus*. The first two species are found in the liver and are commonly known as liver flukes, while the other two invade the rumen. These parasites are of economic importance due to the fact that animals infested with them, especially with the liver flukes, become cachectic and emaciated. In very severe infestations a large percentage of animals may die. Specific recommendations for the control of these worms are not available due to our lack of information regarding their intermediate hosts.

Hookworm disease in man.—It has been shown by the numerous surveys in intestinal parasitism that have been conducted in the Philippines that the incidence of hookworms is quite high. The medical significance of the infestation, however, has not been definitely determined. The earlier workers observed that the parasites produce no ill effects on Filipinos and they attributed this either to the lightness of the infestations (Gomez, 1911) or to the fact that Filipinos are racially immune to hookworms (Schwartz and Tubangui, 1922). On the other hand Leach and his collaborators (1923) and Manalang (1925) reported the existence of typical hookworm disease in Cebu and it appears from their records that the parasites are a public health problem in that island. In view of the generally recognized importance of hookworms from both the medical and economic standpoints, this ill-defined status of the infestation should not be allowed to continue much longer. Further investigations should be carried out in order to determine accurately to what extent the parasites are a menace to the health and working capacity of the people.

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PHILIPPINE MYCOLOGY AND PHYTOPATHOLOGY

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The existence of fungi and the prevalence of plant diseases have long been known, but their respective science, "MYCOLOGY" and "PHYTOPATHOLOGY," are so modern as to require an introduction in a report of this kind. It therefore becomes necessary at the outset to supply this introduction to form a proper conception of these sciences and a background for knowing what may be reported here regarding the development of PHILIPPINE MYCOLOGY AND PHYTOPATHOLOGY.

MYCOLOGY.—The study or investigation of fungi is called *Mycology.* The work on mycology naturally falls into four main divisions or lines of activities, namely: (1) Systematic mycology; (2) Industrial mycology; (3) Medical and Veterinary mycology; and (4) Agricultural mycology.

Systematic mycology is concerned with the scientific naming of the species of fungi in accordance with the principles and rules adopted for the assignment of fungus names called nomenclature; and with the grouping of fungi in conformity with the principles of classification based upon the genetic relationships known as taxonomy. A large amount of systematic work must first be done before definite progress can be made in the more economic aspect of mycology.

Industrial mycology deals with the conditions brought about by fungi, such as the decomposition or fermentation of milk, vinegar, bread, beer, "nata", manures; the molding of candies, cigars and leathers; and the deterioration of fibers, glass, etc. Parasitic fungi or fungi which are endowed with the power of producing disease in animals or plants are called pathogenic, and their study falls into two or three classes of mycology, according to the kinds of the infected hosts as follows: *Medical mycology* in the case of human beings, *Veterinary mycology* in animals, and *Agricultural mycology* in the case of plants. Collectively, these three classes may be grouped under one head "PATHOLOGICAL MYCOLOGY", which then deals with pathogenic fungi and therefore aims at their exclusion and annihilation.

PHYTOPATHOLOGY.—With the recognition of the existence of various other micro-organisms (such as bacteria and other microscopic parasites, example, nematodes), affecting plants, together with the occurrence of various diseases for which no specific causes are known to have exhibited any mode of parasitic etiology and which are called "physiological" or "non-parasitic" diseases, including virus diseases, and the development of the methods and technique employed in parasitology and bacteriology, the scope of the science of plant diseases is no longer the science of fungus diseases (agricultural mycology) alone, but also of all abnormalities in plants. Thus, the science, in its broader scope, becomes what is at present known as "PLANT PATHOLOGY" or "PHYTOPATHOLOGY"—the science of plant diseases and their control.

INSTITUTION ENGAGED IN MYCOLOGICAL AND PHYTOPATHOLOGICAL WORK

The Government institutions engaged in various mycological and phytopathological activities are the College of Agriculture, University of the Philippines, in Los Baños, Laguna, and the Bureaus of Plant Industry and Science, in Manila. The Department of Plant Pathology of the College of Agriculture does the teaching of and research work on the subjects. The Mycology Section of the Division of the National Museum of the Bureau of Science as well as the Plant Pathology Section of the Plant Sanitation Division of the Bureau of Plant Industry do research work too, but all the regulatory and extension work is done by the said division of Plant Industry alone, so that the latter bureau is responsible for the protection of crops in the Philippine Islands against disease.

The present epoch of the growth and development of mycological and phytopathological activities in the Philippines has its beginning from the inauguration of mycological work in the Bureau of Science in 1911, and from the first course of fungus diseases of plants offered in the College of Agriculture in the summer of 1913. The real instruction, however, was started in that same institution in 1916, and five years later in 1920, the erstwhile Bureau of Agriculture (now Bureau of Plant

Industry) and the Bureau of Science inaugurated their cooperative phytopathological research work.

Briefly, the activities of the Bureaus of Science and Plant Industry and the College of Agriculture along these lines are as follows: *Systematic mycology.* The work in systematic mycology includes numerous routine determinations of species of fungi, the collection of materials for the herbaria and for the work of specialists on certain classes of fungi, the distribution of named specimens to the herbarium, and the sending of Philippine fungi to mycologists and institutions in other countries for identification or for exchanges. Some work is also done in connection with the identification edible and poisonous forms of mushrooms.

Industrial mycology. In the Bureau of Science, attempts have been made to do some routine work and researches on fungus spotting of crepe rubber, molding of leaf tobacco in the camarins, molding of cigars in storage, deterioration of glass (optical glass and objectives), deterioration of abaca fibers, etc.

Medical and Veterinary mycology. As in the case of industrial mycology, some routine work on medical mycology is also undertaken in the Bureau of Science with the close cooperation between the mycologist of that bureau and the medical men of the School of Hygiene and Public Health and of the College of Medicine and Surgery, University of the Philippines. Aside from some clinical observations or diagnoses made of animals afflicted with certain pathogenic fungi, very little investigation, if any, has been undertaken in the Philippines concerning research work in Veterinary mycology.

Agricultural mycology or Phytopathology. In the College of Agriculture, the Department of Plant Pathology undertakes two main activities, namely: *Teaching,* to give the students the fundamental principles of the subject, and *research,* to study the causes and control of agricultural or economic plants. In the Bureau of Plant Industry the phytopathological activities are divided into *routine, research, survey* and *extension.* Routine work consists of the numerous determinations of plant disease specimens and advice regarding control measures, and of the examinations of diseased plant materials intercepted at the plant quarantine ports, particularly Manila. Research work consists of such studies or investigations, both in the laboratory and in the field, as will facilitate the determination of the cause or causes and the controi or eradication of various diseases of agricultural and horticultural crops. Survey and extension work is done when the services of plant pathologists are required to investigate the various disease troubles occurring in the fields, orchards or gardens. When possible, the visitations are made, the conditions are carefully studied, and if necessary, control or preventive measures are recommended. Lectures are delivered whenever occasions present themselves, and non-technical or rather popular papers are published to aïd in the dissemination of knowledge regarding plant diseases.

As a part of agricultural mycology activity an extensive study of both the edible and poisonous species of mushrooms is undertaken in the Bureau of Science.

Forest Mycology. Teaching and investigations of pathogenic fungi affecting forest plants and the wood-destroying fungi are attempted in the School of Forestry.

CONTRIBUTIONS TO THE DEVELOPMENT OF MYCOLOGICAL AND PHYTOPATHOLOGICAL SCIENCES IN THE PHILIPPINES

Owing to the limited space alloted to this article it is not possible to give a review of all the contributions since mycological and phytopathological work in this country was undertaken; however, an attempt is here made to mention only some of the outstanding contributions.

The Bureau of Science at Manila has been collecting mycological materials since the development of the botanical work in 1902. This now constitutes the so-called Mycological Herbarium which forms a part of the National Herbarium of the said bureau. Likewise, in the College of Agriculture at Los Baños, the fungus collection of the first Dean, Dr. E. B. Copeland, and of the late Dean, C. F. Baker, form the foundation of the mycological herbarium of the college. The collection in each herbarium forms a valuable nucleus for a working pathological herbarium which has been considerably advanced during the growth of the Department of Plant Pathology of the College of Agriculture at Los Baños, and the maintenance of mycological work in the Bureau of Science in Manila.

"The most imposing publications undertaking of the Garden," said Dr. Copeland in his report to the Director of Plant Industry covering the activities of the National Economic Garden for the year 1933, "is an Enumeration of Philippine Fungi by Dr. Teodoro, filling for this group the same function as Merrill's Enumeration of Philippine Flowering Plants; * * *. This work of Dr. Teodoro comprises a systematic list of all fungi ever reported in the Philippines, a host index, and a bibliography. It will occupy between 350 and 400 pages in octavo book form when published." In view of the fact that most plant diseases are due to fungi, this work will serve as an important foundation to phytopathology.

Aside from the first technical publication on new species of edible Philippine fungi by Dr. Copeland (1905); a popular and somewhat exhaustive treatise on Philippine mushrooms is now almost completed and ready for publication by its author, Mr. Jose M. Mendoza, of the Bureau of Science. The studies of C. J. Humphrey and Simeona Leus-Palo (1931 and 1932), of the same bureau, on the revision of the Genus *Ganoderma* are also important contributions to systematic mycology.

As to contributions to Philippine mycosis or medical mycology, the only comprehensive one so far published in the Philippines is the work of Dr. Africa (1933) on otomycosis, a disease of the ear produced by the growth of a fungus (*Aspergillus fumigatus* Fres.) in the external auditory canal. Of course, in medical reports or treatises there may be found mentioned cases of mycosis, as for instance in an article dealing with the common skin diseases among Filipinos by Dr. Gutierrez (1926) wherein he mentioned the BUNI (a form of ringworm) is due to a small fungus, which he did not name.

Of the numerous contributions of the College of Agriculture to Philippine phytopathology, some of the outstanding ones are: (1) The discovery of the fungus identical to *Phytopathora faberi* Maubl. as the cause of the bud-rot of coconut in the Philippines, by Reinking (Reinking, 1919 and Welles, 1922) on bacterial diseases of plants; (3) the discovery of a certain virus as the cause of the bunchy-top of abaca in the Philippines, and of the transmission of same by the aphid *Pentalonia nigronervosa* Coq., by Ocfemia (1926, 1927, 1930 and 1934); (4) the demonstration of the transmission of the Fiji disease of sugarcane by an insect vector, also by Ocfemia (1933); (5) the work of Victoria B. Mendiola (1930) on Fusarium disease of corn; (6) the discovery of a bacterial stem-rot of hybird seedlings of sugar-cane and Philippine Kassoer in the Philippine Islands, caused by a new species of bacteria which Roldan (1931) named and described as *Erwinia sacchari;* and (7) the report of Celino (1934) on a serious seedling blight of *Cinchona* (quinine).

At this juncture may be mentioned in passing, the important contributions of outsiders, such as the investigation of Doctor Weston, formerly of the U. S. Department of Agriculture (1920, 1921 and 1923) on the downy mildew of maize, undertaken at the College of Agriculture at Los Baños without expense to the Philippine Government; and the works of Dr. Stevens, Former Charles Fuller Baker Memorial Exchange Professor of Plant Pathology (1931 and 1932) on new or noteworthy Philippine fungi, and his co-authors (Stevens et al, 1931-1933) on fungi causing diseases of economic plants.

Since the cooperative phytopathological work of the Bureaus of Plant Industry and Science, and the recent concentration or centralization of phytopathological work of the Department in the former bureau, several important mycological and phytopathological papers or articles have been published by the personnel. Among them may be cited (1) the work of Serrano (1927) on the deterioration of abaca (Manila hemp) fiber through mold action; (2) the report of Clara (1930) on a bacterial leaf disease of tobacco caused by a new species of bacteria which he describes as *Phytomonas polycolor;* (3) the report of Calinisan, Agati and Aldaba (1931) on a new disease affecting the stem of abaca plant; (4) the studies of Reyes (1932) on entomogenous fungi affecting migratory locust and coconut leaf miner in the Philippines; (5) the investigation of Palo (1933) on a severe disease of mango seedlings in the nursery; and (6) the phytopathological surveys of the Trinidad Valley and Baguio made by Fajardo (1934) who has furnished the truck farmers of that region information which may help them solve their plant-disease problems.

In addition to the aforementioned published contributions, a review of the records of phytopathological interceptions at plant quarantine ports filed at the office of the Plant Sanitation Division, Bureau of Plant Industry, in Manila, reveals the fact that, since 1920, when identification of disease organisms became possible due to the employment of plant pathologists in the Bureaus of Agriculture (now Plant Industry) and Science, an enormous number of diseases have been intercepted in all the quarantine stations. Several of these diseases are new to the Philippines, and potentially serious agricultural enemies if not timely guarded against. The records further show that almost all importations of plants from countries that have first class inspection service, are affected by plant diseases.

Finally, in order to give a complete survey of the published contributions to Philippine mycology and phytopathology in this country, I must briefly refer to the following literature:

(1) THE PUBLISHED LISTS OF PHILIPPINE FUNGI

BAKER, C. F. 1914. The lower fungi of the Philippine Islands. *Leaflets of Philippine Botany*, v. 6, Art. 102:2065-2190.

BAKER, C. F. 1914. The lower fungi of the Philippine Islands. *Leaflets of Philippine Botany*, v. 7, Art. 113:2417-2542.

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REINKING, O. A. 1919. Higher basidiomycetes from the Philippines and their hosts, I. *Philippine Journal of Science*, v.15:479-491.

REINKING, O. A. 1920. Higher basidiomycetes from the Philippines and their hosts, II. *Philippine Journal of Science*, v.16:167-179.

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REINKING, O. A. 1920. Higher basidiomycetes from the Philippines and their hosts, IV. *Philippine Journal of Science*, v.17:363-374.

REINKING, O. A. 1921. Higher basidiomycetes from the Philippines and their hosts, V. *Philippine Journal of Science*, v.19:91-114.

RICKER, PERCY LEROY. 1906. A list of known Philippine fungi. *Philippine Journal of Science*, v. 1: 227-294. Supplement.

STEVENS, F. L. 1931. A record supplement to the list of the lower fungi of the Philippine Islands. *Philippine Journal of Science*, v.46:479-536.

WELLS, COLIN G. 1922. A provisional list of the parasitic fungi of the Philippine Islands. *Philippine Agricultural Review*, v. 15: 149-202.

YATES. 1919. Host index of Philippine fungi. Unpublished.

(2) THE PUBLISHED BIBLIOGRAPHIC LISTS OF PHILIPPINE FUNGI

BAKER, C. F. 1919. A contribution to the Philippine and Malayan technical bibliography. *Philippine Agriculturist*, v.8:32-37.

BAKER, C. F. 1922. Additions to Philippine and Malayan technical bibliography. *Philippine Agriculturist*, v.10:363-366.

TEODORO, NICANOR G. 1926. Philippine mycological and phytopathological literature index, I. *Philippine Agricultural Review*, v. 19: 275-291.

(3) THE PUBLISHED WORK ON PLANT DISEASES IN GENERAL

BAKER, C. F. 1914. A review of some Philippine plant diseases. *Philippine Agriculturist and Forester,* v.3:157-164.

BAKER, C. F. 1916. Additional notes on Philippine plant diseases. *Philippine Agriculturist and Forester,* v.5:73-78.

LEE, HENRY ATHERTON. 1921. Observations on previously unreported or noteworthy plant diseases in the Philippines. *Philippine Agricultural Review,* v.14:422-434.

MENDIOLA, N. and R. B. ESPINO. 1916. Some phycomycetous diseases of cultivated plants in the Philippines. *Philippine Agriculturist and Forester,* v.5:65-72.

OCFEMIA, GERARDO O. 1924. Notes on some economic plant diseases new in the Philippine Islands. *Philippine Agriculturist,* v.13:163-166.

OCFEMIA, GERARDO O. 1931. Notes on some economic plant diseases new in the Philippine Islands, II. *Philippine Agriculturist,* v.19:581-589.

REINKING, O. A. 1918. Philippine economic plant diseases. *Philippine Journal of Science,* v.13A:165-274.

REYES, G. M. and F. B. SERRANO. 1924. The use of fungicides in the Philippines. *Philippine Agricultural Review,* v.17:127-133.

TEODORO, NICANOR G. 1925. Phytopathology: its fundamental principles. *Philippine Agricultural Review,* v.18:325-372.

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CONCLUSION AND RECOMMENDATIONS

In conclusion, I must say that mycologists and phytopathologists, like other professionals, recognize that the highest duty in the profession is SERVICE, and that the chief aim in mycology is to determine the nature and kinds of certain fungi affecting their hosts, and that, likewise, in phytopathology the aim is to control or at least lessen losses from the havocs of plant diseases. The question then is, "How can we best serve to this end?" From the mycologist or phytopathologist point of view as an investigator the immediate answer is through RESEARCH, to make it possible to educate the people about the solutions to mycological and phytopathological problems. But to do this the mycologists or the phytopathologists are confronted at the outset with the first problem—that of FACILITIES. However, once these are provided, the mycologists and the phytopathologists are in a position to face the problems through the various methods of research to attain their aims.

In our country the critical conditions brought about by such problems are,—(1) the deterioration of abaca fiber by certain micro-organisms requires research to find a gas that will act as a disinfectant and bleaching agent on the fiber without weakening it; (2) the deterioration of glass (optical glass and object attacked by fungi) offers a promising additional field of research in industrial mycology; (3) the important lines of investigation in medical mycology are fungus diseases of the skin, alimentary disturbances and food poisons due to fungi. "Although otomycosis occurs quite frequently in this country," said Dr. Africa (1933), "no serious attempt has so far been made here to determine its etiology. Aside from some casual mention of this affection by some of our otologists in connection with their clinical observations, our local medical literature completely lacks reference about this subject. This is not surprising when we consider the fact that even the etiology of such an important group as our skin diseases of mycotic nature has also been likewise neglected." For this reason, it is imperative that medical and veterinary mycology should be given consideration; and (4) the frequent occurrence of the various diseases affecting our principal agricultural and horticultural crops demands that plant disease surveys in various parts of the islands be made, and continued from year to year, since it would give pathological workers a definite idea of the distribution of diseases. It would be of value to research pathologists in deciding where their work should lie, in determining the extent and character of their problems and in checking up the results of their campaigns. It would acquaint them with disease conditions throughout the country. A plant disease survey is "A WATCH SERVICE ON THE HEALTH OF PLANTS WHICH TENDS TO CONSERVE THE HEALTH OF FOOD CROPS JUST AS THE PUBLIC HEALTH SERVICE CONSERVES THAT OF HUMAN BEINGS." There are many diseases of agricultural and horticultural crops in the Philippines that are the causes of enormous losses each year, but owing to the absence of sufficient scientific information on their nature, no practicable control measures are known. Moreover, a survey should be made in order that intelligent quarantine action may be taken.

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THE DEVELOPMENT OF NUTRITION WORK IN THE PHILIPPINES

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Although food plays a very important part in the orderly conduct of our daily life and intimately affects human welfare, nutrition studies in the Philippines are still in a period of infancy.

Nutritional work in the Philippine Islands may be divided into six categories:—

1. General surveys on the state of nutrition and metabolism of the people.
2. General composition of Philippine foods and foodstuffs.
3. Relation of vitamins to beriberi.
4. Vitamin and mineral contents of common foodstuffs.
5. Food preparation and preservation.
6. Dissemination of knowledge on nutrition.

I. GENERAL SURVEYS ON THE STATE OF NUTRITION AND METABOLISM OF THE PEOPLE

In 1909, Professor Hans Aron of the Philippine Medical School computed the general composition and caloric values of the daily ration of the inmates of Bilibid Prison (Aron, 1909). In the same year he made a similar computation for the people of the town of Taytay, with additional data on the cost of their daily diets (Aron, 1909). These works may be considered the pioneer investigations on Filipino nutrition.

Concepcion (1919) made the first study of urinary nitrogen by systematic chemical analysis of the urines of Filipino students and of the food intake of inmates of Bilibid Prison. Roxas and Collado (1922) a few years later made a study of the dietaries of students in the College of Agriculture at Los Baños, and compared it with the diets of three families of Los Baños laborers.

An interesting phase of nutrition work was contributed by Santos (1923) in his metabolism studies on Filipino students in the United States, giving indications that residence in a cold climate does not materially alter the metabolism of persons accustomed to tropical life.

The investigations mentioned above have been extended and enlarged in recent times by contributions from the Colleges of Medicine and of Agriculture of the University of the Philippines.

Standards of basal metabolism have been established for Filipinos by Fleming (1923) and by Sison and Ignacio (1927) on "hospital normals," and by Ocampo, Cordero, and Concepcion (1930) on presumably healthy Filipinos. Fleming's work is unique in that it includes a pioneer work on Filipino blood chemistry.

Concepcion's paper entitled "Nutritional Requirements of the Filipinos" (1933) summarizes and correlates the existing knowledge on food requirements of Filipinos up to 1933.

II. GENERAL COMPOSITION OF PHILIPPINE FOODS AND FOODSTUFFS

All the work on foods mentioned above are only computations of constituents and calorific values of daily rations based on percentage composition of similar foods made abroad. Actual analytical work on Philippine foodstuffs have been made by Agcaoili, Brill, Gibbs, Hocson, and del Rosario. The work was extended and later compiled by Adriano and Santos (Adriano, 1925; Adriano and Santos, 1928). This compilation was revised by Hermano in 1932 in which form it is available in a special bulletin of the Bureau of Science.

III. RELATION OF VITAMINS TO BERIBERI

Although the field for vitamin studies is a wide one, most of the vitamin studies in this country have been concentrated on Vitamin B, due to the prevalence here of beriberi. The work of Chamberlain (1911) of the United States Army Medical Corps may be cited as the first important contribution on the subject. This work marked the beginning of a series of investigations intended to elucidate the etiology of beriberi. Notable among these contributions are those of M. Guerrero (1910) and J. Albert (1908), on the etiology of infantile beriberi; and of Vedder on the preparation of tikitiki extract and its application to the treatment of beriberi.

On the experimental side may be mentioned the work of Andrews (1912) on the transmission of human beriberi to animals; and of Strong and Crowell (1912) on the production of beriberi in man by feeding of polished rice.

IV. VITAMIN AND MINERAL CONTENTS OF COMMON PHILIPPINE FOODSTUFFS

On the vitamin contents of Philippine foods, important contributions have been made by Embrey (1923), Gibson (1913), and in more recent times by Santos (1922), Hermano (1930), and Birosel (1932).

On mineral constituents, Marañon and Adriano have made contributions. But more extensive investigations along this line have been done and are still going on in the Biochemical laboratory of the College of Medicine, University of the Philippines under the direction of Dr. Concepcion.

V. FOOD PREPARATION AND PRESERVATION

This line of work was begun in 1924 on a small scale in the Division of Organic Chemistry of the Bureau of Science. Realization of the importance of this line of activity led to a special legislative appropriation in 1925, for the "continuance of the work of developing and encouraging home canning and food preservation as an industry in the Philippines." In 1926 a special Food Preservation Division was created under the direction of Miss Orosa, who intensified the work not only by giving classes in the Bureau of Science but by making demonstrations in the important provincial towns and giving valuable advice in dietetic matters to hospitals, puericulture centers, schools, etc. It may be mentioned that along the line of food preservation and canning, a good deal of work is also being undertaken by the Bureau of Plant Industry. The Division of Food Preservation has recently been fused with the Bureau of Science and its name changed to the Division of Home Economics. With this change the scope of its activities has been enlarged to include not only food preparation and preservation but also, home management, and improvement, and related arts. Pamphlets on food preservation, preparation of sea foods, rice bran, soy bean and other culinary matters have been issued as special bulletins of the Bureau of Science and have also appeared from time to time in the daily newspapers.

VI. DISSEMINATION OF KNOWLEDGE

This phase of the work is well taken care of for various sections of the population, by the Bureau of Education, Bureau of Health, Office of the Public Welfare Commissioner and by the Division of Home Economics. The only shortcoming of this extensive propaganda is that it is undertaken mostly in the English language and therefore can reach only a relatively small part of the population, because while a limited amount of knowledge of conversational English is quite widespread, an intelligent reading knowledge appears to be quite limited. Publication of dietary and nutrition articles in dialect may help more in this great propaganda work. Nevertheless, on the whole, the country is now more nutrition-minded than it has ever been in the past.

It must be mentioned before closing that the bulk of scientific work on diets and nutrition in this country has been borne by the researchers working quietly under the following governmental agencies:—the Division of Organic Chemistry, Bureau of Science, the Department of Agricultural Chemistry, College of Agriculture, University of the Philippines, and the Department of Physiology and Biochemistry, College of Medicine, University of the Philippines. Judging from the past accomplishments, the future of nutrition work may be considered bright. What is only needed is more encouragement to those who are devoting their time and energies to the subject. They should be given more generous support not only in the acquisition of more facilities and equipment but also in the maintenance of those already on hand. Furthermore, expectation of immediate utilitarian results should not be the main objective for which such support is to be given.

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VI. DIVISION OF AGRICULTURE AND FORESTRY

EARLY HISTORY OF PHILIPPINE AGRICULTURE

By JOSE S. CAMUS

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The Philippines, blessed with a benign climate and rich natural resources, has ever been pre-eminently agricultural. It may be said that agriculture, the primitive and most important science of man and the most noble of occupations, antedates Philippine civilization. It has been the greatest asset in the building up of the material prosperity the country now enjoys.

AGRICULTURE DURING THE PRE-SPANISH RÉGIME

Since time immemorial the natives have depended upon the products of the soil for their livelihood. Rice, millet, coconuts, banana, sugar cane, and other minor crops had long been under cultivation before the Spaniards came into the Islands. These agricultural products furnished the wherewithal for the simple needs of the inhabitants. The methods of soil tillage, planting, and cultivation then employed were naturally crude, the tools and implements used antiquated. The lands were parceled out among the people composing the barangay so that each of them had his own field to cultivate. The Chief of the barangays practiced the tenantry system, the tillers of the soil being free men and their families. The natives were, by custom and tradition, very devoted indeed to the cultivation of the soil. When Spain came to rule the Islands, there was thus a fair basis on which to build and further develop agriculture.

DURING THE EARLY YEARS OF THE SPANISH RÉGIME

Spain took great interest in, and did much to foster, the development of Philippine Agriculture. To safeguard the interests of the natives, Spain decreed by a royal edict of April 6, 1588, that public lands were not to be parceled out to the prejudice of the natives, and by a law of June 11, 1594, the right to possession of previous land grants was vested in the State to correct the abuses of some of the early settlers.

At various times, Spain, through her missionaries, introduced into the country some very important animals and plants such as tobacco, cacao, coffee, etc., from other countries. Many of her introductions now figure among the major products of the Islands.

Actual work on crop improvement was started as early as 1612 when a royal decree was proclaimed ordering the people to plant wheat in the lowlands. A century and a half later, that is, in October, 1759, another decree was issued making it obligatory upon all the natives to plant every year some coconuts, cacao, areca palm and pepper. Again in February, 1768, a third decree was issued compelling all Filipinos to plant wheat, rice, corn, and vegetables in addition to useful trees, and to keep at least twelve hens, a rooster and a pig. And for good measure, in the way of encouraging agriculture, an edict was released at that time ordering that all rich natives should own 200 feet of land planted to coconut and another 200 feet of land planted to abaca. The poor were required to plant half this area. Then in 1777, the people were compelled by an order to cultivate and manufacture flax and cotton for exportation to Spain.

THE GOLDEN ERA UNDER GOVERNOR JOSE BASCO Y VARGAS

The golden age in the progress of Philippine agriculture during the Spanish régime can rightfully be placed in the last quarter of the 18th century when Jose Basco y Vargas became Governor of these Islands. To stimulate agriculture was the watch-word of his administration and his achievements along this line were unequalled, much less excelled, by any other colonial administrator. In a public pronouncement he made in 1779, a year after his arrival in the country, he said in part: "If agriculture and industry are the real basis of commerce, it behooves the leaders to ascertain if there exist in this country, the potential basis of its interior and foreign commerce." In line with his principles he founded the "Sociedad Economica de los Amigos del Pais" for the purpose of studying and promoting agriculture, and rural economics, compiling information on Philippine soils and their adaptability to plants, and of the best seasons and methods of cultivation. The proper control of plant pests and diseases was given particular attention so as to stimulate the production of agricultural crops—wheat, rice, cacao, coconut, tobacco, cinnamon, indigo, mulberry trees, pepper, clover, and other economic plants. Thus was ushered in the beginning of fundamental research work to improve the production of different crops under the Spanish régime. In

1780, a set of rules was promulgated governing the planting and manufacture of pepper. The famous Government tobacco monopoly which was established a year later (1781) to increase the revenue of the archipelago, made the farmers proficient in the culture and curing of this important crop. It was Governor Basco who in 1783 initiated the giving of cash prizes to those harvesting the largest crops of pepper, cotton, and indigo as a further inducement to agricultural development. From the year 1785 to the close of the 18th century other laws and regulations, calculated to increase agricultural production, were promulgated, such as those giving instructions for the planting of mulberry trees and the breeding of silk worms, the cultivation of cotton, indigo, coffee, and tobacco, and the converting of cinnamon and nutmeg plants into commercial products. The rapid progress made in the development of Philippine agriculture at this period and the fame that had spread about the fertility of Philippine soil as well as the extent of her natural resources attracted foreign attention.

The splendid work of Governor Basco was carried on by his successors so that at the close of the 18th century the basis for the further progress of agricultural development in the years succeeding was well laid down.

PROGRESS MADE IN THE NINETEENTH CENTURY

With this foundation well established and the people's interest in agriculture well manifested, progress followed a natural course. Despite political turmoil in the Spanish Cortes in 1801, a royal decree was issued relative to the development of agriculture and industry in the Islands. And in 1804, the Government was asked to protect agriculture by declaring cotton, coffee, and indigo, the commercial value of which was very considerable, exempt from duties. Further instructions on the improved methods of culture and curing of tobacco were issued in 1813, and by a royal edict of 1814, greater freedom was conferred upon individual planters in the development of their holdings in the general interest of agriculture and cattle raising. An agricultural advisory board was created at Manila in 1821, and a royal decree authorizing the establishment of agricultural courses and of an acclimatization orchard was issued on April 10, 1822. In 1825, the reorganized "Sociedad Economica de

Filipinas" rendered its first "memoria" on abaca-growing to stimulate the development of this valuable crop, which has remained, until very recently, a complete Philippine monopoly.

The second quarter of the century likewise witnessed a number of important steps taken in the interest of agricultural advancement. When in 1827, the interest in coffee growing was noted to be slackening somewhat, the "Sociedad Economica" reprinted and distributed the pamphlet entitled "Memoria Sobre el Cultivo del Cafe en la Isla de Cuba." This effort of the Society revived the declining interest in coffee growing. In 1828, a decree was issued for the first time providing for the importation of agricultural machinery in the Philippines. This step was significant in that the introduction of improved farm machinery contributed to the improvement of farm operations so essential in a speedy development of agriculture. Again, in an effort to stimulate the cultivation of cotton, a very important agricultural product, the culture of which antedates the Spanish era and on more than one occasion then considered to be the best in the world, the Government in 1836 tried to grow Pernambuco cotton seeds in Antique. Another step taken to give more impetus to the cotton industry was the opening of the port of Manila for the importation of foreign cotton on February 3, 1838. All kinds of inducements, as a matter of fact, were resorted to promote agriculture. The offering of prizes was revived. For instance, a prize of ₱8,000 was given to the planter of a coffee orchard of at least 60,000 square feet, ₱6,000 to the owner of a large cacao plantation, and similar prizes to successful growers of cinnamon. In addition, all laborers who had worked at least five years on an hacienda to the satisfaction of the owner were exempted from paying taxes. The first half of the century was climaxed by an important executive order issued on August 5, 1850, authorizing the establishment of Chinese colonies to help in developing agriculture. All Chinese arriving in the Philippines for the first time were exempted from taxes for one year.

About this time, economic problems began to crop up, causing considerable contention between capital and labor and often leading to serious disturbances, especially in connection with the tobacco industry. To prevent troubles of this nature the Government issued an order in March, 1855, authorizing provincial chiefs to make cash advances to planters of tobacco. In the same year the free exportation of rice was authorized to augment the development of this industry.

May 29, 1861 marked the beginning of the official teaching of agriculture in the Philippines. On this date, the first agricultural school was established in Manila on the site of the old Philippine Normal School founded by the "Sociedad Economica." The Botanical Garden of Manila was started as an important part of this school.

In 1882, the Government tobacco monopoly was abolished because of scandalous abuses and graft perpetuated by many officials which created a wide-spread uprising on the part of the oppressed tobacco growers.

Near the close of the century, agricultural experiment stations were established in many places. One large station was established at La Carlota, Negros, where the work was begun in 1884, and another at Magalang, Pampanga. Smaller stations were established in San Carlos, Cebu; Ilagan, Isabela; Vigan, Ilocos Sur; Daraga, Albay; and La Paz, Iloilo. In these stations interesting experiments were conducted, the most important of which were the introduction of new varieties of crops, the study of pests and diseases, useful and noxious insects, methods of combating locusts, the breeding of animals, improvements of plants, production of better varieties, soil fertility, irrigation and drainage. Sugar cane and tobacco were the two major crops studied extensively. An agricultural monthly known as "Boletin Oficial Agricola de Filipinas" published, from 1894 to 1896, reports on pioneer agricultural research work carried on in the experiment stations, the condition of the crops, market quotations, and a summary of all work in agriculture. It is the authoritative source of valuable information on early agricultural research work in this country.

The work in the different experiment stations and all other activities for the promotion of agriculture were temporarily paralyzed during the trying days of the Philippine revolution which finally culminated in the change from the Spanish to the present American sovereignty over these Islands.

THE UNPARALLELED DEVELOPMENT OF PHILIPPINE AGRICULTURE UNDER THE AMERICAN RÉGIME IS CURRENT HISTORY

The rise of Philippine agriculture during the last three decades and more of American sovereignty, the general public is certainly conscious of. It is current history. Many factors have contributed towards this unparalleled development of Philippine agriculture. Foremost among these is the Government interest in the country's economic advancement; second, the adaptability of the vast natural resources of the Islands to agricultural industries and pursuits; and third, the readiness of the people to further the cause of agriculture owing to their inborn or traditional attachment to, and love of, the soil. The Government Bureau of Agriculture, established in 1901 and split in 1930 into the Bureaus of Plant Industry and Animal Industry, has contributed a great deal to the cause of agricultural improvement in this country. Among other things, it has conducted in its various experiment stations painstaking researches on fundamental agricultural subjects, and through effective publicity, demonstration and extension work, has brought its findings to the people for practical utilization. The agricultural service has protected the country from the introduction and invasion of foreign plant pests and diseases, and has minimized and controlled the interminable depredations of insect enemies such as locusts and leaf miners and numerous other plant pests and diseases. It has introduced into the Islands from various sources a large number of economic plants and created new plant varieties through breeding, many of which have proved to be material successes and now figure among our important major crops. It has successfully fought the most dangerous animal diseases such as rinderpest, anthrax, hog cholera, etc., introduced improved breeds of animals into the country and improved native stock through breeding.

Agricultural education in the country was given due emphasis by the establishment in 1909 of the College of Agriculture at Los Baños, Laguna, and in later years, of farm schools and agricultural high schools in many places in the country. Many other entities of the Government have had some share in the development of Philippine Agriculture.

While the production of those staple crops for home consumption has kept pace with the increasing local demand, the last three decades of the development of Philippine agriculture has really been an epic drama of tropical crop production for export in which sugar cane, coconut, abaca and tobacco, figured the most prominently. The prosperity brought to the country by these products of export, coupled with the ceaseless efforts of the Government to intensify public interest in agriculture and economics, has made the people more farm-conscious and agricultural-minded. Now there is an ever growing tendency not only on the part of the unlettered but also of the intelligentsia to go to the farm and come close to nature, which augurs well for the further development of Philippine Agriculture.

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THE NEED FOR RESEARCH IN AGRICULTURAL ECONOMICS

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GENERAL STATEMENTS

The problems of economics of agriculture assume increasing importance as the country becomes developed and the problems of production, marketing, credit, transportation, taxation, tariff, currency, rural finance, and competition, begin to affect the object and profit of every agricultural enterprise.

Economic problems as they are understood today under the present conditions were never a part of the consideration of agricultural ventures in the pioneer days. Land was abundant, people were few. There was little trade and the problem of the individual was centered on food and how to grow it. The farmer during the early days took to the forest, cleared the virgin land, cultivated it to have a place to live in and to raise enough food. He was not bothered with market, nor tariff, nor limitation. He bartered his excess products for other products of his neighbors to supply his necessities, which were simple and few. As communities grew and the population increased, with the concomitant augmentation of human wants and commodities, economic problems appeared.

The beginnings of Philippine agriculture had been a pioneering work of this kind. Conditions were favorable particularly along the coasts and the banks of rivers. The farmer settled in virgin land, cleared it, planted corn or rice, hunted game, and fished from the sea or river for other food supplies. He raised a few animals to provide part of his food and planted coconut, abaca, and fruit trees for his permanent crops. In a few years under favorable conditions the trees came into bearing and the farmer either sold out or moved to the next vacant space to increase his holdings. The well-to-do land owners began buying adjacent parcels and larger units of holdings were developed. This is the manner in which the extensive coconut and abaca industries of the present time have been largely established. Similarly, the extensive rice paddies in the level plains which now form the rice-growing regions were developed. Within large holdings, especially with Royal land grants, the system of development was virtually the same. Small units were loaned to individuals who cleared the virgin lots and brought the land under cultivation. No rents were exacted from the users until after several years when the land had been fully cleared and cultivated. It is only within the last decade and a half that agricultural development has been undertaken as a purely commercial enterprise. Today these industries and the improvements on land represent a tremendous investment which could never have been built if actual cash had been required for their development. They represent an accumulated labor income of several generations. Although we have hardly graduated from the pioneering methods, and not many agricultural enterprises have been started on a purely commercial basis, agriculture is already facing economic problems of such magnitude and extent that now any agricultural venture is no longer just a mere problem of seeds, soil, climate, pests, diseases, and typhoons, but principally of economics. No man now dares go into an agricultural enterprise without considering whether it will pay, whether there is a market, where he can borrow capital, if there is available labor, etc.

AGRICULTURAL ECONOMICS IN SCHOOLS

It was the economically independent Filipinos who were first to voice protest against the unjust methods of exploitation of the natives and the natural resources of the Philippines by the Spanish rulers. It was the moneyed Filipinos who were first to feel discontent against the social order during the Spanish domination. The foundation of the progress made by Filipinos of the past in educational as well as political accomplishments was the acquired economic independence of the individual. This economic independence gave birth to aspirations of a moral and intellectual order. However the study of economics and the pursuit of the different branches of economic calling did not form a part of education during the Spanish time and were the last to be given emphasis in our schools of the present regime.

During the Spanish time "colleges and universities were founded in Manila which principally gave courses in grammatical, philosophical, theological and juridical studies," the result of which was the strengthening of a wrong mental attitude toward manual labor, holding it in contempt. It was considered menial and below the dignity of a gentleman to be directly engaged in economic pursuits involving manual labor.

In an extensive report entitled "The Development of the Philippines" written by Henry Jackson Water, President of Kansas State Agricultural College, after a special investigation authorized by Act of the Legislature of the Philippine Islands in 1914, which embodies recommendations regarding a development program for the government, agricultural instruction and development, uniting agricultural forces and courses of study, no mention was made of agricultural economics either as a course of study at the College of Agriculture or as an organized activity of the Bureau of Agriculture.

In the College of Agriculture courses were started in 1918, principally to teach elementary principles of economics and farm accounting. Courses have been developed to embrace rural economy. A number of studies in cost of production and tenancy conditions have been undertaken. No facilities have been given or developed for conducting research and survey in agricultural economics in the same manner that laboratories and field stations are provided at present for the studies of chemistry, agronomy, horticulture and animal husbandry.

The University of the Philippines started giving courses on economic subjects in 1910 in the College of Liberal Arts, and with the establishment of the School of Business Administration in 1929, permanently gave due recognition to the economic aspect of national life.

The establishment of vocational schools began with the American regime when demand for skillful artisans in different enterprises began to be felt. Vice Governor-General Gilmore, Secretary of Public Instruction, pioneered "to change the emphasis in education from non-productive academic training to vocational training in order that those who are educated at the expense of the government may be economically productive as well as politically efficient." The Philippine Legislature in 1927 gave specific recognition to vocational training and provided funds for the promotion of agricultural and vocational schools.

ECONOMICS IN THE GOVERNMENT

The economic interest of the government and the measures established to promote economic development partook of the characteristics of the people of the governing power. The Spanish regime in the Philippines and the present American domination had widely divergent policies and methods of economic development. History tells us that during the Spanish time the social order and laws were inimical to the proper development of economic independence of the individual native. The education given in schools and the social institutions established developed a wrong attitude towards manual labor. Under the American regime, however, greater emphasis has been laid on economic development and the Filipinos, alert to the advantages of the more liberal government, acquired a great degree of economic development and consequently came to enjoy the advantages of acquired wealth.

The Bureau of Agriculture in 1915 started a Rural Credit Section under the Demonstration and Extension Division for the endorsement of the rural credit law, Act No. 2508, passed by the Philippine Legislature in 1915. In 1919, this Section was organized into the Rural Credit Division with activities as follows:

1. Organizing, supervising and examining rural credit associations.
2. Helping farmers to obtain loans from banks.
3. Fighting usury.
4. Propaganda work on cooperative activities.

The Division later included in its activity the enforcement of Act 2818, passed March 4, 1919, entitled the Rice and Corn Fund, designed to enable the farmers to extend areas planted to rice and corn, to buy work animals, implements, seeds, and to meet all other necessary expenses in producing these two staple crops. This Division in 1930 was named Rural Economics Division and later in 1931 labelled Agricultural Economics Division but remained fundamentally the same in the function of supervising rural credit cooperative associations and administering the Rice and Corn Fund. In 1932, this Division under the Bureau of Plant Industry was transferred to the Bureau of Commerce.

The Bureau of Plant Industry as organized at the present time has no section of Agricultural Economics, yet the greatest problem of agriculture today is whether it can prosper under the prevailing conditions affecting cost of production, taxation, present market, prices, current rates of interest, present rural unrest, international relations, in other words, under the present pressure of economic conditions. There is no government institution which carries on well organized research activities on the economic factors which determine the present economic conditions of agriculture except the College of Agriculture and other Colleges of the University of the Philippines, which undertake this work as part of the curricula.

CHANGING ATTITUDE

We are indebted to the late Trinidad Pardo de Tavera for the very illuminating analysis of the results of economic development upon the Filipino people during the Spanish sovereignty. How a misguided education produced a wrong attitude toward manual labor, and how such a delusion retarded the Filipino individually and as a nation in acquiring economic independence should serve as a lesson. Under the American regime we have become more enlightened towards the dignity of productive work. We have learned to appreciate the success of a man who has added wealth to the nation's stock. Spurred by the new attitude we have produced successful Filipino bankers, manufacturers, business men, financiers, insurance executives, who furnish strong assurance of the ability of the Filipinos to face the economic problems of the new order with the advent of an independent Filipino government.

So completely have our economic ideas changed; so thorroughly has our obsolete attitude toward labor been overhauled; so firmly has our conviction been established of the need of economic independence during the last decade that leaders of thought and action from the President of the Senate to the chiefs of offices, from University Presidents to school teachers, from city editors to feature writers, hold the economic development of the country to be the keynote of thought, planning and action. The Philippine Economic Association organized in 1933, and the National Research Council, in 1934, will be the great factors in directing our national economic thought. The

United States and the rest of the world watch with critical eyes our ability to carry on an independent existence not by the religious fervor of our people, not by the diplomacy of our politicians, not by literary production, not by the intensity of sentimental feeling, but by our ability and statesmanship of high order to promote a symetrical economic structure which will make our people equal to the tasks in the world's intense economic struggle.

THE NEED FOR AN ORGANIZED OFFICE OF AGRICULTURAL ECONOMICS

The rising tide of agrarian troubles cannot be stopped by superficial remedies applied to seemingly obvious troubles. The root of the troubles should be searched for and permanent remedies applied to the fundamental causes of disturbance. There is a universal complaint against the heavy burden of the land tax. There is a continuous demand for readjustment of taxation. A scientific system should be inaugurated for equitable land taxation. Innumerable problems of credit, marketing, warehousing, distribution, limitation and hundreds of other adjustments in the economic structure brought about by complex, and very often, unforeseen causes require a thorough knowledge of fundamental facts. The establishment of colonies to solve problems of population, of the disposition of public domain, of the development of a balance system of agricultural production—all necessitate a comprehensive knowledge of agricultural economics. Where shall the government look for the necessary knowledge and information? Only a well organized office that can undertake research and survey can accumulate and compile adequate data to be interpreted for the requirements of present and future trends of development. The lack of adequate scientific information under conditions obtaining in the agricultural districts in the Philippines in the following subjects of agricultural economics will illustrate the wide scope of the work:

1. Public Finance in Relation to Agriculture.
2. Agricultural Land Utilization.
3. Agricultural Credit.
4. Rural Population.
5. Rural Social Welfare Work.
6. Agricultural Income.

7. Marketing of Farm Products.
8. Transportation in Relation to Agriculture.
9. Farm Family Living.
10. Rural Organization.
11. Farm Management.
12. Agricultural Insurance.
13. Agricultural Land Tenure.
14. Land Settlement and Colonization.

A government office is greatly needed to give due attention to the problems in the fields stated above—to undertake research and survey, to secure and make the information available in practical form that it may be useful in the daily problems of agriculture and their solution as well as in framing sound governmental policies.

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OUTSTANDING RESULTS OF AGRONOMIC RESEARCH

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In the twenty-five years of its existence the Agronomy Department has contributed to Philippine scientific literature 615 papers. Of these 194 were prepared by members of the faculty, and the remaining 421 were theses of graduating students who majored in the Department. These theses were planned by and the experiments performed under the direct supervision of members of the staff. Of the theses, 127 have been published, abstracts made of several and published, and the rest are awaiting publication. In addition to these contributions there are other researches under way in various stages of completion.

In presenting the results of the agronomic and horticultural researches only the most outstanding ones will be discussed. They are treated by crop, arranged alphabetically.

CACAO

In a test of several cacao varieties, Forastero proved the best under local conditions. The trees planted under shade grew more vigorously and gave considerably higher yield than those planted in the open. Dapdap and madre cacao were found to be good shade trees (David, 1929).

Besides budding, grafting and inarching, the cacao plant can be propagated with reasonable ease by marcottage and by stem cuttings (Anioay, 1932).

For raising cacao seedlings, a soil medium made up of equal parts of garden soil and compost was found advisable (Madrid, 1933).

COCONUT AND OTHER OIL PLANTS

Coconut. A *varietal study* of coconuts in Laguna and Tayabas provinces showed that there are eight fairly distinct varieties in these regions (Desembrana, 1923).

In *propagation* studies it was found that fully ripe nuts for seed proved superior to nuts of any other age, the nuts to be planted whole, on the side, and to be transplanted when 15 to 30 cm. high (Espino, 1923).

It was found that round nuts were heavier, germinated earlier, produced more leaves and roots than oblong nuts (Maceda, 1933).

There was no consistent relationship between size and shape of nuts and percentage of germination (Bayog, 1929). One week of drought was not very detrimental to coconut seedlings but two weeks of dry weather retarded growth considerably.

Round nuts were found to contain more meat than other shapes and were recommended for *copra production.* Other types of nuts had thick husks. The thickness of the shell of all types was variable (Lacson, 1921; Novero, 1922).

Studies on *rate of growth* of coconut trees showed that it varied according to the age of the tree and that it was directly related to yield (Almazan, 1922).

Palms 10 to 30 years old still had the ability to increase the number of leaves. The yield of green nuts increased as the age of the trees advanced (Almazan, 1922). A study of flower biology showed that July and August were the most favorable months for the production of inflorescences, and November and December the most unfavorable. The largest number of female flowers were produced by the inflorescences that appeared during April, May, June, and July. The months from September to January were unfavorable for the production of female flowers (Jimenez, 1926). The coconut is both close- and cross-pollinated. Male flowers open at about six o'clock, and their anthers dehisce at about eight o'clock in the morning. The female flowers in the same cluster become receptive after two or three weeks from the time of the appearance of the inflorescence (Aldaba, 1921).

A study of the *growth of nut* showed that at first the nut grows in length faster than in width, then faster in width and then faster in length. There are three more or less distinct stages in the development of the nut: (1) the first stage lasting up to the age of 4–5 months, the growth is mainly in area of the husk and shell; the cavity assumes almost maximum space during this period. (2) The second stage lasts till the nut is 6–8 months old; the meat appears and the husk and shell grow rapidly in thickness. (3) The third stage is from the time the nut is 8 months old until maturity. During this period the husk, shell, and meat change in color (Fandiño, 1928).

Different phases of copra production have been studied. It appears that *copra may be prepared* in the shell of the nuts without the use of artificial heat, if the germination of the nuts is prevented. The copra produced in the shell had as much oil as the ordinary copra in the market and was superior to it in color, being almost white (Rocafort, 1922).

Various types of copra driers are used in the Philippines. A study of their initial cost, efficiency and cost of operation was made in 1927. The Sariaya type was found to have an advantage over the Laguna and ordinary Tayabas types. Sun-dried copra keeps longer than the kiln-dried. It has the best quality and gives the most profit, if the weather is favorable, but it takes a longer time to make copra this way than by artificial drying. Tayabas coconuts produce more copra than Laguna nuts of the same size (Cruz, 1930).

In an experiment on the *production of coir* from coconut husk, it was found that the best retting solution was either 10 per cent sodium hydroxide or 10 per cent potassium hydroxide. Green husks produced more fiber than dry husks. Mañgipod produced the least fiber while the other varieties had about the same percentages. The fiber of one variety obtained from green husk was found to be the same in strength as that obtained from the dry (Flores, 1923).

Peanut, sesamum, African oil palm, lumbang and a few others have been included in our research work on oil-bearing plants.

COFFEE

Beginning in 1915, a study of the variation in *yield among coffee* trees has been carried on. About 4,000 trees belonging to the Robusta, the Excelsa, and Liberica varieties were included in the study (David, 1932). The highest individual record for Robusta was 6,790 grams and the lowest, 369 grams; for Excelsa, maximum was 10,692 grams, minimum, 800 grams; and for Liberica, maximum was 8,270 grams and minimum, 500 grams. The average yield of fresh berries in kilograms of all trees studied was: Robusta, 1.7, Excelsa, 2.7, and Liberica, 2.2. Marketable beans obtained from the berries were found to be 25 per cent for Robusta, 15 per cent for Excelsa and 11 per cent for Liberica (David and Natino, 1932).

Coffee seedlings have been successfully shield budded, inarched, and cleft grafted and old trees have been top-worked by bark grafting (Romero, 1930). For grafting purposes terminal branches were found more desirable than lateral shoots as the latter had the tendency to extend laterally at the expense of upward growth. Stem cuttings were rooted easily, using hard wood and a 1.5 per cent solution of potassium permanganate as a stimulant (Reynoso, 1933). Other lines of coffee work investigated by the Department were the effect of soil media on growth of seedling, methods of shipping seedlings, control of coffee rust with Bordeaux mixture, and shade for coffee.

CORN

Of 30 corn *varieties tested* the Native Yellow Flint proved to be the heaviest yielder (Macasaet, 1918). The Lagkitan, a semiglutinous variety, proved to be suitable for boiling on cob at early milk stage. This variety may be used as a substitute for the sweet corn which does not grow well under our conditions.

The *season* favorable *for corn production* was found to be when the rainfall was about 312.6 mm. for the whole season (Menor, 1927). The wet season crop was found to give more yield than the dry season and it also costs less to produce on the basis of yield. A planting distance of 1 m. by 80 cm. was found to be best for Native Yellow Flint, closer planting resulting in an increase in the total weight of stover at the expense of the ears, while wider planting resulted in a decrease in total weight of stover and ear (Macasaet, 1918).

In different *fertilizer experiments* a combination of 200 kgm. tankage, 175 kgm. basic slag and 350 kgm. kainit gave the highest increase in yield, being 476 kgm. more husked corn to the hectare than the control. In another experiment using Ammo-Phos and Leunaphos a better increase in yield was obtained from an application of 100 kgm. per hectare of Leunaphos; the increase in yield was 11.4 cavans more than the control (Andaya, 1932; Yatar, 1934).

Experiments on storage of corn showed the advisability of first thoroughly drying the seeds and keeping them in air-tight containers. If this could not be done it was found to be fairly satisfactory to store the dried grains with some gaseous disinfectants as carbon bisulfide, with naphthalene or with absence of oxygen in the seed container (Reyes, 1933). When ears were stored with husks on, the husk afforded additional protection to the grains (Aragon, 1934).

COTTON

Preliminary tests of varieties showed that Acala and Cleveland Big Boll were the highest yielders of lint (Legaspi, 1934). Varieties Pima Egyptian, and Sea Island were found promising and are being observed further. In cultural studies it was found that the best distance for planting was 50 cm. by 70 cm. (Espinueva, 1934); that a 3-9-3 fertilizer mixture applied at the rate of 400 kgm. per Ha. increased the yield three times (Apellido, 1934), and that the best time for cotton planting in this locality is from September to October (Mendoza, 1922).

Selection studies made have shown great possibilities for improvement of the native varieties of cotton. The Ilocano Light Brown variety of cotton has been found to be a hybrid and is not a desirable variety to grow where uniformity of the color of lint is desired (Abrenica, 1933).

FIBERS

Abacá. In *variety tests* in abacá in which over 50 kinds were grown under local conditions, varieties Bongolanon, Visaya, Sinaba, Libuton, Sugmod, Tangonon, Punucan and Maguindanao proved the most promising (Espino and students, 1923).

As far as can be determined, the experimental germination of abacá seeds and the *growing of seedling abacás* for the production of new varieties were initiated in this Department (Mendiola, 1923). Under ordinary conditions the seeds do not germinate in 25 days but when they were soaked for 10 minutes in water at 50°–60°C. germination was considerably hastened.

The optimum soil moisture content for the abacá seedlings was found to be 70 per cent.

The *breaking strength* of a sample of fiber was found to be directly proportional to its tensile strength. The breaking strength seems to be directly related to the thickness of the cell wall. The fiber cells from the middle of the sheath were found to be larger than those from the edges of the same leaf sheath of the same variety. As a rule the fibers from the middle of the leaf sheath of the same variety were coarser and had greater tensile strength than those from the edges (Espino and students, 1923).

Agaves and related fibers. A comparative study of maguey, Mauritius hemp, sisal and zapupe showed that leaves of Mauritius hemp were about three times as heavy as maguey. Compared with maguey, Mauritius hemp produced very little fiber, although the two fibers were about the same length. Sisal had the coarsest fiber and maguey the finest. Mauritius hemp was found to be weak compared with the other species, although it had the greatest stretching power (Espino and Novero, 1923).

FIELD LEGUMES

Soybean. In field tests of different varieties, Ami gave the highest yield (Layosa, 1918). Other promising varieties are the Yue Yin September Yellows, Szechwan Bar District Red, Peiping Fenglein White Eyebrow, Peiping Brown, and the American Black (Aragon, 1934). Ammo-Phos fertilizer test showed that it did not pay to use it with soybean (Aragon, 1934). It was found that it would cost ₱86.90 to produce a hectare of wet season soybean and ₱62.39 to produce the dry season crop (Rozul, 1932).

Peanut. In field tests including Valencia, Kinorales, Tarlac, Lemery, Vigan Lupog, and Spanish Red Varieties, Valencia proved the highest yielder both in the wet and the dry season cultures. Spanish White came next in the production of pods, but was third in the production of straw. Lemery came second to Valencia in production of straw, but fifth in production of pods (Battung, 1933).

It was found that the oil content of peanut was increased following the application of fertilizers (Silayan, 1917). It cost

₱86.57 and ₱77.22 to produce a hectare of wet and dry season cultures, respectively.

Cowpea. Of all the varieties of cowpeas tried the New Era, the White, and the Brownish Red varieties gave the highest yield of seeds and vines in both the wet and dry season plantings (Aala, 1933).

Mungo. In a study of mungo types there were found three main groups based on color of the seeds; namely, yellow, green and black. Strains Urdaneta Green, Lipa Yellow, and Rosales Yellow were the heaviest yielders of green materials, while Aliaga Black, Shiny Green, and Dull Green strains from Binañgonan Green were highest producers of seed. The best time for planting mungo was found to be the earlier part of the dry season. Application of ash increased seed production and hardened the body of the plant (Caguicla, 1933).

Sesamum. The yield was considerably increased by using selected seeds and growing them in plots. The bases for selection were strength of stem, resistance to disease, uniformity to type, resistance to drought, and productiveness. A higher yield was obtained in the dry season planting than in the wet season (Zulaybar, 1914).

FORAGE AND PASTURE PLANTS

Separate studies were made on the cultural requirements of the barit, *Leersia hexandra* Sw. (Ordoveza, 1928), Guatemala, *Tripsacum laxum,* dallis, *Paspalum dilatatum* Poiret., cahumayhumay, *Andropogon intermedius* R. Br. (Paggao, 1934), manimanihan, *Desmodium capitatum* Burm. f. (Arcedo, 1933), and *Indigofera hendecaphilla* Jacq. (Fajardo, 1932).

Studies on Jaragua grass, *Melinis minutiflora* Beauv., showed that the plant is capable of yielding 11,581 kgm. fresh weight during the wet season and 1,223 kgm. during the dry season. Analysis of the Jaragua grass silage showed that it contained 63.6 per cent moisture, 1.11 per cent fat, 2.71 per cent ash, 2.26 per cent protein, 15.54 per cent crude fiber and 14.98 per cent carbohydrate. The fresh Jaragua grass was found to contain 81 calories per 100 grams sample (Obillo, 1934).

RICE

The results of the Department's variety tests on rice have showed that Binocaue, Quinastila, Kinanda, Pinursigue, Carreon, and Initiw are the best yielders of all the upland varieties studied and Iroy, Binalayan, Ramai, Elon-elon and Khao Bai Sri the heaviest yielders of all the lowland varieties tried (Morada, 1921; Aragon, 1933). Variety Ng Tani, introduced from Siam is very promising (Jayme, 1934).

In selection work, 16 strains of Ramai rice were chosen from 318 strains for high yield. Their computed yields varied from 93.66 to 123.65 cavans per hectare (Mejia, 1932; Bayan, 1934).

Results of investigations pointed to the close relationship between rainfall and yield (Abesamis, 1922). The best result in germination was obtained from seeds soaked in water for two days and planted two days later. A delay of more than three days in sowing decreased the percentage of germination considerably. Saturated soil proved more desirable than either the slightly wet soil or soil immersed in water (Hernandez, 1926). As the seedlings became older, but not over six weeks, the number of tillers was increased. Beyond six weeks, however, there was a significant reduction in the tillering power of the plants. Planting the seedlings at a distance of 50 cm. by 50 cm. proved more desirable than planting farther apart (Calvo, 1927).

When the seeds were planted direct to the field, planting them one grain to a hill proved more desirable than when a number of seeds were planted, as is usually done by the farmers. With the drill method, using a machine gave a better crop than by the native method, (Marilao, 1922). In general, the broadcast lowland rice yielded less than the transplanted rice (Capili, 1932).

Pruning the leaves at the early stage of growth of the seedlings seemed to be conducive to higher yield, especially when the plants had the tendency to lodge (Andaya, 1926; Punzalan, 1923).

It was also shown by studies that lowland culture gave higher yield than upland culture, although it costs more per unit area to raise lowland than upland rice (Isidro, 1920). Rice fields previously grown to cogon gave poor rice crops (Abrajano, 1922).

Fertilizer tests on rice showed that under College conditions either of the following applications per hectare may be used to secure increased yield in rice: 100 kgm. ammonium sulfate, 150 kgm. Corona Arroz, 150 kgm. Corona No. 1, 150 kgm. Ammo-Phos, 150 kgm. Hoz, or a home-mixed fertilizer containing nitrogen and potash at the rate of 100 kgm. sulfate of ammonia and 20 kgm. sulfate of potash. The varieties used in the experiment were Ramai and Elon-elon (Benitez, 1933; Butac, 1933; Villanueva, 1933; Roque, 1933; Fontanilla, 1934; Asuncion, 1934; Antonio, 1934; Serquenia, 1934; Ocampo, 1934; Flores, 1934).

A survey on the comparative cost of the different methods of harvesting rice reported the following expenses per cavan: Yatab method, ₱1.80; Palot method, ₱2.01; Lingcao method, ₱1.73; Batangas sickle method, ₱1.88; and the Laguna sickle method, ₱1.33 (Africa, 1920). The cost of producing rice in the Philippines was found to vary from ₱1.56 to ₱2.44 per cavan (Aragon, 1933).

ROOT CROPS

Variety tests of sweet potato gave the following as best yielders for roots and vines: Inincanto, Montevideo, Samar Big Yellow, Los Baños Red, and Los Baños White. The production ranged from 8 to 9 tons per hectare for the dry season culture. For planting, the tip cuttings gave faster growth and higher yield of roots than the base cuttings. In planting the cuttings they should be laid in a bent position (Muñoz, 1914; Merino, 1914; Tenebro, 1933).

With cassava, varieties Aipin Manteiga, Java seedling No. 1964, Mandioca Creolinha, Java seedling No. 239, and Mandioca Tapicuru were found to be high yielders of starch (Sicam, 1933). The different varieties exhibited different demands as to amounts of fertilizer. For instance, Mandioca Basiorao required 150 kgm. per hectare of Ammo-Phos for highest yield; Aipin Valenca and Mandioca Sao Pedro Preto, 200 kgm. (Gonzalez, T., 1934). In the production of gaplek, it was found that drying in the sun was the more economical. Drying in the sun cost ₱80.63 a ton and drying artificially, ₱118.20 (Ganay, 1933). Fairly complete information has been obtained experimentally on cost of production of roots and cost of manufacture of starch and by-products of cassava (Mendiola, 1931).

RUBBER

Observations under Los Baños conditions showed that Para rubber grows more rapidly during the wet than the dry season. But, there did not seem to be any correlation between the weekly rainfull and the weekly growth of Hevea. Diameter growth was correlated with terminal growth. With Hevea there was a distinct periodicity in growth. Under dense shade its growth was poor, in partial shade, luxuriant, and in the open, only medium. A combination of fine clay loam and alluvial soil seemed most favorable to the growth of this plant (Sarmiento, 1916).

Propagation by budding, particularly patch budding, was found successful (Aguanta, 1932). The stem cuttings did not root (Albino, 1928).

Of the 15 superior strains of Hevea clons introduced into this College from the Dutch East Indies, 9 are living. These living clons are Ct. 3, Ct. 88, Tjirandji No. 1, Avros. 49, Avros. No. 80, Avros. No. 163, Avros. No. 152, B. D. No. 2, and B. D. No. 5 (Mendiola, 1931).

SUGAR CANE

Soaking sugar cane points in lime-magnesium sulfate mixture before planting was found to be the best treatment in increasing percentage and rate of germination. The composition of the mixture was 14 kgm. lime, 1.81 kgm. magnesium sulfate diluted to 200 gallons, and the duration of treatment, 48 hours. The treatment was fairly economical, costing about ₱3.00 to treat points for planting one hectare (Calma, 1933).

Husked and unhusked cane points were compared in percentage of germination, and it was found that the unhusked points gave the better result (Cortez, 1934). The length of the seed pieces also contributed to the success of the planting, the longer the seed pieces, the higher the percentage of germination. It was also found that plants grown from long seed pieces grew larger than from short (Alhama, 1933). Likewise it was found that top seed pieces gave a higher percentage of germination than the cut-back (Calma, 1933). When seed pieces are to be shipped a long distance, it was found to be necessary to cut them a little longer to give allowance for rotting in transit (Alhama, 1933). It was found that often the internodal part of the seed piece had a tendency to dry up to the next node. By experiment it was found that by disinfecting the ends of the points with a solution of mercuric bichloride and coating them with melted paraffin would minimize decay.

Seed pieces planted horizontally in the ground at a depth of about 30 cm., proved to be better than any other method (Reyes, 1924).

For rapid propagation, the combination of cut-back and splitting method proved the most efficient. In one investigation it was found that the tillering habits of canes grown by cut-back, splitting, and combination of cut-back and splitting methods of propagation did not materially differ. The canes were ready for another cutting-back in 7–8 months, although in some varieties they may be ready for propagation in 6 months. In the combination method of splitting and cutting-back, approximately 1,830 suckers, cut-back seed pieces, and stumps could be produced in 1 year and 3 months from an average stool of cane (Reyes, 1934). The application of ammonium sulfate at the time of planting increased the degree of tillering (Sabino, 1934).

Shallow tillage gave a higher tonnage of cane than the deep, but the deep produced higher Brix polarization and purity than the shallow (Pedroso, 1931). The cane should be cultivated frequently, up to at least, eight times. It was found that within this range there was a corresponding increase in yield, but not beyond this frequency (Valdez, 1933). A planting distance of 66-2/3 by 100 cm. gave the highest degree of tillering (Toribio, 1928).

In intercropping ratoon canes with legumes it was found that *Calopogonium muconoides* was very effective in controlling weeds, but it had harmful effects on the canes. Soybean and peanut were found to increase the yield of the canes and saved two processes of cultivation, off-barring and hilling up when the canes are small (Valdez, 1933).

There was no significant difference between the yield of sugar cane propagated by "lalas" and by cut-back seed pieces, except that it was found that more sugar was produced by the "lalas" method than by the cut-back method (Nuestro, 1934). The detasseling did not give a significant effect on the cane and amount of sugar produced (Sabalburo, 1934).

TOBACCO

The earliest work on tobacco in the Department was in 1914 when trials were made in the growing of Turkish tobacco. In 1919, a number of cigarette and chewing tobaccos, as the White Burley, Judy's Pride, Gooch, Adcock, White Stem Orinoco, Improved Gold Leaf, and North Carolina Warne were successfully grown (Leaño, 1919). Experiments were also conducted on the manufacture of cigarette and pipe tobacco, and the results show that there are great possibilities in the manufacture of these articles locally.

Judicious use of fertilizers, green manuring, and crop rotation resulted in a significant increase in yield of tobacco leaves (Palafox, 1916; Ramos, 1930). Tobacco worms and the occurrence of diseases were reduced to the minimum when clean culture was practiced. Under local conditions it cost about ₱200 to raise one hectare of tobacco, yielding approximately 32 piculs (Cabauatan, 1934).

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ANIMAL HUSBANDRY INVESTIGATIONS IN THE PHILIPPINES

By VALENTE VILLEGAS
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It is of historical record that when the Spaniards came to the Philippines they found here carabaos, swine and chickens (Morga, 1809). Horses, cattle and sheep were introduced during the Spanish régime (Morga, 1809). In Sulu and parts of Mindanao horses had been introduced by Malayan princes before the Spaniards came (Mackie, 1916). In reading the files of *Boletin Oficial Agricola de Filipinas*, a journal published from 1894 to 1896, inclusive, one gathers that much interest was shown by the government in improving the quality of the stock and promoting the animal industry of the country in other ways. Advice was given as to the proper methods of breeding and the best treatment of certain diseases of animals.

The last three decades of American occupation comprise the period during which scientific investigations in animal husbandry in the Philippines have been carried out. In the early part the introduction of foreign breeds of animals was given special attention. New varieties of forage plants were also imported. For these, credit is largely due to the Bureau of Agriculture and since the division of the bureau to the Bureau of Animal Industry. In the year 1915, the first feeding experiment on swine was reported by Professor Sam B. Durham, then in charge of animal husbandry work in the College of Agriculture, University of the Philippines. Since then, experimental work in animal husbandry has continued uninterrupted and with increased zeal as the years passed. Bibliography on animal husbandry investigations reveals that most of the work on which reports were published was performed in the College of Agriculture.

Observations in the introduction of foreign breeds of animals into the Philippines are interesting. In all instances, the breeds coming from temperate countries such as the United States and Australia did not live long in this country (Gonzalez, 1926). They became easy prey to diseases prevalent here, or because of high humidity and temperature they gradually lost flesh, became weak and finally died. On the other hand, breeds from Oriental countries, although poorer in conformation than those from the colder regions, found themselves "at home" in our tropical climate. They were well adapted to local conditions; in fact, the Nellore cattle are better rustlers and more hardy than the native stock.

To retain the blood of the imported stock, and at the same time to effect improvement in the animals with which they were mated, the Bureau of Agriculture, followed by the Bureau of Animal Industry, initiated a program of upgrading. From this work, significant results were obtained from the use of the Nellore, Ayrshire and Sussex breeds among cattle; from the Arabian, among horses; from the Berkshire among swine; and from the Rhode Island Red among chickens.

The College of Agriculture planned and began a program of breed improvement on a different line. In this plan the blood of the imported breeds was used to advantage. New breeds are being formed by blending the desirable attributes of the foundation breeds. The Berkjala hog represents one result of these efforts in swine. Already it has gone through the process of selection and purification for nineteen years and now it is "better than the Berkshire or any other Occidental breed for the Philippines in ability to live, grow and propagate under our conditions, and better than the native in rate of growth, size, and response to domestication and rational feeding" (Gonzalez, 1932). Similar work is being done with the Philamin, a new breed of cattle. In this breed "The aim is to blend into one breed the hardiness, good grazing qualities and resistance to disease of the Nellore; the docility, efficiency as work animals and prolificacy of the Philippine Native; and the rapid rate of maturity and excellent beef conformation of the Hereford". (Manresa, 1934).

Still another method of animal improvement resorted to consists in the betterment of such breeds as are adapted to local conditions through breeding by selection. The Bureau of Animal Industry has recently introduced a dairy breed of cattle from India, the Scindi. At the College of Agriculture, the development of a strain of Cantonese fowls known as the Los Baños Cantonese chicken was made possible by selection with emphasis on egg production. When selection was started with them the yearly production per bird was 29.8 eggs. In 1932-1933, the annual egg production ranged from 133 to 139 for each bird. "Miss Aggie" belonging to this breed laid 237 eggs one year.

Preliminary to the carrying out of feeding experiments a survey of the feed supply of the country was made. In 1903, a report on the "Forage supply of Manila" was written (1908). Later, in February, 1908, the Director of Agriculture prepared a report on "Forage Investigations in the Philippine Islands" for the Secretary of War. On September 1, 1910 (1911) the Secretary of War appointed a Forage Board with representatives from the Civil Government and the United States Army, one of the duties of which was "to investigate and report whether native forage can be substituted for that now being used by the Army in the Philippines..." The following year, Professor C. V. Piper, Agrostologist of the United States Department of Agriculture, made a study of the forage problems of the Islands and reported the results of his work under "Forage crops and forage conditions in the Philippines" appearing in Vol. IV, No. 8, of the Philippine Agricultural Review.

The feeding value of a large number of forages, principally as regards their palatibility for horses, cattle and goats, have been studied (Taleon, 1934). Also, the preparation of sound, nutritious and palatable silage made out of corn and sugar cane tops have been shown to be feasible under Philippine conditions. The coefficient of digestibility of silage made from the Yellow Flint variety of corn was determined with native carabaos.

Intensive experimentation has been carried out with the grains, mainly for fattening pigs for the market and to increase egg production in chickens. Studies were made to find out the best combination of concentrates for efficient production. New materials were tested to determine their worth for feeding purposes with a view of increasing the supply of feeds as well as to find out substitutes for standard materials on the market. One noteworthy finding in animal nutrition in the Philippines is the usefulness of prawns (*Palaemon lanceifrons* Dana), commonly known as shrimps, for animal feeding.

Among the cereals tested are corn, palay and mungo. Other feeds tried out include copra meal, corn bran (tahup sa mais) and rice bran. Animal protein supplements like shrimps, fish meal, snails (*Vivipara angularis* Muller), meat scraps, tankage and powdered buttermilk have also been tested by experimentation.

Important results have also been obtained with cane molasses, cassava and cassava refuse meal for swine and poultry.

Studies on the feed and water requirements have been made with horses, carabaos, cattle, sheep and goats. The effects of certain combinations of minerals on swine and the salt consumption of carabaos and cattle have also been determined.

Research work has not been limited to the breeding and feeding experiments already referred to. Of late, much attention has been given to the preparation of meat products such as ham, sausages and bacon. The preservation of eggs, the manufacture of dairy products and the tanning of leather have also been studied. Important contributions have been made on methods of weighing and selecting large farm animals; on the height, age, conformation, etc. of horses in Laguna and Batangas; on the feeding and management of calesa and race horses and on the performance of the latter at the San Lazaro race course, Manila; on the fertilizing value of the solid excreta of horses; on the breeding habits of the horse, ox, carabao, sheep, goat and chicken; on the dentition of carabaos and cattle in relation to their age; on the duration of service and serviceable life of work cattle; on the inheritance of color among cattle; on the effect of oophorectomy in cattle on pregnancy, lactation and beef production; on the dairy qualities of native cows and goats; on the normal activity of the carabao and chicken; on crossing the zebu with carabao; on the chemical composition of milk of native carabaos and Indian buffaloes; on the efficacy of different methods of controlling intestinal parasites in sheep and goats; on the growth and maturity of swine and chickens; on the improvement of the Philippine swine; on the relation of head characters to egg production in the Cantonese chickens; on the accuracy of weighing chickens; on the physical qualities, fertility and hatchability of hens' eggs; on the effect of artificial illumination on the growth of chicks; and on the construction of structures and equipment for farm animals.

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DEVELOPMENT OF FORESTRY IN THE PHILIPPINES

By FLORENCIO TAMESIS
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Forestry as a science is a subject new to this country and consequently a brief history of its striving against odds will not be out of place.

As early as 1865 during the Spanish régime an organization known as the "Inspeccion General de Montes" was created to take care of the administration of the public lands, forests, and mines of these Islands. Handicapped by lack of information, the service was not able to proceed as fast as desired. However, great efforts were made by the early officers in gathering and systematizing scientific information on the natural resources of the country. Among the outstanding men were M. Blanco, Fernandez-Villar, and Vidal-Soler who, with limited facilities, were able to gather valuable information and publish valuable works, particularly on systematic botany. Unfortunately, the big fire in Intramuros on September 27, 1897, destroyed the valuable natural collection, leaving nothing to guide the future but the fragmental information gathered later on and the basic laws and regulations.

In 1900, shortly after the Military Government was established in the Islands, an office known as the "Forestry Bureau" was created, which later on was organized into the present Bureau of Forestry. The service started on a general principle of the old Spanish laws with adaptation of American forestry practice primarily to meet the native necessities and customs.

Lack of knowledge of the forest wealth made it necessary to organize the service along two distinct lines, namely, administrative and investigative. These two general lines of work were carried on, the administrative attending to the various problems affecting revenue, land disposition, land reclamation, and utilization of forest products; while the investigative looked into the various technical and scientific forestry problems which presented themselves in the course of the development of the forest industry. The principal aim was and still is the perpetuation of the forest resources and finding the best uses possible for the products.

The preliminary research work carried out was mainly for the purpose of guiding the administration, exploitation and utilization of forest products and the land segregation for agricultural and industrial development.

Among the first studies made were the reconnaissance of bodies of timber of economic importance primarily to determine the character of the forests for the exploitation of their products and the delimitation of public lands for disposition under the Public Land Act. These were and still are the practical researches or studies carried on by the Bureau since its organization; and the table on page gives the figures obtained from the compilation of the work accomplished up to the end of the year 1933.

The outstanding contribution of the Bureau of Forestry to the world has been the result of scientific reconnaissance studies showing that the Dipterocarp forests of the Philippines were the predominant family type and that if a large basic lumber industry was to be developed, the woods of this family had to be used.

Technological and practical studies were concentrated on this family and the use of these woods was not only demonstrated locally for construction and other purposes, but the woods have been made known throughout the world and an export trade developed.

Aside from the purely survey work done, studies were made on various specific forestry problems, which were published in bulletins of the Bureau, and scientific articles on forestry were published in forestry and other scientific journals. Among the most important of these are the following:[1]

The Forests of the Philippines, Parts I & II, by H. N. Whitford.

Commercial Woods of the Philippines: Their Preparation and Uses, by E. E. Schneider.

Philippine Dipterocarpaceae, I & II, by F. W. Foxworthy.

Minor Products of Philippine Forests—Bulletin No. 22 (in three volumes). This bulletin contains the materials in Bulletins 15 to 21 and also considerable additional material. Edited by William H. Brown.

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[1] For complete list of publications of the Bureau of Forestry, see appendix.

Types of Forest	Estimated Area as of the Year 1932 *				Estimated Volume of Standing Timber **	
	Per Cent	Hectares	Sq. Miles	Acres	Cubic Meters	Board Feet
Virgin or Original Lowland						
Dipterocarp	36.22	10,731,955	41,436	26,519,040	1,051,731,590	445,934,194,160
Seasonal						
Molave	1.33	394,078	1,521	973,440	7,881,560	3,341,781,440
Seasonal						
Without Molave	1.33	394,078	1,521	973,440	8,275,638	3,508,870,512
Marshes (Mangrove)		(320,789)	(1,239)	(792,683)	1,924,734	816,087,216
Fresh Marsh, Nipa and Mangrove	2.07	613,062	2,367	1,514,880		
Mountain						
Mid-Mountain	6.50	1,925,944	7,436	4,759,040	PROTECTION	FOREST
Mossy	2.20	651,858	2,517	1,610,880	"	"
Second Growth Vegetation Forest						
Pine	1.77	525,403	2,029	1,298,560	26,270,150	11,138,543,600
Broad leaved	8.52	2,523,515	9,743	6,235,520	PROTECTION	FOREST
Bamboo	.10	29,630	115	73,600	"	"
Grass						
Grass or Parang	18.71	5,543,899	21,405	13,699,200		
Cultivated	21.25	6,296,178	24,310	15,558,400		
	100.00	29,629,600	114,400	73,216,000	1,096,083,672	464,739,476,928

On the collection of botanical materials and the building up of a botanical herbarium as well as in the preparation of Merrill's "Enumeration of Philippine Flowering Plants", the Bureau of Forestry personnel helped a great deal. Merrill credits the Islands with 191 families, 1,527 genera, and 8,359 species excluding ferns and fern allies. This work is a distinct contribution to the knowledge of flowering plants. In this work, particular mention was made of Mr. Hugh M. Curran, Professor of Tropical Forestry, University of the Philippines, and one of the charter members of the National Research Council of the Philippine Islands, for an exploratory survey of the whole archipelago. His immense collection of botanical material, and information about it, are of great value. Besides the work on botanical collection, there were collected and identified about 16,000 specimens of woody plants, representing one of the biggest collections of tropical woods in the world. Numerous specimens of minor forest products have been assembled in the Forest Products Museum.

The researches in the various phases of forestry played no small part in the development of the lumber and the subsidiary industries of the Philippines, which started from a million and attained in eighty-million peso trade within the short space of thirty-three years. Among the most important studies which brought about this industrial development are the following;

1. Studies of important timber species—
   (a) Anatomical study of structures which made possible correct determination of species for the industries.
   (b) Mechanical and other physical tests on timber which made possible their safe and economical use.
   (c) Tests on resistance to decay, insects, and marine wood borers which made possible the selection of the right kind of wood for various uses requiring durability under various conditions.

2. Studies on mangrove swamps and tannin manufacture which led to the establishment of a cutch factory in Zamboanga, capitalized at about ₱600,000.00.

3. Study on the anatomical structure of woods and on timber impregnation which resulted in the establishment of a commercial treating plant—creosoting and zinc-meta-arsenite treating plant.

4. Studies on other minor forest products, such as, rattan, almaciga, Benguet pine, and other products, which opened up new industrial possibilities.

5. The quest for suitable reforestation crops which resulted in the discovery of the possibility of growing Cinchona (quinine tree), wattle, mahogany and balsa and other exotic trees of economic importance in the Philippines.

In spite, however, of the progress made in the forest industries, there are still many possibilities for their development which would result in a much greater trade. Forestry research, therefore, still remains one of the most important problems, which deserves attention and serious consideration, and there are numerous other problems still unsolved, particularly of silviculture, management and utilization. Since 1907 when this work was started, over 266 projects have been developed and 165 papers published on various phases of forestry problems. At the present time, there are a number of projects in progress. With financial help, I firmly believe that more work could be accomplished, which would greatly redound to the improvement of the forest industries of the Islands, to the benefit of the government and the people.

APPENDIX A

DEPARTMENT OF AGRICULTURE AND COMMERCE
BUREAU OF FORESTRY
MANILA

LIST OF PUBLICATIONS BY THE BUREAU OF FORESTRY

BULLETIN No. 1. 1903. Report on investigation in Java in the year 1902 by ELMER D. MERRILL.

BULLETIN No. 2. 1906. The charcoal industry of the Philippine Islands by WM. M. MAULE.

BULLETIN No. 3. 1906. A compilation of notes on India rubber and gutta-percha.

BULLETIN No. 4. 1906. I. Mechanical tests, properties, and uses of thirty Philippine woods. II. Philippine sawmills, lumber market, and prices by ROLLAND GARDNER.

BULLETIN No. 5. 1906. A preliminary working plan for the public forests tract of the Insular Lumber, Negros Occidental, P. I. by H. D. EVERETT and H. N. WHITFORD.

BULLETIN No. 6. 1906. A preliminary working plan for the public forest tract of the Mindoro Lumber and Logging Company, Bongabon, Mindoro, P. I. by M. L. MERRITT and H. N. WHITFORD.

BULLETIN No. 7. 1907. A preliminary check list of the principal commercial timbers of the Philippine Islands by H. N. WHITFORD.

BULLETIN No. 8. 1908. The forests of Mindoro by MELVIN L. MERRITT.

BULLETIN No. 9. 1909. A preliminary substitute for Lignumvitae by W. I. HUTCHINSON.

BULLETIN No. 10. 1911. The forests of the Philippines. I. Forest types and products. II. The principal forest trees by H. N. WHITFORD.

BULLETIN No. 11. 1912. The uses of Philippine woods.

BULLETIN No. 12. 1912. Volume tables for round timber. Compiled by WILLIAM KLEMME.

BULLETIN No. 13. 1915. Ipil-ipil. A firewood and reforestation crop by D. M. MATHEWS.

BULLETIN No. 14. 1916. Commercial woods of the Philippines; their preparation and uses by E. E. SCHNEIDER.

BULLETIN No. 15. 1918. Philippine bamboos by WILLIAM H. BROWN and ARTHUR F. FISCHER.

BULLETIN No. 16. 1918. Philippine forest products as sources of paper pulp by WILLIAM H. BROWN and ARTHUR F. FISCHER.

BULLETIN No. 17. 1918. Philippine mangrove swamps by WILLIAM H. BROWN and ARTHUR F. FISCHER.

BULLETIN No. 18. 1919. Philippine palms and palm products by WILLIAM H. BROWN and ELMER D. MERRILL.

BULLETIN No. 19. 1919. Philippine fiber plants by WILLIAM H. BROWN.

BULLETIN No. 20. 1920. Philippine resins, gums, seed oils, and essential oils by AUGUSTUS P. WEST and WILLIAM H. BROWN.

BULLETIN No. 21. 1920. Wild food plants of the Philippines by WILLIAM H. BROWN.

BULLETIN No. 22. 1921. Minor products of Philippine forests. Three volumes. This Bulletin contains the materials in Bulletins 15-21, and also considerable additional material. Edited by WILLIAM H. BROWN.

BULLETIN No. 23. 1923. A dictionary of names applied to trees of the first, second and third groups. Compiled by the Bureau of Forestry.

BULLETIN No. 24. 1923. Commercial products from lumbang oil by A. P. WEST and F. L. SMITH.

FOREST REGULATIONS. 1926. Published in English and Spanish.

MISCELLANEOUS

ANNUAL REPORTS for recent years.

QUESTIONS AND ANSWERS ON RUBBER CULTURE IN THE PHILIPPINES by FLORENCIO TAMESIS.

LIST OF PUBLICATIONS
1907-1934

DENDROLOGY

Herbarium of the Bureau of Forestry (Division of Forest Studies and Research). By D. R. MENDOZA. *The Makiling Echo*, XIII: 1: 55-56, January, 1934. (Historical).

A dictionary of names applied to trees of the first, second, and third groups. *Bureau of Forestry Bulletin* No. 23, 1926. (Survey or Practical).

Some useful Philippine trees. By M. D. SULIT. *The Makiling Echo,* XI: 4: 215-225, October, 1932. (Survey or Practical).

Two tree species occasionally found in mangrove swamps unreported. By C. MABESA. *The Makiling Echo,* XIII: 2: 113, April, 1934. (Survey or Practical).

A preliminary check list of the principal commercial timbers of the Philippine Islands. By H. N. WHITFORD, *Bureau of Forestry Bulletin* No. 7, 1907. (Experimental or Laboratory).

The forests of the Philippines. Part II. The principal forest trees. By H. N. WHITFORD, *Bureau of Forestry Bulletin* No. 10, 1911. (Experimental or Laboratory).

Philippine mangrove swamps. By W. BROWN and A. F. FISCHER. *Bulletin* No. 16, 1918. (Experimental or Laboratory).

The trees. By F. NANO. *The Ranger,* 1: 6:7, October 1921.

A monograph of the genus Rhizophora. By F. SALVOZA. *The Makiling Echo* IX: 4: 45, October 1930. (Experimental or Laboratory).

Leaflets of Philippine Dipterocarps. By F. SALVOZA. *The Makiling Echo* XI: 2: 73-116, April, 1932. (Experimental or Laboratory).

Leaf key to leguminous trees and shrubs in the Bureau of Forestry Plantations. F. SALVOZA. *The Makiling Echo* XI: 4:188-204, October, 1932. (Experimental or Laboratory).

Dendrology lectures. *Supplement to Bulletin* No. 10. By F. SALVOZA. 1931-1934. (Philosophical or Synthetical).

Check list of Dr. Merrill's enumeration of Philippine flowering plants. 8,359 species, 1,527 genera and 191 families. By F. SALVOZA, 1934. (Experimental or Laboratory).

Check list of ferns and flowering plants of Makiling Region. By F. SALVOZA, 1934. (Experimental or Laboratory).

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APPENDIX B

ABSTRACTS

PONCE, SEVERO S. S. Mahogany as a reforestation crop. *The Makiling Echo*, 12(1):13-33, 6 fig., 1933. *Swietenia mahogani* was first introduced successfully into the Philippines in 1913; *S. macrophylla* in 1907. Both, but particularly *S. macrophylla* have grown fairly rapidly. Diams. of over 40 cm. and heights of 20-23 m. have been attained by individual trees in 14-15 years; *S. macrophylla* in 9 years. W. M. SPARHAWK. *Bio. Abs.* 8(3):745, March, 1934.

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14205. LALOG, NICANOR P. Comparative effects of the duration of direct sunlight on the establishment of plantation of camagon (*Diospyros* *discolor* Willd.) *The Makiling Echo,* 12(3):142-163, 1933. Camagon is widely distributed in the Philippines, but is nowhere abundant. It is cultivated for its edible fruit and for timber, which is adaptable for many uses. Nursery studies commenced with the sowing of seed at Los Baños in 1923; field plantations date from 1927. Rate of growth increased with length of exposure to direct sunlight up to about 7 hours a day; 5-7 hours appeared to be the optimum for successful establishment and growth; shade is necessary at least 1 year after planting. Five hours exposure is the optimum to induce early flowering and fruiting. The results indicate that camagon can be used successfully for reforestation. It has a high percentage of germination and is easy to raise in nurseries. Growth is rapid compared with other Philippine hardwoods; trees of 50-cm. diameter can be grown in 42 years. It can be planted under inferior spp., which can be cut or girdled after 1 to 2 years. It may be transplanted when 130 cm. high. W. N. SPARHAWK. *Bio. Abs.,* June-July, 1934.

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Professor A. P. RACELIS' article entitled "Sustained yield management in the Philippines" which was published in *The Makiling Echo,* volume VI, No. 2, page 2-8, April, 1927, was republished in full in the *Indian Forester,* volume LIV, No. 2, p. 118, February, 1928.

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PHILIPPINE HORTICULTURE, PAST AND PRESENT

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Four phases may be recognized in the development of horticulture in the Philippines: the period of plant introduction before the Spanish occupation; the period of plant introduction during the Spanish régime; the period of plant introduction and experimentation during the early part of the American occupation; and the improvement work through experiment and controlled or technical growing as at the present time.

Of the earliest period, very little is known, although it is certain that when the Spaniards came, there was already a fair supply of fruits and vegetables in the Philippines (Buzeta, 1850; Blair and Robertson, 1907; Craig and Benitez, 1916). According to Merrill (1912) most of these plants had been introduced, perhaps some during the early colonial days and others at a much earlier date.

During the Spanish régime, officials of the government, but chiefly the priests, introduced a large number of valuable horticultural plants, especially fruits and vegetables. Much was done to encourage the growing and multiplication of these plants. In addition to the issuance of royal decrees (Blair and Robertson, 1907) making it obligatory for farmers to plant their quota of these valuable crops, prizes were offered to farmers with the largest plantations, especially of coffee, cacao and spices (Artigas, 1922).

But there was no fixed system of planting and there was no studied plan of plant introduction. It was quite haphazard, each interested priest or government official following his own ideas. And often they were the result of circumstances. Moreover, the plants introduced were not followed through. A hindering condition was the atmosphere prevailing, which was not conducive to cooperation by the Filipinos with either government or church. Consequently, though much was done in adding to fruit and vegetable production, nothing systematic was accomplished.

With the advent of American occupation, work along plant introduction and search for superior strains grown locally were emphasized. These endeavors were carried on principally by the Bureau of Agriculture (now divided into bureaus of Plant Industry and Animal Industry) and by the College of Agriculture and in a lesser degree, by the bureaus of Education, Science and Forestry.

The Bureau of Education was first in encouraging vegetable gardening among school children (Foreman, 1908). Superior strains of seeds were obtained from reliable seed houses in the United States for planting. The establishment of home gardens was encouraged and prizes were offered for the best garden. The influence of this work which attracted a large number of contestants soon extended to parents and is now a permanent contribution by the Bureau of Education in the field of horticulture.

Among the earliest projects of the Bureau of Agriculture was the gathering from various regions within and outside the Philippines of horticultural plants and introducing these selected materials in different parts of the Philippines. At first these materials were distributed free of charge or responsibility; later, the recipients were required to make certain observations which were turned over to the interested bureau for record. As the demand increased a nominal charge was made for the planting materials. This was done to conserve the materials, as only the interested would buy, and to supplement the funds for the purchase of more materials.

The Bureau of Agriculture was very fortunate in securing in 1911 the services of Mr. P. J. Wester, horticulturist of fame and possessing a great deal of experience, thus making him the right man for developing the then almost virgin field of regulated, systematic Philippine horticulture. He proved equal to the situation. His success in the task assigned to him was marked, indeed, wonderful. For some time he had almost complete monopoly of reports on horticultural subjects in the Philippines. These reports were comprehensive and proved very useful to farmers and others interested particularly in the practical side of horticulture.[1]

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[1] For detailed information on the work of Bureau of Plant Industry see special bulletin "Bureau of Plant Industry Contributions to Knowledge of Philippine Agriculture" by Manuel L. Roxas, Jose S. Camus, and Eduardo R. Alvarado. 1931. 238 p. Bureau of Printing, Manila.

With the establishment of the College of Agriculture in 1909, courses were offered in fruit growing, vegetable raising, and in floriculture and landscape gardening. Important principles involved in the successful culture of horticultural plants were emphasized and the work was attacked more from the scientific standpoint, supplementing this with actual field observation. Most of the early planting materials came from the collection of the Bureau of Agriculture although a large number of valuable propagating materials were obtained by the College directly from various parts of the Philippines and from other countries.

The developing of the horticultural projects was considerably strengthened by the arrival in 1920 of Prof. J. E. Higgins, well trained in tropical horticulture, an experienced teacher, and a technician of high repute. Advances in horticultural studies were considerably accelerated and with the help of students majoring in the subject more researches along horticultural lines were performed and offered by students as theses for graduation from the College (Gonzalez, 1934).

The work in the Bureau of Science in horticulture was confined for the most part to chemical and botanical studies of certain fruits and vegetables. The Bureau of Forestry was instrumental in making some introductions principally along lines of shade plants and ornamental trees and planting materials used for reforestation work.

Much advancement in horticulture as has been made during the past thirty-five years, the foundation is barely laid. In fact it is only of late that the importance of the subject has begun to be appreciated by Filipinos. In countries earlier developed than the Philippines, fruits, vegetables, and flowers are considered major crops and until such a conception becomes more widespread in the Philippines, Philippine horticulture will not hold its proper place. To reach this stage a great deal of work and very painstaking studies will have to be made. The present problem is no longer the lack of propagating materials but rather the proper selection of strains and varieties for perpetuation of desirable, heritable characters and proper care of these plants from planting to disposal of the products. This would include miscellaneous orchard operations including tillage and soil management, propagation, fertilization, pruning, pollination problem, control of diseases and pests, proper presentation of the fruits and other products and even the difficult subject of marketing. Such subjects as storage, preservation, manufacture and utilization of by-products should be included.

It has not been found possible to incorporate all the literature in this necessarily brief article. A more complete bibliography on Philippine horticulture is in preparation.

Literature on Philippine horticulture may be found largely in these journals: *Boletin Oficial Agricola de Filipinas*, 1894-1896, published by the *Servicio Agricola de Filipinas; The Philippine Journal of Science*, 1906—,the Bureau of Science, Manila; *The Philippine Agricultural Review*, 1908-1929, the Bureau of Agriculture, Manila; *The Philippine Journal of Agriculture*, 1930—,the Bureau of Plant Industry; the *Philippine Agriculturist and Forester*, later, *The Philippine Agriculturist*, 1909—,College of Agriculture, University of the Philippines, Los Baños, Laguna; *University of the Philippines Natural and Applied Science Bulletin*, 1930—,U. P. Manila; *The Makiling Echo*, 1919—,School of Forestry, University of the Philippines, Los Baños, Laguna; *Philippine Public Schools*, 1928—, the Bureau of Education, Manila; *The Philippine Farmer*, 1915-1918, the Bureau of Agriculture, Manila; *The Fortnightly News*, 1930—,the Bureau of Plant Industry, Manila; *College of Agriculture Biweekly Bulletin*, 1932—,U. P. Los Baños, Laguna.

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A BRIEF SURVEY OF HORTICULTURAL WORK IN THE PHILIPPINES

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Horticulture, especially the growing of spices, has played an important role in the history of our country. For in 1521, when Magellan sailed from Spain to look for spices, he dis-discovered the Philippine Islands. Horticulture, either in the form of growing fruit trees, vegetables, flowering plants, spices, beverages, or rubber and oil producing plants, is one of the branches of agriculture proper that will contribute much to the wealth of the archipelago. Here abound many fruits, vegetables, nuts, etc.; either exotic or native, that can very well be grown profitably.

Between 1659 and 1785 a number of laws and regulations were promulgated for a greater production of some horticultural crops like coconuts, cacao, coffee, pepper, cinnamon, cloves, and some useful fruit trees and vegetables. During the Spanish régime cash prizes were offered to those who could plant and harvest more pepper, coffee, cacao, mulberry and some agronomical crops in order to promote their cultivation. And in 1822 agricultural experiment stations and acclimatization orchards, were established, particularly in Albay, Cebu, Ilocos, Iloilo, Isabela, Negros and Pampanga. In these different stations and gardens, however, emphasis had been put on the investigations of agronomical crops like tobacco, sugar cane, abaca, rice, peanuts, mungo and indigo, and hardly any attention given to horticultural crops.

In looking upon Philippine horticulture as it was before the American régime, the most striking feature, was undoubtedly the apparent neglect of its development. For horticulture, especially pomology, was then considered to be an industry of less importance than agronomy or animal husbandry, and even today the word horticulture itself is a misnomer to many and in fact it has often been subordinated to the other line of agriculture—agronomy. In the Philippines, fruit has, in the past, been looked upon as a luxury, an article that could be dispensed with.

the cultivation of plants by man, was not further advanced in the Philippines until lately. Good fruits of various kinds are now looked upon as a necessity, an aid to the proper utilization of the heavier food materials, and for invigorating the various organs of the body. Everyone now knows the value of vegetables, the medicinal plants, the beverages and the vitamin content of fruits. Besides, fruit trees are planted not only for their fruits or other products like tuba, vinegar, oil, etc., but also for their shade and their ornamental value. Vegetables, on the other hand, supply the major portion of our daily diet, and the medicinal plants, the drugs and other pharmaceutical preparations. But even with this potential value today the evident inattention to modern horticultural principles is still a common fault of the orchardists, the vegetable growers, the nursery men, etc. One who has given any study, even in a very superficial way, to the horticultural practice in the Philippines at present, must gain the impression at the very start that no considerable results can be attributed to it, in many cases the Filipino fruit or vegetable growers are not getting much from their yields.

To the Spaniards, however, credit should be given for bringing into the Islands many of our fruits, vegetables, spices, beverages, and ornamental plants of today, as well as for the establishment of the mandarin orange industry in Batangas, the coffee industry in Batangas, Mt. Province and in Mindanao, and the growing of vegetables in many parts of the archipelago.

A few years after the American occupation of the Philippines, the interest in the betterment of horticultural products was given a great impetus, as indicated by the increasing volume of inquiries and requests for seed and plant materials and the development of plantations. As regards the major activities of the Bureau of Agriculture (now Bureau of Plant Industry), since 1901 the horticultural development of this institution has had four stages, as follows: Vegetable growing up to 1910, flowering plants up to 1912, fruit and vegetable drive up to 1929, and fruit, vegetable and ornamental plants up to date.

There are but very few fruits and vegetables that are indigenous to the Philippines. Nearly all of them were introduced by the Spaniards or perhaps by the Hindus and Malayan traders during prehistoric times, and a few have been brought here since the American occupation. The introduction of seeds and plants of new or improved varieties or strains became almost at once one of the most important works of the Bureau of Agriculture (now Bureau of Plant Industry), since 1901, and the Los Baños College of Agriculture since 1908. The Bureau of Education, the Bureau of Forestry, the Bureau of Non-Christian Tribes, and the City of Manila have also contributed to further this work. This work has gradually gained ground until both institutions—the Bureau of Plant Industry and the Los Baños College of Agriculture—were unable to meet the demand of the farmers. As a result of this valuable piece of work there are now established in the Islands, although in a limited number, fruits, vegetables and ornamental plants of the improved varieties or strains, as for example, the Cayenne pineapple, the Hawaiian papaya, citrus fruits, avocados, vegetables, flowering plants, etc. Besides these introductions attempts have been made to domesticate some of our little known fruits and vegetables. Since 1922 there have been cultivated in one of the experiment stations of the then Bureau of Agriculture, 476 varieties consisting of 22 species of citrus, 37 varieties or strains of sweet potatoes, 31 varieties or strains of cassava, 52 varieties or strains of yams, 15 varieties or strains of gabi, 22 pineapple varieties, 227 species of fruit trees consisting of 299 varieties, 110 varieties of bananas, 15 varieties of muskmelon, 11 varieties of watermelon; and a number of coffee, tomato, cabbage, pepper, and eggplant varieties; and many other things like talinum and basella. These have been valuable additions to the horticultural flora of the Philippines.

Excepting the mandarin orange in Batangas, the lanzones in Laguna, the coconuts in Tayabas, Mindanao, Laguna, the Bicol regions, and elsewhere, the coffee in Batangas, Mindanao and Mt. Province, fruit growing in the Philippines can scarcely be said to have been handled in a business-like manner. For it is unfortunate that even the fruits that found their way here long ago, such as the lanzones, mangosteen, mandarin orange, etc., are not well disseminated in some parts of the Philippines where they can be grown equally well if not better than in their present locations. Lately, however, mango, citrus, and avocado orchards, banana and papaya plantations, and many others have been set out. There is scarcely room for doubt that the establishment of cacao, coffee, citrus fruits, spices, medicinal plants, cashew and pili nuts, mango, and banana plantations and the like, and the growing of vegetables and root crops will contribute materially to the future economic life of the country. With the present knowledge of the asexual propagation of most of our fruit trees, such as budding, marcotting, grafting and inarching, that have been popularized during the American occupation, together with our present knowledge on the proper distancing, cover cropping, varietal adaptability, the control of the various pests and diseases, the use of proper stock plants, mulching and other orchard managements, the difficulties of our fruit industry have been partly solved. During the Spanish régime asexual propagation by marcotting and by cuttings were the only ones practiced on a limited scale on our chico, ciruelas, and the like.

A number of contributions to horticultural science have been published both by the Los Baños College of Agriculture and the Bureau of Plant Industry.

Having reviewed the past and present horticultural situation in the Philippines let us turn to the statistics for the year 1932 alone to see the money drained from the Philippines, owing to the neglect of horticulture. During this period the following horticultural products were imported, which represent more than six per cent of the total importations of the Islands:

Cacao, and manufactures of	₱ 523,021
Coffee, raw and prepared	1,179,495
Cassava and potato starch	135,582
Fruits and nuts (fresh and canned)	2,274,730
Fruit juice and ginger ale	71,952
Flavoring extracts	56,170
Gums and resins	95,271
India rubber and manufactures of	2,217,329
Medicines, dyes and dyestuffs	206,427
Spices	65,856
Tea	135,301
Vegetables (fresh, dried, pickled, canned)	3,067,272
Vegetable oils (castor, olive and palm oils)	105,095
Total	₱10,133,501

The total horticultural export during the same period amounted to ₱31,910,331, but it was mostly of coconut products.

This export is more than eleven per cent of the total exports of the Islands, and is represented as follows:

Coconuts (copra, cake, meal, desiccated, shredded	₱30,910,338
Cacao	2,676
Coffee	351
Fruits and nuts (fresh and canned)	716,507
Gums and resins	137,098
Lumbang, ilang-ilang and other oils	14,438
Vegetables	2,899
Vegetable lard and butter	126,024
Total	₱31,910,331

The most important horticultural products of the Philippines in 1932, as per the Philippine Statistical Review, Vol. 1, First Quarter, 1934, No. 1, pp. 23-24, published by the Department of Agriculture and Commerce, are as follows:

Coconuts (copra, oil, tuba)	₱33,485,500
Cacao	910,530
Coffee	635,580
Citrus fruits	904,970
Castor beans	32,290
Fruits and nuts	23,364,140
Lumbang	292,940
Root crops	6,427,780
Rubber	18,000
Vegetables (fresh and dried)	2,685,880
Total	₱68,757,610

Owing to the long distance to our principal markets, the perishable nature of most of the fruits cultivated in the Philippines, and strict quarantine regulations in other countries we can hope to export but a few kinds. However, with proper handling we should have but little trouble in placing oranges, lemons, cacao, coffee, pomelos, nuts, bananas, etc., in the principal markets. Canned and frozen mangoes and other fruits for example will undoubtedly find a ready sale in other countries and by developing this industry we may also partly solve our sugar limitation problem since every can of mango will carry so many spoonfuls of sugar. Besides, jams, jellies, marmalades, fruit sirup, wines, flavoring extracts prepared from our fruits are destined to be of primary importance. In these forms the Philippine fruits may find their way not only to our nearby markets, but to those in America and Europe. At present most of the fruit preserves used in the tropics come from the Temperate Zone but there is no reason why the tropics should not at least send an equivalent amount of preserved tropical fruits in exchange.

Fruits and vegetables are the two great horticultural products, but there is a third, spices, the production of which in some countries yields great profits, like ginger, pepper, cinnamon, etc. Another horticultural product to be considered is the cultivation of medicinal plants.

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PLANT PEST AND DISEASE CONTROL IN THE PHILIPPINES

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Perhaps the first governmental move toward controlling plant pests was made in the year 1909 when Mr. D. B. Mackie, then Agricultural Inspector, was ordered by the Director of Agriculture to investigate and report the damage done by the rats which were, at the time, damaging rice in various parts of Luzon. Mr. Mackie submitted his reports of his trips in the provinces of Laguna, Albay and Sorsogon in June of 1909 (1910). It was in 1912 when the first locust Act, requiring obligatory labor in the control of locusts was enacted. From that time on, the newly created Pest Control Section of the Bureau of Agriculture was engaged in the campaign against the locust. About the same year, 1912, Mr. Jones, then entomologist of the Bureau of Science, was transferred to the Bureau of Agriculture. Mr. Jones became the Chief of the Section and Mr. Mackie the Assistant Chief. Investigations on the life histories and control measures of important pests were made. However, in view of the continuous locust infestations and the lack of personnel of the section, the activities were mostly confined to locust inspection and extermination work.

In 1916, when the locust infestations abated, the investigations on the control of other plant pests and some diseases were given more impetus. Some time was devoted to the control of coconut bud-rot in the province of Laguna and the work was later extended to other coconut regions of the Philippines. The eradication of the abaca bunchy-top in the province of Cavite and Laguna was also tackled. Not long after, Mr. D. Mackie became the chief of the Plant Pest Section because of the resignation of Mr. Jones. Mr. Mackie left the service in 1918.

The former Bureau of Agriculture started its work in Plant Inspection about 1912. (Merino, Teodoro and Otanes). But this activity was confined to certifying plant materials exported to the United States. It was not until 1920 that the regular plant quarantine work was organized and functioned. Great care was taken to guard against the introduction of certain injurious pests and diseases. Fruits from Mediterranean fruit fly infested countries were excluded. Administrative Orders regarding the importation of seeds and other plant materials were promulgated.

With the increased commercial intercourse with other countries, plant quarantine work has become more complicated. Plant quarantine does not deal with plant pests alone. It also includes within its scope any organism that may disturb a given biota. Plants or animals which are not proved to be hundred per cent beneficial should be looked upon with suspicion. Every means of conveyance must be suspected as a possible carrier of pests or diseases. As the prohibition of the bringing of animals (other than insects) that might produce negative benefit could not very well be included in the Plant Quarantine Act, it later became necessary to recommend the enactment of other laws to stop the importation of birds which might prove injurious to agriculture should they become established. Certain concerns were very insistent about importing mongoose for the purpose of "controlling" field rats. We have invariably disapproved such requests. The experience of some countries with this animal has been very disastrous. To insure greater protection, the Bureau of Plant Industry maintains plant inspection service in all ports of entry in the Philippines. Our examination of parcels in these ports, both in the Custom Houses and Post Offices, total more than one million parcels a year. Our interceptions of insects and plant diseases included some of the most injurious. Among them were the sugar cane borer from Hawaii, (*Rhabdocnemis obscurus*) the coffee berry borer from Java and Sumatra, (*Stephanoderes hampei*), the San Jose scale from the United States, the powdery mildew of sugar cane from Formosa (*Sclerospora sacchari*), the grain spot from America, (*Helminthosporium oryzae*) the *Phoma citricarpa* on citrus from China and many other dangerous pests and diseases. The notorious Mediterranean fruit fly in other countries demanded our utmost vigilance. To prevent the introduction of exotic pests and diseases, importations of plant materials are either quarantined, disinfected, or fumigated. Plant materials exported are inspected, disinfected or fumigated, if necessary, before being certified. For these services, nominal charges are made and these fees make our plant quarantine unit almost self-supporting.

PLANT PEST CONTROL DONE BY THE PEST CONTROL DIVISION (PLANT SANITATION)

Locust Extermination Campaigns

Perhaps no country in the world can claim as much resourcefulness as to the ways of controlling the locust than the Philippines. We have adopted, and are employing, means that are considered primitive and wasteful by some people, but other people disagree. They believe that such methods are the best and most effective. These methods consist in driving the hoppers into the pits, digging the locust eggs out, plowing the ground in which the eggs are found, etc. and catching the flyers by means of nets. Pathogenic fungus has been tried without success; trials with poisonous gases were made without results; the bounty system was tried with disastrous effect. An array of different insecticides were used as spray. The soap-kerosene-emulsion, the resin-kerosene, the sodium arsenite, and the different kinds, grades and textures of soaps were used in experiments with more or less satisfactory results. We have found the powdered, common laundry soft soap to be the most economical and satisfactory. Gasoline blow torches were used with fair results. Aeroplane scouting and dusting was resorted to, hopper-dozers in the form of nets were tried, and wood rollers to kill hoppers were also tried. Arsenical poisons in the form of dust, solution, and baits of different carriers were, and are now, adopted. These are considered the best and most practical means of controlling locusts. The bagasse as carrier, and molasses as attractant, proved to be the best bait and most practical single remedy for hoppers (F. Vargas, 1933).

Locust Acts

Act 2472 evolved from Act 2121 and Executive Order No. 72. This Act, among other things provides for the cooperation of the different bureaus, duties of provincial and municipal officials and obligatory labor from male inhabitants from 16 to 60 years of age.

Act. No. 3146.—This law provides for taxation of male inhabitants in lieu of the above Acts. Taxation may be extended for several years regardless of the absence of infestations, until enough reserve funds to meet the exigencies of future locust invasions are had, if the Provincial Locust Board so decides.

Act No. 3163.—This Act provided ₱100,000 for scouting and fighting locusts in the isolated and remote places. Later, to make the appropriation yearly, Act 3271 was enacted. Act 3223 was enacted to supplement the preceding one, making the unexpended balance of the sum provided not revertible.

The effect of the activities due to the enforcement of the Act providing funds was gratifying. The results were the finding of permanent breeding grounds on the islands of Luzon, Mindoro and Bohol. The locusts found in the isolated areas were destroyed. The yearly ravages of Locusts in Luzon, Mindoro and Visayas were controlled. From 1924 to 1928 the infestations were greatly minimized. (Camus, 1931). In 1929 there were no known infestations. In the years 1930 and 1931 the infestations were sporadic and were easily put down. The scouting work was not extended to Mindanao because the appropriation was suspended. The island of Mindanao was suspected as a potential locust breeding ground. The present wide infestations in Mindanao, Visayas and Bicol regions, as a matter of fact, originated from some foci between Lanao and Bukidnon.

From the time the annual appropriations were abolished, the locust campaigns have been fairly successful because of special appropriations. The results are proportionate to the moral and financial support given us. However, to be clear, permanent control must not be expected from such appropriations given us. Permanent control is tied up with the population problem. Uncultivated areas must be reforested and agricultural lands must be settled and cultivated.

Coconut-Leafminer (*Promecotheca cumingi*)

The leafminer outbreak of 1929 at San Pablo was the greatest and most extensive so far known. The infestation spread rapidly; within a year's time it spread to the provinces of Laguna, Tayabas and Batangas and over seven million trees were infested. Every conceivable means of control known here and abroad was resorted to by the Bureau personnel. Many more millions of trees were saved from attack. Because of our experience here successive infestations in other coconut regions were controlled in short order.

Because of the leafminer infestation pest control was provided with more inspectors. From then on insect pests were controlled on a greater scale. The leafminer control has shown the value of pest control work both by the use of mechanical and biological methods, the extensive use of parasites, in particular. (Roxas, 1930-1932).

Control of Cane Grubs particularly those of Leucopholis irrorata. Not only has the division contributed to a considerable extent on the life history and habits of the grubs but it has also led in the actual control of the pests, particularly in Negros and in Batangas. It has been instrumental in properly emphasizing the use of parasites on the grubs, and also on other pests. This has helped induce the Philippine Sugar Association to introduce wasp parasites from Australia which were liberated in Negros.

Control of Rice Insects, particularly the Grass Armyworm (Spodoptera mauritia) Rice bug (*Leptocorisa acuta*) and rice borers, particularly *Schoenobius incertellus* and *Scirpophaga innotata.* The Division has popularized the use of calcium arsenate as a control for the armyworms. It has also evolved a field method by which the egg parasites of the rice borers and rice bugs may be liberated and continue their beneficial work. This is also employed for other insects.

Tobacco Insects. The Division has popularized the use of calcium arsenate as a remedy against tobacco leaf eating insects, particularly *Prodenia litura* and *Chloridea assulta.* Satisfactory remedies have also been found for the cigarette beetle *Lasioderma serricorne.* One of these is the use of vacuum fumigation with hydrocyanic acid and other gases. (Mackie, 1917). The early work accomplished here has, as a matter of fact, contributed to the development of the method in the United States and other countries, which is extensively used not only for the cigarette beetle but also for other insects affecting stored and other plant products.

Insects of Fruit Trees. The Division has also given due attention to the control of insects affecting fruit trees, particularly those on mango, as the mango hoppers *Idiocerus clypealis* and *Chunra niveosparsa* and the twig borer *Euclea capito.* As to Citrus, the scale insects particularly *Parlatoria ziziphus* the bark borer, *Agrilus occipitalis,* and the green bug *Rhynchochoris serrata,* have received particular attention. Extensive work on the control of Citrus insects has been done, especially in Batangas.

Insects Affecting Truck Crops. Vegetable gardeners and truck crop growers have been benefited by the work of the Division, particularly as to the control of various caterpillars, especially *Crocidolomia binotalis, Pieris Sp., Plutella maculipennis* which are very destructive to cabbage and other cruciferous plants. Spraying has become a part of the operation of many vegetable growers as a result of the work, particularly in Pampanga, Trinidad (Benguet) and Nueva Vizcaya.

Coconut Insects. Aside from the coconut leaf miner, the Division has also attended to the control of the black or rhinoceros beetle (*Oryctes rhinoceros*), red beetle (*Rhynchophorus ferrugineus*), slug caterpillars (*Thosea spp.*), red scale (*Chrysomphalus aonidum*), etc. Administrative orders have been promulgated in connection with the control of the black beetle and the red scale, based on the data that have been obtained on the biology of the insects.

Abaca Insects. The banana root weevil (*Cosmopolites sordidus*) and plant lice, bagworms and slug caterpillars, particularly *Thosea sinensis,* have received especial attention. The life history and habits and control of *Thosea sinensis* have been studied in Davao where it caused havoc to abaca and the actual control of this as well as other pests and diseases was done under the direction of the personnel of the Division.

Indeed, there is no phase of economic entomological work, there is no crop, no plant product, etc., attacked by insect or other pests, in which the services of the Division have not been sought. In the control of insects affecting ornamental plants and shade trees and stored products the Division has rendered useful service. Complaints are often received about these. So also in the control of household insects, such as cockroaches, termites and ants, about which inquiries are often received and the information and help as to the control of these furnished.

Control of Other Pests

Rats. In the control of rats, the Division is often consulted and it has given or gives not only verbal or written information but its personnel have personally directed actual field campaigns, particularly in Camarines Sur, Tayabas, Negros and in Central Luzon. The use of white arsenic has become a well known control measure practised by farmers in almost all sections of the Islands. Calcium cyanide has also been employed and planters, especially those in Negros, have become familiar with its use against rats.

Miscellaneous Pests. Under this, wild hogs, sparrows ("mayas"), porcupines, squirrels, bats, snails, slugs, earthworms, crickets, Loranthus ("dapo") should be especially mentioned on the control of which, information and actual help have been furnished to the parties concerned. Even in connection with insects and other allied creatures that affect man and domestic animals, directly and indirectly, our help has been solicited. In addition to cockroaches, inquires about houseflies, mosquitoes, ticks, poisonous spiders, etc., have been received and the information furnished.

Work on Beneficial Insects

It is necessary also to call attention to what has been accomplished in connection with beneficial insects. In the study and actual control of the many insects that are harmful to man, directly and indirectly, valuable information has also been obtained as to their natural enemies, particularly the parasites and predators, that keep such harmful insects in check. A considerable number of these beneficial insects have been identified as a result. The information thus acquired has helped serve as a basis for the introduction of parasites from other countries to control local pests. The extensive utilization of parasites as a method of control has already been alluded to in connection with the control of the coconut leaf miner. This method has also been applied in connection with other pests, such as the slug caterpillars in Davao and more recently the caterpillars which have caused havoc to the pine trees at Baguio.

Introduction of Parasites from Other Countries

The Division has attempted to introduce certain parasites from other countries to control local pests. Some of the early introductions are *Opius fletcheri,* a hymenopterous parasite of the Melon fly, and *Opius humilis,* a parasite of the Mediterranean fruit fly, introduced here to control the mango fruit fly and other fruit flies. These introductions were made early in 1923. Subsequently the Division has cooperated with the College of Agriculture and the Philippine Sugar Association in connection with the introduction of other beneficial insects. Among these are *Encarsia flavoscutellum,* to control the wooley aphis (*Oregma lanigera*) on sugar cane, two species of *Campsomeris* (*C. tasmaniaensis* and *C. radula*) for the purpose of controlling cane root grubs. Other introductions are the following: Tachinid parasites (*Ceromasia sphenophori*) from Hawaii for controlling the sugar cane weevil borer here; *Euplectrus platyhypenae,* also from Hawaii to control army worms; the lady bird beetles (*Cryptolaemus montrouzieri*) from Hawaii and the Hemerobids (*Sympherobius barberi*) from California to control mealy bugs; and the parasite (*Comperiella bifasciata*) from Japan to control the red scale destructive to coconut and other plants.

Recently (March, 1934) living specimens of the following were introduced:

1. *Trichogramma minutum:* an egg parasite particularly of lepidopterous insects.
2. *Apanteles glomeratus,* a parasite of cabbage caterpillar.
3. *Chaetogaedia monticola,* a parasite of cutworms and armyworms
4. *Frontina archippivora,* a parasite of cutworms and armyworms
5. *Archytis cirphis,* also a parasite of cutworms and armyworms
6. *Litomastix floridana* parasitizing Plusia larva
7. *Hyposoter* (cocoons)
8. *Telenomus nawai,* a parasite of the eggs of armyworms.

Along with these live specimens of toads (*Bufo marinus*) were brought from Hawaii into the Islands for the purpose of controlling injurious insects, such as root grubs and their adults, crickets, injurious moths, etc. Lately (August, 1934) at our request Mr. D. T. Fullaway, Entomologist of the Hawaiian Board of Agriculture and Forestry, sent us specimens of *Trichogramma japonicum,* a parasite of rice borers, particularly *Chilo simplex.* The Philippine Fruit Packing Corporation has also introduced the following from the Hawaiian Islands:

Silvestrina koebeli Felt, a coccidomyid predator on mealy bugs.

Diomus margipallus, a small coccinellid predator on the pineapple mealy bug.

Hyperaspis silvestri, another Coccinelid predator on mealy bugs.

Cooperation is being established with workers of other countries, so this parasite introduction work may be continued. We have also extended all available facilities at our disposal to investigators from other countries, who have come here for the purpose of getting local parasites.

Beekeeping

Several importations of Italian bees, each consisting of a few colonies, were made. We were able to maintain the colonies for a few years, but due to lack of funds, and to the pressure of pest control work the project was given up. However, the experience gained has served as a basis for future work and for furnishing information to other institutions, as well as to individuals, interested in raising Italian bees in the Philippines. In this connection some data have also been obtained on some of our local honey bees, particularly *Apis indica.* Colonies of these bees can be hived and raised for profit where nectar-bearing flowers are plentiful.

SOME HIGH LIGHTS OF THE ACTIVITIES ON PLANT DISEASE CONTROL BY THE BUREAU OF PLANT INDUSTRY

The control of plant diseases as a definite organized activity of the Bureau was not established until 1920, when the training of four graduates of the College of Agriculture by Mr. H. A. Lee, with the cooperation of the Bureau of Science, was first started.

Among the early important diseases of plants that brought forth the great need for plant disease investigations and their control are the destructive coffee rust (*Hemileia vastatrix*), the coconut bud-rot, (*Phytophthora faberi*), bunchy-top (virus) (Calinisan, 1931) of abaca and the black-rot or black pod (*Phytophthora faberi*) of cacao. The control of bud-rot was conducted as early as 1908 on account of its menace, threatening to wipe out the coconut industry. Then the bunchy-top disease totally destroyed some of the abaca plantations but at present the prospect of restoring them is very promising since the control of the disease by eradication is well in hand and more recently some varieties, Sinibuyas, Kinalabao and Putian, seem to withstand the disease in Cavite.

Abaca disease

Since the destruction of the abaca plantations in Cavite and Laguna by bunchy-top, a general survey of this most important disease was done in all principal abaca growing districts. Administrative Orders were issued to preclude the distribution of the disease to other non-infected regions. Destruction of the infected stools in Cavite and Laguna was resorted to as a preventive measure.

After a lapse of several years of investigation it was confirmed that the disease is caused by a virus and is transmitted by a black aphid, (*Pentalonia nigronervosa*). The disease practically wiped out the abaca industry in Laguna and Cavite. The prospect of restoring the industry by the finding of resistant varieties is very promising. The bud-rot disease is now well under control by eradication while the control measure studies of the diseases on cacao are still under investigation.

Immediately upon the establishment of the pathology cooperative work between the Bureaus of Agriculture and Science the control of a number of important diseases threatening the sugar industry had to be undertaken. The discovery of the introduction of powdery mildew (*Sclerospora sacchari*) of sugar cane from Formosa, Japan, and its eradication in Payatas; Fiji disease on the Calamba Sugar Estate; (Lee, 1921) mosaic disease (virus), (Reyes, 1927) pineapple disease, (*Thielaviopsis paradoxa*), red-rot, (*Colletotrichum falcatum*) (Serrano, and Marquez, 1926) of sugar cane; the control of tobacco diseases, *Pythium debaryanum, Phytomonas polycolor, Sclerotium* sp. etc.,) (Clara, 1930) in the seed beds by seed disinfection and soil sterilization, and banana wilt, (*Fusarium cubense*) were among the most important diseases that confronted the Plant Pathology staff of the Pest Control Division.

On other crops, the control of fruit rots of pineapple, (*Erwinia ananas, Thielaviopsis paradoxa*), control of citrus canker, (*Phytomonas citri*) by eradication, "dapo" on citrus, (*Loranthus philippensis*) gummosis and bark rot diseases, regulation of the distribution of seedlings and spraying with fungicides, control of stem-rot, (*Sclerotium oryzae*) (Reyes; 1929) of rice and important field diseases of tobacco such as Fusarium wilt, (*Fusarium oxysporum*) and wild fire (*Phytomonas anguatla,* (Clara, 1925) have constantly taken the attention of the personnel. Various disease problems on truck crops, field crops, including ornamental plants, and numerous diseases on orchard trees are being encountered. Control measure services in the form of demonstration and advice have now become an important established function of the Bureau of Plant Industry. For the improvement and development of this service the Bureau established its plant pathology laboratory with essential facilities and research staff. Some of the most recent important studies are on control of black-pod disease of cacao caused by *Phytophthora faberi*, die-back of cacao caused by *Gloeosporium* sp., the stem-rot of rice caused by *Sclerotium oryzeae*, control of citrus blight (*Phytophthora faberi*), the blossom blight of mango, and the control of the objectionable green spot of tobacco leaf wrappers particularly on Sumatra wrappers. A considerable number of control measure studies are also being conducted on truck crop diseases found on potatoes, potato blight (*Phytophthora infestans*, scab, *Actinomyces scabies*), various diseases on peanuts, legumes, cabbages, celery, cauliflower and other vegetable crops.

The bacterial fruitlet brown rot.—It was found at a certain altitude that this disease was not as serious as in warm regions. Timely spraying of the fruits with Bordeaux mixture before the flowers opened has been found to be a very effective control. (Serrano, 1928). With these findings about this pineapple disease, we helped a new industry capitalized by many millions of pesos.

CONCLUDING REMARKS

Plant Pest and disease control work in the Philippines is still in its infancy. A considerable amount of work no doubt has already been accomplished, even exceeding expectations, considering the facilities at our command. However, more support —moral as well as financial—is needed so as to improve the work and thus obtain more results in protecting our agricultural interests from the menace of plant pests and diseases.

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SOILS SURVEYS CLASSIFICATION AND MAPPING IN THE PHILIPPINES

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It was early in its history that the Philippine Bureau of Agriculture commenced making soil surveys. Loaned from the U. S. Bureau of Soils, Dorsey began a very important line of research for the Philippines when he surveyed and mapped the soils of the Batangas area, Luzon (1903). In addition to his Batangas survey, Dorsey spent some months travelling in the Philippines, and was able to record, although in the most general way, something of the character of the soils in the abaca regions, and in the neighborhood of a number of widely scattered parts in the Archipelago. Some little attention was also devoted to the soils and agricultural conditions in La Union Province.

But Dorsey's successor Sanchez, also loaned from the U. S. Bureau of Soils, was given neither encouragement nor facilities. From Manila after two years with the Bureau of Agriculture, Sanchez wrote in 1905 in part as follows: "It has been definitely decided by the Philippine Bureau of Agriculture not to make any soil surveys nor carry on any soil investigations along the lines conducted by the Bureau of Soils. I, therefore, have decided to return to the United States on the expiration of my two-year contract, January 1, 1906. I am sorry I failed to organize the soil survey work in this country, as I was expected to do on being sent out here; but I think you understand that I was not even given a chance to show what I could do. On the day previous to my arrival in these Islands, Prof. Scribner, the then Chief of this Bureau, had left for the United States, and a man unacquainted with the work of the Bureau of Soils, took his place. I explained to the new chief the nature of our work and the advantages to be derived from it, but failed to persuade him to allow me to carry on the work in these Islands. * * *"

The tragedy for soil science and for agricultural research as a whole is that the soil survey was not continued, even in a very modest way. If this had been done, we would today have an invaluable mass of data for many lines of soil research and for the very practical needs of soil fertility maintenance and improvement. As it is, we are still completely ignorant of even the important soil characteristics of vast and important tracts of agricultural and forestry lands of the Islands.

While after this there was little real soil survey work to record for a long time, it is well here to mention briefly some of the more important studies of Philippine soils. The Bureau of Science, with its generous support for scientific work, and its excellent laboratory equipment, made the next contribution to the knowledge of the soils of the Philippines, when Walker (1910) presented his study of the sugar cane soils of the Island of Negros. While representing much good work, as we realize now too much emphasis was placed upon conventional mechanical and chemical analyses, and the report did not give much assistance in solving the fertility problems nor materially aid in soil conservation in the most important sugar producing island of the Philippines.

Under the Bureau of Public Works G. A. Graham in 1909 and 1910 made soil surveys of certain irrigation district projects. These unpublished surveys have apparently been lost or destroyed by fire, although Cox and Arguelles (1914) have preserved a portion of one map and some of the data.

Desiring to determine the principal characteristics of the soils producing the main Philippine crops, Cox presented (1911) the results of the analyses, mostly chemical, by the Bureau of Science of 180 samples from widely scattered localities in the Islands. In Cox's study as a whole, he followed the very old but relatively fruitless method of attack upon soil classification and interpretation, namely, to attempt to characterize soils from the laboratory point of view, as contrasted with the modern and much more effective method of solving soil problems, by adequately studying the soil profile *in the field*.

A subsequent paper by Cox and Arguelles (1914) presents in a similar way the results of mechanical and chemical analyses of the soils of various regions of Luzon. As in the previous paper, the vast mass of data are presented in the hope that they will assist in the development of a soil classification based upon crops. The climatic factors are given and their controlling effect upon the crops is recognized, although there had not been appreciated the relationships which exists between the climate and the nature of the soils themselves.

In an endeavor to explain the variations in the flora on Mt. Makiling, Brown and Arguelles (1917) made a study of the soils of this mountain. After making many determinations of the chemical characteristics of the soil and of the water content of the soils, they concluded that it was the moisture content of the soil and not differences chemically that was the determining factor in the character of the flora.

To try to obtain a better understanding of the conditions surrounding the production of abaca fiber in the Philippines, Sherman (1928) working at the Bureau of Science, studied the chemical and physical characteristics of samples of abaca soils from Davao and the Bicol provinces. An innovation in his work is the attempt to rate the soils studied, as to the amount of each of the several nutrients as compared with the amounts in what he terms "standard Philippine agricultural soils", although it is not clear what data were used in establishing the standards. These studies, like all others on soils, reported from the Bureau of Science, were primarily from the laboratory point of view. Such a viewpoint, while of distinct value, can never give the broad comprehensive understanding of the soils of a region that a field survey and the making of a soil survey map can give. The most profitable and illuminating soil studies are those in which the soil survey field work, comprising the detailed study of profiles and the making of a soil map, are followed by adequate sampling and the study of these samples by suitable physical, chemical, and biological methods in the laboratory, in order to interpret the soil profile and other field observations.

In spite of the lack of interest in soil surveys and mapping on the part of the Insular Government, the writer, with the support of the late Dean Baker, was able in 1925 to interest private parties in having soil surveys made and the results published. Thus it was that soil survey maps and reports were made and published of the Silay-Saravia and La Carlota districts, Occidental Negros. (Pendleton, 1927, 1931). For the Philippine Sugar Association a reconnaissance soil survey was made of most of the agricultural lands of the province of Occidental Negros. For private parties other unpublished surveys have been made by Pendleton of tracts in Iloilo, Mindoro, Laguna, La Union and Ilocos Sur provinces. The Bureau of Forestry made possible a study of the soils of the Bokakeng Forest Management

Project, Baguio, (Pendleton and Aquino 1932); while for the Bureau of Education soil studies were made of farm school lands at Muños and Trinidad.

In connection with the instruction in soils at the College of Agriculture, thesis students under the supervision of the writer have done a vast amount of soil survey and mapping on a very intensive scale of the Campus and environs of the College. This material is still in manuscript, but hopes have been held out that it may be published.

Recently the University gave formal approval for a measure of cooperation between the College of Agriculture and the Bureau of Plant Industry, to enable the writer to devote part time to the development of a soil survey for the study of at least some strategic agricultural regions of the Islands. It remains to be seen whether or not sufficient interest and support will be forthcoming to inaugurate and maintain even a modest soil survey organization, the results of which are so desperately needed in connection with questions of diversification of crops, land classification into forest and agricultural use, soil erosion control, etc. The support of the National Research Council is solicited for the encouragement of the proposed soil survey.

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THE IMPORTANCE AND DEVELOPMENT OF SOIL CHEMISTRY AND SOIL BIOLOGY AS RELATED TO AGRICULTURE IN THE PHILIPPINES

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Soil is the foundation of agriculture, and in a country like the Philippines where agriculture is the basic industry of the people, a thorough knowledge of the soil conditions as related to crop production is a factor of vital importance. Under soil conditions there are two fundamental studies which are directly concerned, namely: the chemistry of the soil and the microbiological activities occurring in the soil.

SOIL CHEMISTRY

Soil chemistry deals with the reserve plant foods present; it is an index of the potential fertility of the soil.

Possibly the first work along systematic study of the chemical composition of soil, in relation to soil fertility for higher crop production, was done at Rothamsted Experiment Station in Harpenden, England. This is the oldest experiment station in the world. The results obtained from this station have been the basis of various investigations all over the world. In later years other European countries, including the United States, have established similar experiment stations although modified to a certain extent to fit local conditions.

The work on soil survey in the United States was formerly based on soil classification but in later years, due to the rapid decrease of the fertility of the soil because of continuous cropping, chemical analysis became the important program in soil survey. In view of this, Hopkins, (1910) Hilgards, (1906) and Lyon (1915), considered the foremost soil men of the United States, wrote books advocating the maintenance of soil fertility by fertilization and proper management.

Today as the result of intensive study on the chemical composition and physical condition of soil in agricultural lands, Hawaii and Java were able to produce the highest yield of sugar per unit area. It is admitted, however, that other factors such as improved varieties, control of diseases and pests, have contributed also toward higher production. In Hawaii, the Sugar Planters Association maintained, under the supervision of experts, an experiment station at Honolulu for chemical and biological work on soil. (The work on soil in the Federal Station in Java is the biggest activity of the station). Dr. Arrhenius, the Swedish chemist, has been engaged under contract by the Javanes Government to undertake the chemical soil survey in Java. As a result of this extensive work on soil, Java today ranks the highest in sugar production per unit area.

In the Philippines, however, the work on soil chemistry has been very limited. Probably the work of Herbert S. Walker (1910) on "The Sugar Industry in the Island of Negros", was the first investigation done in soil chemistry. Here the author mentioned normal and poor soils and attempted to correlate the chemical analyses with the actual yield per hectare. The works of Cox, and Arguelles, (1914) and of Brown and Arguelles (1917) are also important contributions to our knowledge of the chemistry of Philippine soils.

The work of Alicante on "The Abo-Abo Soil of Occidental Negros" (Alicante, 1928) contributed very important data especially in relation to sugar cane production. Abo-abo (ash-like material), a local name, is a special type of soil found in big areas in cetrain cane districts of Occidental Negros. Previously this soil was defective for sugar cane even with the application of commercial fertilizers. The results of the investigation however, showed that the soil was lacking in colloidal property, therefore it had poor retentive power for moisture. Also because of the nature of its stratification, underlaid by gravel and rocks, the capillary water has no chance to go up to the surface soil. This condition was modified by the application of filter-press mud, a by-product from the sugar central which contains high percentages of organic matter and lime. This material was found to increase the retentive power of abo-abo soil. Today this peculiar soil type is just as productive as other normal soils of Negros.

The work of Tirona and Arguelles (1932) "The Soils of Renovated Abaca Fields in Davao and the Reported Inferior Growth of this Plant therein", published in the Philippine

Journal of Science, Vol. 52, No. 2, October, 1933, also to a certain extent correlated the chemical analysis of soil with crop production.

The College of Agriculture of the University of the Philippines also has contributed some information toward the chemistry of some soils in the Philippines.

Possibly the most intensive work on the chemistry of soil in relation to crop production has been conducted by the Chemistry Department of the Philippine Sugar Association. This department has conducted a chemical soil survey all over the cane districts in the Islands. This survey covered thousands of hectares. In connection with it fertilizer experiments were conducted in several places in each district. The results from such experiments were correlated with the chemical analyses of the soils and then given to the farmers for field application. It is safe to state that sugar cane production is the most highly developed industry in the Islands as compared with other crops.

SOIL BIOLOGY

The science of soil microbiology is still in its infancy. Burill, Beijerink, Hellriegel, Wilfarth, Lipman, Winogradsky, and a few others were responsible for the development and application of this science to agriculture. With the discovery of soil microbiology, the soil investigators today have a better grasp of the soil conditions as affecting crop production. Soil biology is an index of soil productivity.

In countries where scientific agriculture has been developed the study on the activities of the micro-organisms occurring in the soil has been found to be one of the most important investigations contributing to the success of the industry. By the action of the organisms the constituents in the oil, both of organic and inorganic origin, are transformed into available forms for the consumption of the plant. It has been proved that by chemical action alone such transformation would require a much longer period. Besides, there are groups of organisms that actually enrich the soil because they have the power to fix the atmospheric nitrogen. It has been estimated that there are 75,000,000 kilos of atmospheric nitrogen resting on an acre of soil. Through the action of the micro-organisms such nitrogen can easily be made available for the use of the plant.

Lipman, Waksman, (1932) Fred, (1916) Whiting, (1917) and many others have shown that the productivity of the soil is directly correlated with the activities of certain types of organisms inhabiting the soil.

The results of Dr. Arrhenius work on the biological survey of the sugar cane soils of Java are considered valuable contributions to the sugar industry of Java. It has been reported that the results of this investigation have been used extensively as a guide in the fertilization of sugar cane soils in Java.

At present we have very little information regarding the biological activities of our Philippine soils as related to crop production. The work of Alicante (1927) on the nitrifying power of some Philippine soils, is possibly the first one in which the activities of the nitrifying organisms were correlated with the crop producing power of the soil. Here it was shown that soils with high nitrate production were found to be productive, while soils with low nitrate production are poor. The work on "The Abo-Abo Soil of Occidental Negros," showed a direct correlation between crop production and biological activities in the soil.

The work reported in the 1929 annual report (1929-1933) of the Philippine Sugar Association, conducted on a much larger scale, showed a correlation between bacterial activities and cane production.

As agriculture, particularly in the Philippines, is becoming more complicated because of the necessity of reducing the cost of production, research on soil conditions particularly in relation to the physical, chemical, and biological properties of soil, should be emphasized.

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STATUS OF FARM MECHANIZATION IN THE PHILIPPINES

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Early attempts to introduce mechanical power for farm operations in the Philippines gave discouraging results. Miller * (1913), writing on power plowing in the Islands, made the statement that prior to the occupation of the Islands by the Americans in 1898, a set of cable plows and two or three traction engines, all of European make, were brought to the island of Negros for tests. The units were tried on sugar cane plantations. The result of the tests was so unsatisfactory that for a period of about seven years people made no further effort to use mechanical power on the farm. It was reported that in these tests, with a deep plowing of from 30 to 40 centimeters, the subsoil was brought to the surface, which gave a poor crop. The traction wheels were found to be narrow and the mechanical construction very cumbersome.

In the agricultural districts, where working animals were either butchered for food or were killed by disease during and following the period of political unrest, the need for mechanical power was felt with increasing urgency. An American-made plowing engine and gang moldboard plows were imported by the Bureau of Agriculture in 1904 and were tried in the rice region of Central Luzon. Successful results were obtained on moist sandy loam soil, but the plow failed to work on dry clay soil. Light disk plows were also tried but were found to give results only on moist soil; when the units were tried on heavy clay soil, the results were unsatisfactory.

The Bureau of Agriculture from 1905 to 1908 carried out investigations with the object in view of improving the design

* Miller, Z. K. 1913. Power plowing in the Philippines. *The Philippine Agricultural Review.* Vol. VI., No. 2, p. 66-73. *plates II-V.*

of the plows so as to make them better adapted to Philippine conditions. Alterations were made on the arrangement of disk plow settings and stronger materials were used. With these changes, the results in plowing were satisfactory on light, sandy, and moist soils, but they were still not very effective on heavy clay soil.

In large sugar centrals, steam cable plowing was done to quite an extent because it worked well where the light tractor plow or the use of draft animals failed. These steam units are not now used. Many centrals have been pioneers in the use of large cultivators, harrows, and tractors of different makes. The fuels used were steam, kerosene, gasoline, alcohol, distillate, and alcohol-blends. Strangeley, sugar centrals which for many years depended on farm machinery extensively have reverted to the use of man and animal labor for most of their tillage practices. The reason, apparently, is that some of the traction engines which used kerosene as fuel were not very successful because the engines and the plows were not strong enough to stand hard usage and were not economical.

Studies were also made by the Bureau of Agriculture in 1909-1910 on the adaptability of small walking moldboard plows. With four bullocks as the motive power, 10-inch plows were found to be fairly satisfactory on moist soils. Several American-made light plows were found to do excellent work with one bullock. The practice usually followed was first to plow the ground to a depth that the animal could easily pull, then harrow it and finally to cross plow with deeper cut.

The College of Agriculture, University of the Philippines, was one of the government entities to make an early attempt to use modern implements on the farm. But many of the tillage machines were found to be either too heavy for the draft animals or too cumbersome to use. Few of the implements fully met the specific needs. No extensive studies have been undertaken to determine the suitability of foreign-made implements to Philippine conditions.

From 1910 to date very few authentic studies have been published on tractors, gang moldboard plows, disk plows, harrows, harvesters, cultivators, or on threshing machines, hullers, grinders, etc. Publications that might show definitely the relative merits and faults of farm mechanization are not available. Apparently, there have been no reliable and extensive tests on the use of modern mechanical equipment, of labor-saving devices on the farm, and on the relation between cost of crop production and the use of machines. Extensive experimental studies are necessary to establish the basic facts and principles of methods that will meet the mechanical requirement of present agricultural practices in the Philippines.

CERAMICS IN THE PHILIPPINES AND ITS POSSIBILITIES

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In this article, an account of ceramics in the Philippines will be given and the possibilities of the industry discussed. Enamelling on metal and the manufacture of cement, gypsum, lime, and allied products will not be taken up as these industries do not really fall under the term ceramics, although they bear a close relationship to the true ceramic industries.

EARTH AND CLAY PRODUCTS

The manufacture of clay products has been carried on for a long time in groups of small establishments in thirty-six of the forty-eight provinces of the Islands. The products consist chiefly of primitive unglazed pottery ware, brick, tile, and pipes. Very little, if any, has been produced along the line of fine ceramics, although some of the manufactured ware reveals considerable skill on the part of the artisan, especially when the limited equipment and the crude implements of manufacture are taken into account.

The manufacture of pottery is practiced as a household industry in much the same way as in the Aichi and Gifu Prefectures in Japan, and in Westerwald and Bunzlau in Germany. The making of pots is done by women while the men attend to the obtaining of the raw material and the marketing of the product. The trade occupies the same place in the family economic system which hat making, embroidery, or hand weaving occupies in some towns, and the work is taken up and dropped according to the family convenience or needs. Whereas in the foreign places mentioned, the art of pottery-making has been fostered and has advanced beyond the rudimentary stage, in the Philippines the industry has remained in the same primitive state in which it was in the beginning. Pottery as a household industry has assumed respectable proportions in foreign countries and products of all kinds, from the finest porcelain to the crudest earthenware, are produced. In the Philippines the output is limited to unglazed red ware made from a mixture of alluvial ferruginous clay of high plasticity and river sand, the latter being necessary to counteract shrinkage. The methods of manufacture in vogue in the Philippines nowadays, interesting as they may be, will not be described as they would in no way be materially different from the several accounts which have appeared in the publications of the Bureau of Science. Several cuts reproduced in this article have been obtained from the publications which are given below (Adams and Pratt, 1910; Crowe, 1912; Christie, 1914; Witt, 1918; Dar Juan and Reyes, 1924-1925).

Primitive and undeveloped as the pottery industry may be in the Philippines, and limited as the output of the individual manufacturer may be, the industry is not at all insignificant. Its extent as reported by the provincial treasurers to the Bureau of Science in 1925 (more recent data not available) amounted to ₱202,784. This figure is not complete as it does not show returns from several provinces. Neither does it include the production of potteries in the vicinity of Manila. In this region, the production is fairly large and consists of flower pots (pasó), large jars (bañga), round-bottomed pots (palayok) for cooking rice, containers for sugar, rice, vinegar (tinajas or tapayan), conical-shaped receptacles (pilones) used in the manufacture of sugar. These products are readily sold on account of the proximity of the places of manufacture to populated centers. The census report of 1918 shows that even 14 years ago the annual production in the vicinity of Manila amounted to ₱96,869. In spite of the use of imported household utensils such as aluminum, enamel, and metal-ware, which have to some extent displaced the products of local potteries in recent years, it would not be an exaggeration to place the annual production of pottery and clay products in the Philippines at about half a million pesos. Adams and Pratt estimated this at ₱400,000 for 1909, while the census report for 1918 placed it at ₱434,227.88. According to 1918 Census, during the period from 1903 to 1918, the number of pottery establishments in the Philippines registered an increase of 60 per cent.

A half million pesos derived from an industry which has remained undeveloped, should provide an incentive to help it forge ahead. Modern methods of manufacture will certainly give the pottery industry a greater impetus and make it more efficient. In the opinion of the writer, gradual development which would not involve large investments should start with the production of more glazed articles to replace the red unglazed ware of the market, and the introduction of a suitable type of furnace to obtain better burning. Improvement in the quality of the products would create a better appreciation of the ware by the consumer and the pottery industry could then command a better market.

The manufacture of ceramic material for constructional work such as common and sintered bricks, sand-lime brick, refractory silica ware, vitrified tiles, and sintered sewage pipes offers alluring incentives for exploitation. Suitable raw materials in workable quantities have been proven to exist. Experiments on these materials were undertaken by the Bureau of Science and the results have established their suitability for the purpose. (Cox, Reibling and Reyes, 1912; Witt, 1916). The table of imports given below was obtained from the annual report of the Insular Collector of Customs.

Imports	*1931*	*1930*	*1932*
Fire-brick	₱133,256	₱187,213	₱165,910
Other brick	15,147	37,482	7,130
Tiles	177,823	159,359	6,409
Sewage pipes and conducts	142,478	37,621	157,511
Total	₱340,478	₱421,675	₱336,960

These figures show that there is a market for the above mentioned products. The problem of fuel and means of transportation should be solved, in the opinion of the writer, before the class of goods described could be successfully exploited. The use of oil-fired furnaces and the development of a kiln suitable for firing with coconut shells shall reactive due consideration. In several countries of South America, coconuts and coconut shells have been used as fuel with favorable results.

The prospect of manufacturing white ware and porcelain does not seem to be so attractive. In the past only two serious attempts to make porcelain have been registered in the Philippines. A Japanese merchant, M. Tagawa, built and operated a kiln in Bocaue, Bulacan. A more serious effort was made by Enrique Zobel who built a plant and installed some machinery on the Pasig River west of San Pedro Macati. Some fine specimens were produced in this factory. Both enterprises failed, and with their failure efforts to make porcelain and sintered ware of a better quality ceased.

There are many deposits of white burning or light colored earths in the Philippines. Quartz of a grade suitable for the manufacture of fine ceramic ware is not wanting, but the known sources are located at a considerable distance from the clay deposits. What has been said of quartz applies equally well to feldspar and feldspathic materials. As far as the writer is aware, no promising source of feldspar has been reported so far. Nature does not seem to have been as kind to the Philippines as it has been to such places as Tokitsu, Tajimi, and Seto in Japan, Meissen in Germany, and Karlsbad in Czechoslovakia, where all raw materials are centralized in one spot and where the cost of transportation and fuel are reasonably low. Porcelain and vitrified ware could be made out of Philippine raw materials, but it is doubtful if under existing conditions the local product could be manufactured at a cost which would enable it to compete with ware imported from countries which have the advantages of priority in the industry, of a centralized source of raw materials, of a cheap source of fuel and skilled labor, and of excellent means of transportation.

GLASS

A glass factory operated in Santa Ana some time ago was the forerunner to the present plant in San Juan. This plant turns out bottles for its chief product and operates mainly on "cullet" (broken glass). The operation of the factory is very intermittent and its production does not meet the demand. The total imports of glass and glassware for 1931 amounted to ₱1,376,391 of which ₱465,173 corresponds to imports of empty bottles, jars and demijohns, and ₱263,287 to tableware. The manufacture of these articles could well be undertaken in the Philippines. Dar Juan and Elicaño conducted experiments which demonstrated the feasibility of Philippine raw materials for glass making. When the relatively high cost of fuel and transportation, and the lack of skilled labor in the Philippines are considered, it would seem as though it would be inadvisable to exploit the industry with small plants similar to the one operating in San Juan. The cost of production of such a plant is too high to enable the product to compete successfully with the imported. A plant equipped with oil-fired day tanks of about two tons glass capacity in conjunction with semi-automatic blowers of a type similar to the Schiller machine would be more efficient and desirable. Such a plant would operate on fuel oil, which is cheap in the Philippines. It would be less dependent on skilled labor which is locally very expensive and scarcely available. The use of tanks instead of crucible pots for melting glass would lessen the hazard of breakage and the consequent outlay on crucible. A two ton day tank would cost approximately ₱6,000. Blowing machines and molds to operate with such a tank would require a similar outlay of capital. Such a plant should meet the demand for bottles, flasks, tumblers, and small pressed ware.

With the development of the ceramic industries in the Philippines, nearly two and a half million pesos worth of imports could be retained in the Islands and an excellent source of employment for the masses would be provided. At a time when all nations are striving to become self-sufficient, to give serious thought to the exploitation of the ceramic industries would not be amiss.

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TESTS AND STANDARDS

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Section 1875 of Act No. 2711, known as the Administrative Code, provides, as one of the functions of the Bureau of Science, to "maintain laboratories respectively devoted to chemistry .... in which shall be conducted all government work appropriate to their several functions, whether required by the Bureau of Science itself or other Departments or Bureaus of the Insular Government."

It has therefore been a general policy to perform various tests on supplies and materials purchased by the Philippine Goverment such as food, drugs, building and road materials, paints and oils, textiles, etc., at the Bureau of Science, as a protective step in the buying and accepting of delivery of said supplies and materials. Oftentimes the Bureau of Science is called upon to settle controversies between the government purchasing office and private individuals and firms regarding the delivery of goods, and it has been found necessary to draft certain sets of tests for the various articles purchased. These sets of tests constitute the specifications for class or quality of materials required by the Government. The Federal Government Specifications, the U. S. Navy Specifications, and the Specifications of the American Society for Testing Materials are followed as much as possible except for some minor changes to suit them to local conditions.

The largest industrial enterprises of the country, among which may be mentioned the cement industry, the lime industry, the sugar industry, the paint and oil industry, all owe their existence to this particular activity of the Bureau. Thousands of tests on cement and concrete are made annually. Physical tests on steel, rope, asphalt, bricks, tiles, stones, cloth, paper, are also performed. Analyses are made of rocks, clays, minerals, soils and fertilizers, iron and steel, paints, pigments, oils, metals and alloys, crude chemicals, cellulose materials, waters, for the government as well as for private individuals, and these analyses constitute the basis for the establishment of other industries.

The Bureau of Science, in accordance with Article 2711, is the Custodian of the fundamental Standards of weight, the kilogram "L" and the fundamental standard of length, the meter No. 20, for the Philippine Islands. These standards have been compared by the International Bureau of Weights and Measures at Severs, France and have been declared by law the fundamental standards of the government. The standardization of weights and measures thus becomes one of the regular functions of the Bureau. Comparisons of the secondary standards of weights and measures used by the Provinces and Municipalities are periodically made with the primary standards.

This laboratory of tests and standards is really the nucleus of industrial research because here one makes an acquaintance with the constituents that go into the manufacture of industrial products. One gets a large amount of information regarding our local natural resources. Here is the rich hunting ground for any researcher.

A large amount of research work is carried on in the U. S. Bureau of Standards in connection with routine work. It seems quite the logical thing to do since it is very difficult to separate routine from research or vice versa. Efficiency is always attained where these two activities go hand in hand.

Report of the National Research Council of the Philippine Islands

PART III

BIOGRAPHICAL DATA AND BIBLIOGRAPHY OF THE WORKS OF THE MEMBERS AND ASSOCIATES OF THE NATIONAL RESEARCH COUNCIL OF THE PHILIPPINE ISLANDS

The biographical and bibliographical data on the life and works of the members of the National Research Council of the Philippine Islands have been compiled in this part of the report with the coöperation of the staff of the Scientific Library of the Bureau of Science, for the purpose of making available as reference to research workers the numerous contributions of the scientists in the Philippines scattered in the different scientific publications. The bibliography is classified under three headings: books, scientific contributions and general contributions. Treatises, manuals, monographs and brochures are classified under books; original scientific articles are grouped under scientific contributions, articles of general scientific interest which are not necessarily supported with experimental observations are printed under general contributions. The Council does not pretend that this bibliography is complete, but an effort will be made to supplement it in order to make it as complete as possible. The letters and figures given after the reference in periodicals represent the call numbers of the reference as classified in the Scientific Library of the Bureau of Science.

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CAMUS, JOSE S.—Bu. of Plant Industry; 44 C. Arellano, Malabon. *Agronomy, Farming.* Malabon, Rizal, Jan. 12, 92. B. Agr., Univ. Philip., 14. Sil Chemist, Behn, Meyer & Co.; Agric. Asst., 14, Agric. Insp., 16, Supervising Insp. of Rice and Corn Stations, 20, Agron., 21, Asst. Chief, Agric. Extension, 22, Actg. Chief, Div. of Agric. Extension, Insp.-at-large, 25, Bu. of Agr.; Asst. Dir., 27, Actg. Dir. 28, Actg. Chairman, Fiber Standardization Board, Bu. of Agr., Delegate for the Bu. of Agr. to the Panama Pacific Internat. Exposition, san Francisco, Calif., 15. Member Philip. Delegation to the Internat. Agric. Conference and Exposition in London, 21. Studied Agric. conditions in Ceylon, Egypt, France, Belgium, England. Member, Philip. Delegation to the Fourth Pan-Pacific Sci. Congress in Java, 29. Travelled extensively all over Sumatra, Straits Settlements, Siam and Indo-China to make a survey of the Agric. conditions. Asst. Dir, 30, Director, 1934, Bu. of Pl. Industry. Philip. Sci. Soc. Charter member, Nat. Res. Council P. I.

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CARREON, MANUEL—Bu. of Educ., Manila; 272 Inverness, Manila; San Fernando, Pampanga. *Psychology*. San Fernando, Pamp., June 17, 99. B. A. (with honors), U. P., 17; B. A. (with Phi Beta Kappa honors), Univ. of Nebraska, 20; Columbia Univ., 21, post

CARREON, MANUEL—Continued.
graduate studies; Univ. of Chicago, 22; M. A., Univ. of Minnesota, 21; Ph. D., Univ. of Minnesota, 23. Instr. and Asst. Principal, City Schools, Manila, 17-19; Instr., and Dir., Psychology Clinic, Philip. Normal Sch., Manila, Aug. 23-July 24; Professorial lect., Univ. Philip., Baguio, 24-26; Chief Measurement Research Dept. & Supt., Academic Div., Bu. of Educ. July, 24. Am. Assn. for the Advancement of Sci., charter member, Nat. Res. Council P. I. Fellow, Am., Assn. for the Advancement of Sci.

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CLEMENTE, AMANDO—Dept. of Chemistry, Univ. Philip.; 235 Sandejas, Pasay. *Chemistry.* Pulilan, Bulacan, Oct. 25, 91. A. B., Univ. Philip., 14; M. S., U. P., 17; Ph. D., Univ. of Chicago, 20. Asst. Chemist., Bu. of Sci., Manila, 20-26; Physicist, Philip. Gen. Hosp., 24-26, 28-29; From Student Asst. to Prof. and Head of Chemistry Dept., U. P., 10; Dean, Junior Coll., U. P., Cebu, 26-27. Am. Chemical Soc.; Am. Assn. for the Advancement of Sci.; Sigma Xi; Phi Kappa Phi; Sigma Pi Sigma; Philip. Sci. Soc.; U. P. Fellow to U. S., 18-20; Charter member, Nat. Res. Council P. I.

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CLEMENTE, LEOPOLDO S.—Dept. of Zoology, U. P.; 138 Andres Bonifacio, Caloocan, Rizal; Paombong, Bulacan. *Zology.* Paombong, Bulacan, Sept. 30, 96. B. Agr., Agri. College, U. P., 17; B. S. A., Agric. Coll., Univ. of Ill., U. S., 20; M. S., 21, Ph. D., 23, Univ. of Ill. Asst. in Agron., 17-18, Asst. Agron., 18-19, Agric.

CLEMENTE, LEOPOLDO S.—Continued.
College, U. P.; Instr. in Zoology, Jr. College, U. P., Cebu, 23-25; Asst. Prof., 25-34; Asst. Prof. & Actg. Head, Dept. of Zoölogy, U. P., 34 ——. Sigma Xi; Philip. Sci. Soc.; Am. Assn. for the Advancement of Sci. Philip. Parasitological Soc.; Charter member, Nat. Res. Council P. I. Scholar in Genetics, Univ. of Ill.; Fellow in Genetics, Univ. of Ill.

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CONCEPCION, ISABELO.—College of Med., Univ. Philip.; 547 Herran; 589 Zamora, Pasay. *Physiology and Biochemistry.* Malate, Manila, July 8, 86. M. D., U. P., 12; Graduate student, Univ. of Chicago, Yale, Columbia, Harvard Med. Sch., Johns Hopkins and N. Y. Instr. in Physiology, 14, Asst Prof., 18, Asso. Prof., 22, Head, Dept. of Physiology, 26, Prof. & Head, Dept. of Physiology, Coll. of Med., 27, U. P. Philip. Sci. Soc.; Charter member, Nat. Res. Council P. I. U. P. Fellow, abroad.

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15-20; Forester, State Dept. Agr., N. C., 21-29; Prof., Tropical Forestry, Agric., Coll., Laguna; Forester, Bu. of Forestry, P. I., 29. Collaborator, Forest Research, Yale, 20. Charter member, Nat. Res. Council P. I.

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Sci.; Philip. Soc. for the Advancement of Res.; Philip. Sci. Soc.; Charter member, Nat. Res. Council P. I. Philip. Govt. Pensionado to Univ. of Wisconsin, 25-27.

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Univ. Philip., 26-30; Member, Board of Examiners for Mining Engineers, 27-30, 34; Actg. Dir., Nat. Museum, Manila, 30; Tech. Dir. of Exhibits, Philip. Participation, and Special Repres. of the Sec. of Agr., and Nat. Resources in the Internat. Colonial and Overseas Exposition of Paris, 31; Prof. of Geol., Univ. of Santo Tomas, 32; Assayer, Asst. Geol., Asst. Chief, Div. of Geol. and Mines, Chief Geologist, Bu. of Sci.; Chief, Nat. Museum Div., Bu. of Sci.; Manila, 18-33; Chief, Div. of Mineral Resources, Dept., of Agr. and Commerce; Asst. Dir., Bu. of Sci., 34. Sigma Xi; Paleontological Soc. of America, Am. Malacological Union; Conchological Soc. of Great Britain and Ireland; Philip. Sci. Soc.; Charter member, Nat. Res. Council P. I.

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23. From Graduate Asst. to Instr. in Chemistry, U. P., 16-21; Asst. Prof. and Actg. Head, Geology Dept., U. P., 24-26; Asso. Prof. and Head, Geology Dept., U. P., 28-30; Head, Dept. of Geology and Geog., U. P., 30; Official Delegate of P. I. Govt. & U. P. to the Third Pan Pacific Science Congress, Tokyo, 26. Philip. Pharm. Assn.; Sigma Xi; Fellow, Amer. Assn. for the Advancement of Sci.; Kappa Ipsilon Pi; Philip. Sci. Soc.; Sigma Pi Sigma; Am. Geog. Soc.; Charter member, Nat. Res. Council P. I.; Asso., Second Congress for Prehistoric Research in the Far East. U. P. Fellow to Chicago and Leland Stanford Jr. Univ., 21-24.

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Chief, Div. of Epidemiology, 33-34, Manila; Prof. of Biometrics, Univ. Philip., 27-34. Colegio Médico-Farmacéutico de Filipinas; Philip. Is. Med. Assn.; Am. Med. Assn.; Manila Med. Soc.; Am. Public Health Assn.; P. I. Public Health Assn; Charter member, Nat. Res. Council P. I., Rockefeller Foundation Fellow to Johns Hopkins Univ. 22-23.

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MANALANG, CRISTOBAL.—San Lazaro Hospital, Manila; 3539 Taft Ave. Ext. Psy; Nagcarlang, Laguna. *Pathology* and *Bacteriology.* Nagcarlang, Laguna, July 10, 91. M. D., Sch. of Med., Marquette Univ., Milwaukee, Wisconsin, 14; D. T. M., Univ. Philip., 17. Asst. in Path. 15; Instr. in Path. and Bact., 17; Asst. Prof. of Path. and Bact., 19, Univ. Philip.; Pathologist, Zamboanga Gen. Hosp.; Chief Pathologist, Culion Leper Colony; Delegate from the Philip. to Pan-Pacific Sci. Congress, Australia; Delegate, U. S. to the Internat. Congress of Tropical Med. and Hygiene, Cairo, Egypt. Charter member, Nat. Res. Council P. I. Awarded Univ. Philip. Alumni Assn. Medal, 33.

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Universitat Muenster, Germany, 29. Asst. Prof., Sch. of Pharmacy, U. P., 29; Instr., Coll. of Med. U. P., 24; Asst. Prof. of Chemistry and Biochemistry, Coll. of Med., Univ. of Sto. Tomas, 25; Instr., Coll. of Pharmacy, Nat. Univ., 25-27. Deutsche Chemische Gesellschaft, 31-32; Colegio Médico-Farmacéutico de Filipinas, 32; First Vice Pres., Philip. Pharm. Assn.; Philip. Sci. Soc.; Charter member, Nat. Res. Council P. I.

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TEODORO, ANASTACIO.—Agric. Coll., Laguna. *Agricultural Engineering.* Sta. Cruz, Laguna, Apr. 15, 97. B. Agr., U. P., 18; M. S., Cornell Univ., 21; Ph. D., Cornell Univ., 28; Stanford Univ., 19; Univ. of Wisconsin, 19-20; Iowa State Coll., 21. Instr., 21-25, Asst. Prof., 25-32, Asso. Prof., 32, Actg. Head, Agri. Engin. Dept., 28-33, Agric. Coll. U. P.; Head, Agric. Engin. Dept., U. P., 33; Consulting Agric. Eng., Bu. of Agr., 23-28. Phi Kappa Phi; Am. Soc. of Agric. Eng.; Soc. of Automotive Eng.; Am. Assn. for the Advance-

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ment of Sci.; Soc. for the Advancement of Research; Philip. Sci. Soc.; Charter member, Nat. Res. Council P. I.; Los Baños Biol. Club; Philip. Soc. of Technical Agriculturists. Fellow, Am. Assn. for the Advancement of Sci., Research Fellow, Iowa State Coll., 21; Philip. Govt. Fellow to U. S., 19-21, 26-28.

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Field Inspector, 24, Actg. Chief, Plant Pests Control Div., 24-27, Chief, Plant Disease Section, 27-32, Bu of Pl. Industry; Resident Plant Pathologist & Ornamental Horticulturists, Economic Garden, Los Baños, 32 ——. Am. Phytopathological Soc.; Bot. Soc. of America; Soc. of Am. Bacteriologists; Am. Horticultural Soc.; Crop Protection Institute; Internat. Crop Protection Board; Inst. of Agr. at Rome (Correspondent); Philip. Sci. Soc.; Charter member, Nat. Res. Council P. I. Fellow, Am. Assn. for the Advancebent of Sci., 34.

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de Farmacia); Colonel, Filipino Army, Med. Corps, Pharmacy Section; Congress Delegate for Zambales, Filipino Govt.; Prof. of Chem., Liceo de Manila, 00-17; Honorary Commissioner to St. Louis Exposition, 04; Pres., Pharmaceutical Examining Board, 06; Pres., Liceo de Manila, 07-13; Founder, Manila College of Pharmacy, 03; Asst. Dir. Bu. of Education, 17, Under-Sec. of Public Instr., 17 ——; Asst. Dir. of Census, 18; Acting Pres., Univ. Philip., 21. Colegio Méd.-Farm. de Filipinas, Asso., Nat. Res. Council P. I.

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ALDECOA, ELADIO R.—1740 Rizal Avenue, Manila. *Dental Surgery.* San Jose, Camarines Sur, May 8, 88. D. D. S., U. P., 20; D. M. D., U. P., 25; Certificate of Post-Graduate Instruction, Northwestern Univ. Dental School; Sec. of Faculty, Prof. in Dentistry, School of Dentistry, U. P., 21-29; Dean, Prof. & Founder, Coll. of Oral & Dental Surgery, 32-34. Sec., Nat. Dental Assn.; Pres., N.D.A., 27-28, 29-30, 34; Pres., Post-Graduate Dental Study Club, 32-34; Member, Board of Directors, Philip. Odontological Soc.; Am. Dental Assn.; Asso., Nat. Res. Council P. I. Fellow of Internat. Coll. Dentists (F. I. C. D.), 29; U. P. Fellow to Northwestern University Dental School to specialize in Dental Prosthesis and Pyorhea alveolaris, 26. Fellow to Internat. Coll. of Dentists, April 5, 29. Honorary Title (F. I. C. D.) conferred by the Board of Regents of the Internat. Coll. of Dentists.

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ALOÑA, GREGORIO.—Philip. Constabulary & Bu. of Civil Service; 727 Kansas Ave., Malate; Imus, Cavite, Apr. 24, 90. *Dental Surgery.* Imus, Cavite, Apr. 24, 90. R. N., School of Nursing, Philip. Gen. Hosp., 13; D. D. S., Philip. Dental Coll., Manila, 17; Clerk, Bu. of Lands, 08-10; Supervising Nurse, Philip. Gen. Hosp., 13-16; Chief, Sanitation, Manila Hotel, Manila, 16-17; Dental Surgeon, 18-19, Camp Claudio, Philip. Nat. Guard; Prof., Philip. Dental Coll. & Centro Escolar Univ., 27-32; Capt. & Dental Surgeon, Philip. Constabulary, Manila, 19 ——; Member of Dental Examiners, 33 ——; Chairman, Technical Committee to inspect Dental schools, 33 ——, Dept. of Public Instruction. Vice-President & Member, Board of Dir., Nat. Dental Assn.; Member, Board of Dir. Philip. Soc. of Stomatologists; Pres., Cavite Dental Assn.; Asso., Nat. Res. Council P. I. Philip. Govt. Pensionado to the Army Medical Center, Wash. Carlisle, Pa.

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The relation of oral sepsis to general health. Read at the Dental conventions.

Importance of early recognition of oral sepsis as direct factors in the development of many systemic infections. Read at Dental conventions.

Clinicians have regarded from time to time the systemic diseases with focal lesions, the teeth are usually considered the focus. Read at Dental conventions.

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Etiological factors and symptomatology. Read at Dental conventions.

Different types of pyorrhea. Read at Dental conventions.

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The effect of pyorrhea on the system. Read at Dental convention.

Treatment. Read before the Dental conventions.

The influence of the constabulary dental surgeon to the community. Read before the Dental conventions.

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Function of the dental surgeon to the organization in general. Read at Dental conventions.

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ANGELES, ESTANISLAO.—College of Engin., U. P.; 1525 Economia, Sampaloc; San Simon, Pampanga. *Electrical Engineering.* San Simon, Pampanga, May 6, 95. A. B., 17, B. S. M. E., 21, M.S.M.E., 23, U. P. Mech. Electrician, 22; Instr. in Elect. Engin., 23-24, Asst. Prof. of Elect. Eng., 26-28. Philip. Assn. of Mech. and Elect. Engin.; Asso., Nat. Res. Council P. I.

ANGELES, SIXTO DE LOS.—Metropolitan Theatre Bldg., Room 39, Manila; Coll. of Med., Univ. Philip.; 11 J. Ruiz, San Juan, Rizal. *Legal Medicine.* San Mateo, Rizal, Aug. 6, 75. A. B., San Juan de Letran, 90; Cultural & Pre-Law, Sto. Tomas, 92; L. M., Sto. Tomas, 98. Pres., Board of Health, 01-03; Repres., Philip. Assembly, 12-14; Regent, Univ. Philip. 12-14; Pres., Anti- T. B. Soc., 13-14. Colegio Médico-Farmacéutico de Filipinas; Philip. Is. Med. Soc.; Society of Medical Jurisprudence, N. Y.; Asso., Nat. Res. Council P. I.

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ANZURES, PABLO.—Coll. of Med., U. P.; 621 Economia, Sampaloc; Manila. *Legal Medicine.* Sampaloc, Manila, Aug. 17, 94. A. B., Univ. Philip., 17; M. D., Univ. Philip., 21. Instr. in Legal Medicine, U. P., 24 ——. Manila Med. Soc.; Philip. Is. Med. Asso.; Philip. Sci. Soc.; Asso., Nat. Res. Council P. I.

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AQUINO, DIONISIO I.—Agric. Coll., Laguna. *Soil Technology.* San Jacinto, Pangasinan, May 8, 98. B. Agr., Coll. of Agr., U. P., 21; B. S. A., Univ. Phiilp. 23, M. S., Iowa State Coll., 27; Ph. D., Iowa State Coll., 30. Asst. in Agro., 24-26; Instr., Soils, 30, of Agro., 31, Coll. of Agr., U. P. U. P. Research Fellow at the Iowa State Coll; Special Fellow of the U. P. to U. S.

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ARAGON, VICENTE B.—Agricultural College, Laguna. *Agronomy.* Aliaga, N. Ecija, Apr. 5, 95. B. Agr., Coll. of Agr., U. P. 32. Agric. Asst., Bu. of Agr., 18-24; Farm Manager, Bu. of Educ., Manila, 24-29; Instr. in Agro., Coll. of Agr., U. P., 29 ——. Los Baños Biol. Club.; Asso., Nat. Res. Council P. I.

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ARENAS, PROCESO R.—686 Alvarez, Sta. Cruz, Manila; San Roque, Naic, Cavite. *Medicine.* San Roque, Naic, Cavite, July 2, 97. private Practitioner. Asso., Nat. Res. Council P. I.

AVELLANA, JOSE B.—Santol Sanatorium, Caloocan, Rizal. *Medicine.* Born on Feb. 24, 91. A. B., Ateneo de Manila, 08; M. D., Univ. Sto. Tomas, 13. Medical Res. and Chief, "Sanitario", Mt. Province, 14-16; Dir. of Hosp., and Chief Interne, Mt. Prov. Hosp., 16-17. Asso., Nat. Res. Council P. I.

AYUYAO, CONRADO D.—Philip. Gen. Hosp.; Magalang Pampanga. *Eye, Ear, Nose,* and *Throat.* Magalang, Pampanga, Nov. 26, 90. M. D., Univ. Philip., 22. Instr., in Opthalmology, Otology, and Rhino-laryngology, Univ. Philip., 27-29, 30-31; Asst. in Eye, Ear, Nose, and Throat, 29, Instr. in Eye, Ear, Nose and Throat, 32 ——, U. P. Manila Med. Soc.; Philip. Is. Med. Soc.; Asso., Nat. Res. Council P. I.

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BACH, JOHN.—Coast and Geodetic Survey, Manila; 1022 Pennsylvania, Manila. *Geodesy.* Kristiansand, Feb. 10, 77. C. E., Technical School, Frondheim, Norway. Surveyor, Argentina Govt., 96-01; Surveyor & Cartographer, U. S. Coast Survey, P. I., 02 ——. Asso. Nat. Res. Council P. I.

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BALCE, SOFRONIO Y BARBIN.—Chem. Dept., U. P.; Indan, Camarines Norte. *Chemistry.* Indan, Camarines Norte, Mar. 11, 00. A. B., 20, B. S., 22, M. S., 24, U. P. Student Asst. in Chem., U. P., 19; Asst. in Chem., 22-23, Instr., 24-26, Asst. Prof. of Chem., 28 ——, U. P. Philip. Sci. Soc.; Asso., Nat. Res. Council P. I.; Amer. Assn. for the Advancement of Science.

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BALTAZAR, EULALIO P.—Agric. Coll., Laguna. *Agronomy.* San Fernando, La Union, Feb. 12, 97. B. S. A., Coll. of Agr., Univ. Philip., 22; M. S. A., Univ. Philip.; Ph. D., Univ. of Texas, 33. Student Asst. in Plant Physiology I., Coll. of Agr., 19-20; Research Student Asst. in Fiber & Oils, 20-21, Student Asst. in Agro. & Hort., 21-22, Graduate Asst., 22-25, Coll. of Agr., Univ. Philip.; Teacher, Biol. & Phys., Bu. of Educ., 25-28; Instr. in Agro., Coll. of Agric., Univ. Philip., 28 ——. A. A. S. S.; Univ. of Texas Science Club; Sigma Xi; Asso., Nat. Res. Council P. I. U. P. Special Fellow to Univ. Texas, 31-33.

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BALUYOT, SOTERO.—San Fernando, Pampanga. *Electric Engineering.* San Fernando, Pampanga, Jan. 3, 89. B. S. C. E., Univ. of Iowa, 14. Asst. Eng., Bu. of Public Works, 11; District Eng. for Isabela, Antique, Ilocos Norte, Bulacan and Pangasinan, and Special Engineer on the San Jose–Sta. Fe Road, 12-19; Engineer for the Pampanga Sugar Dev. Co., Inc., 20; Gov. of Pampanga, 25-31; Senator from the Third Senatorial District. Philip. Inst. of Engineers and Architects; Asso., Nat. Res. Council P. I.

BANKS, CHARLES S.—1411 Leveriza, Pasay, Rizal.

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zaro Hosp., 25-28; Cebu Leper Dept., 28-29; Asst. Surgeon, Bu. of Health, 29-32; Chief, Section of Nutrition, Bu. of Health, 33——. Capt., Medical Reserve Corps, U. S. Army, Manila 30; Sec., Advisory Committee on Nutrition, 33 ——. Culion Med. Soc.; Manila Med. Soc.; Cebu Med. Soc.; Far Eastern Assn. Trop. Med.; P. I. Med. Assn.; Am. Med. Soc.; Asso., Nat. Res. Council P. I.

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FELICIANO, AMADO T.—Dept. of Zoölogy, U. P.; 905 San Marcelino, Malate; San Fernando, Pampanga. *Zoölogy.* Bamban, Tarlac, Sept. 9, 97. D. V. M., Univ. Philip., 23; M. S., Univ. Philip. 32. Teacher, Tarlac High School, 23-24; Asst. Instr., Univ. Philip., 24-27; Instr., Univ. Philip., 27 ——. Philip. Sci. Soc.; Philip. Soc. of Parasitology; Asso., Nat. Res. Council P. I. U. P. Fellow to Japan, Formosa, U. S. & some European countries, 34.

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FELIZARDO, MANUEL I.—Div. of Marine Railway and Repair Shops, Bu. of Public Works; Manila. *Mechanical Engineering.* Manila, 01. B. S. M. E., (With Highest Honors), Univ. Philip., 22. Asst. Mech. Eng. in the construction of Pier 7; Actg. Supervising Eng. of the Div. of Marine Railway and Repair Shops, Bu. of Public Works; Member, Board of Exam. for Mech. Engineers, 27. Am. Soc. of Mech. Eng.; Philip. Assn. of Mech. and Electrical Engineers; Asso., Nat. Res. Council P. I.

FERNANDO, ANTONIO S.—Coll. of Med., U. P.; 817 Taft Ave., Manila; Bulacan, Bulacan. *Eye, Ear, Nose, Throat.* Bulacan, Bulacan, June 13, 93. A. B., 16, M. D., 19, U. P. Instr., 23-25, Asst. Prof., 25 ——, Eye, Ear, Nose, Throat, U. P. Manila Med. Soc.; P. I. Med. Assn.; Amer. Med. Assn.; Asso., Nat. Res. Council P. I.

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FERNANDEZ, JOSE A.—Insular Psychopatic Hosp.; Bu. of Health, Mandaluyong, Rizal. *Psychiatry.* Columbia Univ., 6 mos., 23; Certificate in Psychiatry, Harvard Univ., 24; Johns Hopkins, 2 mos., 25; N. Y. Psychiatric Inst., 6 mos., 25; M. D., Coll. of Med., U. P., 20; Resi., San Lazaro Hosp. 29-30; Asst. Alienist, Ins. Psy. Hosp., Mandaluyong, Rizal, 26. Colegio Médico-Farmacéutico de Filipinas; Manila Med. Soc.; Philip. Is. Med. Assn.; N. Y. Neurological & Psychiatric Assn.; Asso., Nat. Res. Council P. I. Philip. Govt. Fellow to Columbia Univ.; Harvard; Johns Hopkins Univ.; Psychiatrict Inst.

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FERNANDEZ Y ASIS, RICARDO.—Coll. of Med., U. P.; 1242 Pennsylvania, Malate; Balincagin, Pang. *Physical Therapy.* Balincagin, Pang., Feb. 7, 76. Asst. Prof. of Phys. Therapy, U. P., 15-19; Prof. Lect. on Phys. Therapy, U. P., 19-22; Asso. Prof. of Phys. Therapy, Univ. Philip., 27, 34 ——; Repres. at the Int. Congress of Roentgenology at Stockholm, Sweden, 28. Manila Med. Soc.; Colegio Médico-Farm. de Filipinas; Am. Radium Soc.; Asso., Nat. Res. Council P. I. Govt. pensionado to ...., 27.

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FERRIOLS, VICENTE.—Bureau of Animal Industry; 549 Maria Clara, Sampaloc. *Veterinary Medicine.* Olongapo, Zambales. D. V. M., Coll. of Agr. and Mechanical Arts, Ames, Iowa, 12. Veterinarian, Bu. of Agr., 12-16; Asst. Chief Veterinarian, 16-27; Chief, Animal Disease Control Div., 27 ——. Am. Veterinary Med. Assn.; Philip. Veterinary Med. Assn.; Asso., Nat. Res. Council P. I.

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FRANCISCO, JOSE R.—Heacock Bldg., 120 Escolta, Manila; 256 Balintawak, Caloocan, Rizal. *Dentistry.* Binondo, Manila, Nov. 15, 94. D. S. S., Coll. of Physicians & Surgeons, Northwestern Univ., 16; Philip. Nautical Sch., 2 years. Member, Board of Dental Examiners, Dept. of Public Instruction, 24-25; Member of Board of Dental Surgery, Dept. of Public Instruction, 27; First Lieut. Dental Surgeon, Philip. Nat. Guard, 18; Dean, Manila Coll. of Dentistry, 29. Asso., Nat. Res. Council P. I. Fellow, Lect. & Post Graduate Foundation of the Coll. of Physicians and Surgeons, 25.

FRANCISCO, SIXTO A.—Bu. of Health, Manila; 147 V. Mapa St., Sta. Mesa, Manila; Batangas, Batangas. *Tropical Medicine.* Batangas, Batangas, Apr. 18, 91. Liken Medical Coll., Tokyo, Japan & Imperial Univ., 11-12; Chicago Univ., 13; M. D., Coll. of Med., Univ. of Ill., 17. Coll. Physician, Coll. of Agr., U. P., 19-33; Prof. Lect. in Physiology, Coll. of Agric. 20-21; Dir., U. P. Infirmary, Los Baños, 30-33; Chief, T. B. Control Section, Bu. of Health, 33. Vice-Pres., Philip. Is. Med. Assn., 23; Miembro Titular, Colegio Médico-Farmacéutico de Filipinas; Asso. Editor, Revista-Médica, 33; Pres., Laguna Med. Soc., 33; Asso., Nat. Res. Council P. I.

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FRANCO, CECILIO.—Coll. of Med., U. P.; 755 Florida, Manila; San Luis, Pampanga. *Surgery* and *Gynecology.* M. D., Univ. Philip., 18. Instr. in Surgery and Gynecology, Coll. of Med., U. P., Attending Surgeon, Philip. Gen. Hosp.; Surgeon, U. P. Infirmary; Attending Physician and Surgeon, Maternity and Children's Hosp. Manila Med. Soc.; Philip. Is. Med. Assn.; Am. Med. Assn.; Asso., Nat. Res. Council P. I.

FRANCO, FELIX.—Fish & Game Administration, Port Area; Mexico, Pampanga. Forestry. Mexico, Pampanga, Oct. 12, 92. B. S. F., Montana State Univ., 21; M. F., Cornell Univ., 22. Dist. Forester, Baguio, Manila, Naga, 22-27; Asst. Chief, Div. of Forest Management, Bu. of Forestry, 28-30; Chief, Div. of Forest Fauna and Grazing, 31-32; Asst. Chief, Fish & Game Administration, 33-35. Sigma Xi; Philip. Sci. Soc.; Asso., Nat. Res. Council P. I. Philip. Govt. Pensionado to Montana and Cornell Univ., 19-22.

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GABRIEL, PROCESO.—Univ. of Santo Tomas; 731 Calero, Sta. Cruz, Manila. *Medicine.* Sta. Cruz, Manila, July 3, 77. A. B., Ateneo de Manila, 95; M. D., Univ. Sto. Tomas, 03. Municipal Physician,

GABRIEL, PROCESO—Continued.
Bu. of Health, Manila, 03-15; Asst. Surgeon, Philip. Health Service, 15-24. Member, Infant Mortality Committee; Chairman, Leprosy Committee; Member, Colegio Médico-Farmacéutico de Filipinas; Asso., Nat. Res. Council P. I.

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Los Baños Biol. Club; Soc. for the Advancement of Res.; Philip. Sci. Soc.; Philip. Res. Council; Am. Soc. of Plant Physiologists; Am. Soc. for Horticultural Science; Asso., Nat. Res. Council P. I. U. P. Fellow to Cornell Univ., 24-27.

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Pharm., U. P., 21-30; Asso. Prof. of Pharm., U. P., 30 ——. Philip. Is. Med. Assn.; Am. Med. Assn.; Manila Med. Soc.; Asso., Nat. Res. Council P. I.

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GUTIERREZ, MARIANO.—Bu. of Plant Ind.; 498 Vermont, Malate; Laoag, Ilocos Norte. *Agronomy.* Laoag, I. N., March 25, 92. B. S. A., U. P., 17. Asst. Agron., 24-28; Plantation Asst., Wrapper Tobacco Project, 28-30; Chief, Agro. Section, Bu. of Pl. Ind., 30 ——. Asso., Nat. Res. Council P. I.

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HENARES, HILARION G.—Continued.
Engineer, S. E., Brouser & C. San Francisco, U. S., Summer, 20; Testing & Mechanics, Fulton Iron Works, San Luis, Missouri, 22; Supt. of Fabrication, Isabela Sugar C. Inc. Asso., Nat. Res. Council P. I. Harrison Fellow to Univ. Philip., 18-19.

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HIZON, PRIMO H.—549 P. Paterno, Manila. *Pharmacy.* Mexico, Pampanga, Feb. 9, 72. Licentiate in Pharmacy, Univ. Santo Tomas, 92. Prof. in Quantitative Chemistry, 06-25. Colegio Médico-Farmacéutico de Filipinas; Asso., Nat. Res. Council P. I.

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HOCSON, FELIX.—School of Pharmacy, U. P.; 1616 Maytubig, Malate. *Pharmaceutical Chemistry.* Sta. Cruz, Manila, May 2, 84. Ph. C., Univ. Michigan, 09; Pharm. D., Sto. Tomas, Manila, 16; D. D. S., Philip. Dental Coll., 23. Instr. in Pharmacology, 10; Asst. Prof. of Pharmacy, 14; Asst. Prof. & Actg. Dir., Sch. of Pharmacy, 16, Univ. Philip.; Asso. Prof., 17, Prof. & Chief, Dept. of Pharmacy, 19, Actg. Head, Dept. of Pharm. Chemistry, & Actg., Dir., School of Pharmacy, 27, Sch. of Pharmacy, Univ. Philip. Colegio Médico-

HOCSON, FELIX—Continued.
Farmacéutico de Filipinas; Manila Medical Soc.; Philip. Pharmaceutical Assn.; Philip. Stomatologists; Nat. Dental Assn.; Asso., Nat. Res. Council P. I.

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IRA CONCEPCION, FELIX.—Manila Coll. of Pharmacy & Dentistry; 154 Villalobos, Quiapo, Manila; 2003 Rizal Ave. *Clinical Pathology.* Meykawayan, Bulacan, June 11, 97. A. B., Ateneo de Manila 15; M. D., Univ. Sto. Tomas, 20. Resident Physician, San Juan de Dios Hosp., 20-27; Actg. Prof. of Chemical Pathology, Univ. Sto.

IRA CONCEPCION, FELIX—Continued.
Tomas, 27-33; Prof. of Bacteriology, Philip. Dental Coll., 32-33; Instr. in Bacteriology, Parasitology, Manila Coll. of Pharmacy, 22-23. Colegio Médico-Farmacéutico de Filipinas; Journal Club; S. Juan de Dios Hosp.; Private Federation of Medical Practitioners; Asso., Nat. Res. Council P. I.

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JIMENEZ, JOSE.—Farmacia San Fernando. *Pharmacy.* A. B., 20; Ph. C., 21; Univ. Philip.; Phar. D., Univ. Sto. Tomas, 25. Asst. in Chem., Univ. Philip., 21; Instr. in Pharmacology, U. P., 21-23; Vice-Pres., Colegio Médico-Farm. de Filipinas, 34 ——; Prof. of Materia Médica, Afable Med. Coll.; Treas., Philip. Pharm. Assn., 31-32; Member Board of Pharm. Examiners & Insp., 30-34; Chairman, Board of Pharm. Examiners, 34 ——; Manager and Proprietor, Farmacia San Fernando. Asso., Nat. Res. Council P. I.; Philip. Sci. Soc.

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JOSON, Y PABLO TORIBIO.—Insular Psychopathic Hosp., Mandaluyong, Rizal. *Psychiatry.* Gapan, Nueva Ecija, Apr. 27, 95. B. A., Univ. Philip., 15; M. D., Univ. Philip., 20. Resident Physician, Bayom-

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bong Hosp., 20-21; Chief, Bayombong Hosp. & District Health Officer, Philip. Health Service, 21-23; Dist. Health Officer, Philip. Health Service, 23-26; Asst. Alienist, Insular Psychopathic Hosp., 28. Asso., Nat. Res. Council P. I. Fellow to Harvard Med. Sch. & other Schools in America & Europe, 26-28.

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LAUREL Y GARCIA, ALBERTO.—Bureau of Health; 5 Calle Paris, Tanauan, Batangas. *Bacteriology, Entomology.* Tanauan, Batangas, Nov. 21, 01. B. Sc., Univ. Chicago, 28. Field Dir., 28-29; Field Dir. & Gr. Bacteriologist, 29-31; Field Dir. & Entomologist 31 ——, Bu. of Health. Am. Public Health Assn.; Philip. Sci. Soc.; Soc. of Philip. Parasitologists; Asso., Nat. Res. Council P. I.

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LAVA, VICENTE G.—181 David, Manila; 74 Wilson St., San Juan, Rizal. *Chemistry.* Bulacan, Bulacan, Dec. 24, 94. B. S., U. P., 16; Ph. D., Univ. of Columbia, 23. Physical chemist, Bu. of Sci., 23-25; Asso. Prof., U. P., 25-29; Chemist, N. Y. City Appraiser's Lab., U. S. Treas. Dept., 31-34; Res. Asso., N. Y. City, 31-34; Consulting chem., Consolidated Mines Inc. Am. Assn. for the Advancement of Sci.; Am. Chem. Soc.; Philip. Sci. Soc.; Asso., Nat. Res. Council P. I.

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Philip. Govt. Traveling Fellow, 20-23; Grasselli Fellow, Oberlin Coll., 29-30.

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LEIVA, LAMBERTO.—8 Havana, Sta. Ana, Manila. *Tropical Medicine.* M. D., Univ. Philip., 17; D. T. M., Harvard Medicine, 21. Asst. in Parasitology, 17, Instr. in Parasitology, 19, Asst. Prof. of Parasitology, 21, Asso. Prof. in Parasitology, U. P.; Prof. of Parasitology, Afable Coll. of Med., 34; Editor, Journal Philip Is. Med. Ass., 25-31. Cambridge Entomological Club, Mass.; Manila Med. Soc.; Philip. Federation of Private Med. Practitioners; Asso., Nat. Res. Council P. I. U. P. Fellow to Univ. of Calif., Havana, Woods Hale Biol. Lab., 19-21.

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LEON, ANTONIO I. DE.—Agric. Coll., Laguna; Manila. *Chemistry*. Manila, July 31, 94. A. B., 18, B. S. Chem., 20, M. S., 22, U. P.; Ph. D., Univ. of Minnesota, 30. Instr. in Chem., U. P., 21-24; Asst. Prof. of Chem., U. P., 31 ——; U. P. Repres. to Amer. Assn. of Coll. of Pharm., at St. Louis, Missouri, 27. Amer. Chem. Soc.; Assn. for the Advancement of Sci.; Philippine, Sci. Soc.; Asso., Nat. Res. Council P. I. U. P. Fellow to Minnesota, 25-29.

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LIMSON, MARCIANO.—Coll. of Med., U. P.; 1063 Singalong; Guagua, Pamp. *Anatomy.* Guagua, Pamp., Jan. 11, 93. M. D., Univ. Philip, 20. Instr. in Anat., U. P., 21-24; Asst. Prof. of Anatomy, Univ. Philip., 24 ——. Manila Med. Soc.; Asso., Nat. Res. Council P. I.; Philip. Sci. Soc.; Philip. Is. Med. Assn. Rockefeller Fellow to Univ. of Minnesota, 28-30.

LLAMAS, ROSENDO, R.—Kneedler Bldg.; 524 San Marcelino. *Obstetrics.* Born in 87. M. D., Univ. Philip., 10. Private Practitioner. Manila Med. Soc.; Asso., Nat. Res. Council P. I.; Colegio Méd.-Farm. de Filipinas.

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LUCAS, PABLO.—Bureau of Printing; 1330 Herran, Manila; Polo, Bulacan. *Printing.* Polo, Bulacan, June 30, 89. Graduate of the United Typothetae Sch. of Printing, Indianapolis, 20. Apprentice Printer, Govt. Bu. of Printing, 03-06; Supt. of work, Bu. of Printing, 17-19; Dir., Bu. of Printing, 22——. Asso., Nat. Res. Council P. I. P. I. Govt. Pensionado abroad to specialize in Typography and Gen. Printing Management, 19-21.

LUISTRO, FERNANDO D.—Maridagao Rubber Station, Pikit, Cotabato. *Agronomy.* Lipa, Batangas, May 30, 91. B. Agr., Coll. of Agr., Univ. Philip., 15. Instr., Agronomy, Coll. of Agr., U. P., 20; Technical Asst. Bu. of Non-Christian Tribes, 20-27; Asst. Agronomist Bu. of Plant Industry, 27-31. Philip. Soc. of Technical Agric.; Asso., Nat. Res. Council P. I.

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MABBUN, PABLO.—Agric. College, Laguna; Cagayan. *Rural Economics.* Born in Cagayan. B. S. A., U. P. Instr. in Rural Engineering, 25 ——. Asso., Nat. Res. Council P. I. U. P. Fellow to U. S.

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MABESA, CALIXTO.—Bureau of Forestry; Hiligaran, Occ. Negros. *Wood Technology*. Hiligaran, Occ. Negros, May 8, 92. Ranger, U. P., 15; B. S. F., 23, M. F., 24, Syracuse Univ., N. Y. Ranger, 15-20, Temporary Forester, 25, Forester, 25——; Bu. of Forestry; Asst. Prof., Wood Technology, Sch. of Forestry, U. P., 34——; Asst. Chief, Div. of Delimitation and Improvement, Bu. of Forestry, 34——. Asso., Nat. Res. Council P. I. Govt. Pensionado to Syracuse Univ., N. Y., 23-25.

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MANDANAS, ANICETO Y.—Coll. of Med., Univ. Philip.; 18 Gregorio del Pilar, Manila; Taal, Batangas. *Surgery.* Taal, Batangas, Apr. 17, 88. M. D., Univ. of Ill., 16. Capt., Philip. Nat. Guard, 17-18; Asst. Prof. of Surgery, Univ. Philip. 17 ——; Asso. Prof. of Surgery, Afable Med. Coll., 33 ——. Philip. Is. Med. Assn.; Manila Med. Soc.; Philip. Federation of Private Med. Practitioner; Asso., Nat. Res. Council P. I.

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MANE, ANDRES M.—Agricultural College, Laguna. *Agricultural Zoology.* Calamba, Laguna, Nov. 30, 34. B. Agr., 29, B. S. A., 32, Coll. of Agri., U. P. Graduate Asst. in Agric. Zoölogy, Coll. of Agr., 29 ——. Los Baños Biological Club; Soc. for the Advancement of Research.; Asso., Nat. Res. Council P. I.

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MAÑOSA, MANUEL.—Bureau of Health, Manila.

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Prof. Coll. of Agr., Univ. Philip., 29——, Los Baños Biol. Club; Am. Soc. of Animal Production; Am. Genetic Assn.; Am. Assn. for the advancement of Science; Philip. Sigma; Nat. Bio. Soc.; Genetic Soc. of Am.; Philip. Sci. Soc.; Asso., Nat. Res. Council P. I. U. P. fellow to Wisconsin, 25-28; Limjap fellow to Coll. of Vet. Sci., U. P., 16-21; Student pensionado, Bu. of Educ. to Philip. Sch. of Arts and Trades, 11-13.

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PIO DE RODA, ALFREDO.—Coll. of Med., U. P.; 1599 Dapitan, Sampaloc; Indang, Cavite. *Bacteriology.* Indang, Cavite, Sept. 5, 98. A. A., 23, M. D., 28, U. P.; Certificate of Attendance, Tradeau Sch. of Tuberculosis, Sarawac Lake, N. Y., 32. Instr. in Sanitary Bacteriology and Immunology, U. P., 28-31, 33 ——. Philip. Is. Med. Assn.; Manila Med. Soc.; Asso., Nat. Res. Council P. I. Rockefeller Foundation Fellow to Trudeau Sch. of Tuberculosis, N. Y., 31-32.

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REYES, GAUDENCIO M.—Bu. of Plant Industry; 37 Mindoro, Paco; Antipolo, Rizal. *Plant Pathologist.* B. Agr., U. P., 20. From Plant Insp. to Asst. Pathologist, Bu. of Agr. 26-29; Asst. Mycologist, Bu. of Sci., 29-33; Asst. Pathologist, Bu. of Plant Ind., 33 ——. Philip. Sci. Soc.; Philip. Soc. of Technical Agriculturists; Philip. Phytopathological Soc.; Pan-Pacific Sci. Club; Asso., Nat. Res. Council P. I.

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BOOKS

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RODRIGUEZ, FILEMON.—Dept. of Public Works; 805 Nebraska, Malate; Makalelon, Tayabas. *Civil Engineering*. Makalelon, Tayabas, Dec. 25, 03. B. S. C. E., U. P., 26. Jr. Civil Engineer, Bu. of Public Works, 26; Asst. Civil Eng., 26-29; Asst. Chief, Operation and Maintenance Section, Irrigation Div., Bu. of Public Works, 29-30; Tech. Asst., Dept. of Public Works, 33 ——. Junior member, Am. Soc. of Civil Eng.; Asso., Nat. Res. Council P. I. Govt. Pensionado to U. S., 30-31.

RODRIGUEZ, JOSE NATALIO.—Bu. of Health; P. O. Box 288, Cebu, San Marcelino, Zambales. *Tropical Medicine*. San Marcelino, Zambales, Dec. 1, 96. M. D., Univ. Philip., 20; C. P. H., Johns Hopkins Graduate School, 32. Resi. Philip. Gen. Hosp., 21-22; Actg., Chief Physician, Culion Leper Colony, 24-26. Cebu Med. Soc.; P. I. Med. Assn.; Am. Med. Assn.; International Leprosy Assn. (Councilor); Asso., Nat. Res. Council P. I. Fellow to Johns Hopkins, Leonard Wood Memorial, 31-32. Fellow to India, 26-27.

BOOK

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— Pellagra in the Philippines. *Philippine Islands medical association. Journal,* v. 10: 217-221. Illus. R97.5: P57.

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ROMULO, CARLOS P.—306 Vermont, Malate; Camiling, Tarlac. *Journalism.* Camiling, Tarlac, Jan. 14, 99. B. A., Univ. Philip., 18; M. A., Columbia Univ., 21. Asst. Prof. of English, Univ. Philip., Asso. Prof. and Actg. Head of the Dept. of English, 24, Prof. Lect. of English, U. P., 28; First Editor of *the Tribune,* 25; Editor-in-Chief of the T. V. T. Publications, 30; Publisher of the D-M-H-M Newspapers. Asso., Nat. Res. Council P. I.

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ROSARIO, CASIMIRO DEL.—Dept. of Physics, U. P.; 104 Nebraska, Ermita; Bantayan, Cebu. *Physics.* Bantayan, Cebu, June 13, 96. B. S. C. E., Univ. Philip., 18; M. S., Yale Univ., 24; Ph. D., Univ. Penn., 32. Instr. in Physics, Univ. Philip, 20-22; Asst. Prof. of Physics, 33 ——. Philip. Sci. Soc.; Asso. Member, Nat. Res. Council P. I.; Sigma Xi; Am. Physical Soc.; Optical Soc. of Am. Am. Assn. for the Advancement of Sci. U. P. Fellow abroad, 22-25; Sterling Fellowship.

RUIZ, MARIANO V.—Bu. of Sci.; 709 Tennessee, Ellinwood Dorm.; Laoag, Ilocos Norte. *Chemistry.* Laoag, Ilocos Norte, Feb. 2, 01. Armour Inst. of Tech., Chicago, 21-32; Univ. of Chicago, 22-23; B. S., Univ. of Iowa, Iowa City, 29. Tech. Asst., Luzon Sugar Co., 30-31; Asst. Chemist, Phoenix Chem. Lab., Chicago, 29-32; Gen. Manager, Lu-vi-min Mg. Co., & Inc. Laoag, Ilocos Norte 32-34 ——. Philip. Lambda Upsilon; Am. Inst. of Chemical Engineers; Am. Chem. Soc.; Asso., Nat. Res. Council P. I. Fellow to study the Sewerage and Water System of Chicago, 28-29.

RUSTIA, GUILLERMO.—Coll. of Med., U. P.; 919 Taft. Ave.; Baliwag, Bulacan. *Obstetrics.* Baliwag, Bulacan, Feb. 20, 89. M. D., U. S. T., 13. Instr. in Obstetrics, U. P., 17-23; Non-Resi. Instr. in Obst., U. P., 23-26; Asst. Prof. in Obst., 26 ——; Asst. Prof. of Obstetrics, U. P. Manila Med. Soc.; Asso., Nat. Res. Council P. I.; Philip. Is. Med. Assn.

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RUSTIA-SISON, FILIBERTO.—Arias Bldg. Manila; 1926 Leveriza, Malate, Manila; Baliuag, Bulacan. *Dentistry.* Baliuag, Bulacan, Jan. 3, 95. A. B., Univ. Sto. Tomas, 18; D. D. S., Philip. Dental Coll., 20. In charge, X-Ray Dept., Coll. of Dentistry, Nat. Univ., Manila; Private Practitioner. Am. Dental Assn., Nat. Dental Assn. of the Philip. Is. Sociedad Dental de Filipinas, 25; Philip. Soc. of Stomatologists, 32; Asso., Nat. Res. Council P. I.

SACAY, FRANCISCO M.—Agricultural College, Laguna. *Agricultural Education.* Meycauayan, Bulacan, July 24, 04. B. Agr., 25, B. S. A. 27, Coll. of Agr., U. P.; M. S., 30, Ph. D., 31, Cornell Univ. Instr., Coll. of Agr., 31 ——. Am. Farm Econ. Asso.; Nat. Educ. Assn.; Soc. for the Advancement of Research; Sigma Xi; Phi Kappa Phi; Asso., Nat. Res. Council P. I. Fellow, Univ. Philip. to U. S., 28-31.

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28-31; Mycologist, Bu. of Sci., 31 ——. Asso., Nat. Res. Council P. I.

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SULIT, CARLOS.—Bu. of Forestry, Manila; 41 Basco, Intramuros; Agric. Coll., Laguna. *Forestry.* Ranger, School of Forestry, Univ. Philip. 15; M. F., Yale Forest School, U. S., 25. Ranger, Supervisor, Forester, Chief, Bu. of Forestry, 15-34; Asso. Prof. of Forest Management in U. P., Collecting & Disbursing Officer. Los Baños Biol. Club; Philip. Sci. Soc.; Soc. of Am. Foresters; Asso., Nat Res. Council P. I. U. P. Fellow to Yale Univ., 23-25.

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Sugar Central, 25-26; Asst. Engineer, Philip. Engineering Co., 26-28; Chief Engineer, Philip. Engineering Co., 28 ——; Actg. Manager, Philip. Engineering Co., 30-31; Member, Board of Examiners for Electrical Engineers, 30 ——. Rizal Center Fraternity; Philip. Assn. of Mechanical and Electrical Engineers; Asso., Nat. Res. Council P. I.

TANGCO, MARCELO.—Coll. of Lib. Arts, U. P.; 149 Solis St., Tondo, Manila. *Anthropology.* Manila, Jan. 16, 93. A. B., 16, H. S. T. C., B. S. E., 18, U. P.; M. A., Harvard Univ., 22. Instr. in Anth., 21, 24-27, U. P.; Asst. Prof. of Anth. and Entomology, 27 ——. Alpha Epsilon Sigma; Nat. Geog. Soc.; Philip. Sci. Soc.; Asso., Nat Res. Council P. I.

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17-19; Prof. and Head, Dept. of E. E. N. T., U. P., 20-34. Manila Med. Soc.; Colegio Méd-Farm. de Filipinas.; Asso., Nat. Res. Council P. I.

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VASQUEZ-COLET, ANA.—Bu. of Science; 1504 Taft Ave. Ext., Manila; Sto. Tomas, Jaen, Nueva Ecija. *Bacteriology.* Sto. Tomas, Jaen, Nueva Ecija, Sept. 1, 92. M. D., Univ. Philip., 17. Prof. of Bact. and Parasitology, Centro Escolar de Señoritas, 27-29; Asst. Bacteriologist, Bu. of Sci., 29 ——. Asso., Nat. Res. Council P. I.

VELASCO, FELIX I.—San Lazaro Hospital; 1024 Misericordia, Manila; Asingan, Pangasinan. *Obstetrics* and *Dermatology.* Asingan, Pangasinan, 93. M. D., U. P., Physician in charge, Leper Dept., San Lazaro Hosp. Manila Med. Soc.; Asso., Nat. Res. Council P. I.

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VILLA, VICTORINO.—1740 Avenida Rizal, Manila; Matalom, Leyte. *Dentistry*. Matalom, Leyte Nov. 1, 98. D. D. S., Sch. of Dentistry, U. P. 24; M. S., Northwestern Univ. Dental Scho., 31. Instr., Univ.

VILLA, VICTORINO—Continued.
Philip., 25-31; Asst. Prof., Univ. Philip., 31-32; Instr. Educ. Institute of the P. I., 32-33. Nat. Dental Assn.; Am. Dental Assn.; Asso., Nat. Res. Council P. I. Univ. Philip. Fellow to Northwestern Univ. Dental School, 30-31.

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VILLALON, AUGUSTO PIO.—Southern Is. Hosp., Cebu. Cebu. *Medicine.* Marikina, Rizal, May 5, 86. M. D., Univ. Philip. Dist. Health Officer, Bu. of Health, Laguna, 11; Physician, St. Lukes Hosp., 11.13; Pres., Sanitary Div. & in charge of Gynecology & Obstetrics Dept.,

VILLALON, AUGUSTO PIO—Continued.
Bu. of Health, 17; Actg. Dist. Health Officer & Chief, South. Is. Hosp. Cebu, 17; Chief, South. Is. Hosp. & School of Nursing, 18 ——; Dir., Maternity House & School of Midwifery, 22-32; Cebu, Special Rep. Office of the Public Welfare Commissioner, Puericulture Center-Public Welfare, 26-33; Med. Examiner, Hawaiian Sugar Planters Assn., Cebu, 17; Div. Surgeon, Philip. Railway Co., 30 ——; Company Physician, Philip. Long Distance Telephone Co. Cebu, 26 ——; Company Physician, Hao Hin & Co., 30 ——; Company Physician, Insular Navigation, 30 ——. Fellow, Am. Med. Assn.; Manila Med. Soc.; Cebu Med. Soc.; Cebu Assn. of Med & Allied Sciences; Philip. Public Health Assn., Asso., Nat. Res. Council P. I.

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VITUG, WENCESLAO.—Philip. Gen. Hosp.; 557 Pennsylvania, Manila; Lubao, Pamp. *Medicine.* Lubao, Pamp., Sept. 28, 92. B. A., U. P., 15; M. D., U. P., 18. Instr. in Med., U. P., 20-23; Non-resident Instr. in Med., U. P., 23-25; Asst. Prof. of Medicine, U. P., 25-34. Manila Med. Soc.; Philip. Is. Med. Assn.; Fellow, Am. Med. Assn.; Asso., Nat. Res. Council P. I.

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— Pt. II. The composition of Philippine woods. Anubing, balakat, malaikmo, balakat-gubat bolongeta and santol, by F. M. YENKO, LUZ BAENS, A. P. WEST and H. M. CURRAN. *Philippine journal of science,* v. 47: 343-349. Q1.P56.

— The composition of Philippine woods, by F. M. YENKO and A. P. WEST. *University of the Philippines. Natural and applied science bulletin,* v. 2: 236. Abstract. Q75.U5.

YUSON, RESTITUTO.—657 P. Florentino, Manila; Gapan Nueva Ecija. *Radiology.* Gapan, Nueva Ecija, May 19, 04. A. B., M. D., Univ. Sto. Tomas, 27. Radiologist, St. Paul's Hosp., St. Luke's Hosp., and Hosp. Español Santiago. Philip. Is. Med. Assn.; Asso., Nat. Res. Council P. I.

GENERAL CONTRIBUTIONS

1932. "La radiología como factor imprescindible en el tratamiento quirúrgico de la tuberculosis". *Revista filipina de medicina y farmacia,* v. 23: 251-256. R97.5: R4.

Report of the National Research Council of the Philippine Islands

(For the period from March 23, 1934, to February 28, 1935)

PART IV

LABORATORIES AND SOME OF THE SPECIAL EQUIPMENT AVAILABLE FOR RESEARCH

The Bureau of Science of the Department of Agriculture and Commerce, a well-known scientific institution in the Far East, has well-equipped biological and chemical laboratories in addition to laboratory facilities for work on physical tests, on standards, metallurgical analysis, fire assaying, mineral and other determinations. Furthermore, the Bureau of Science offers to research workers the facilities of its famous scientific library, and the use of its botanical, zoological, and geological collections. The different scientific departments of the University of the Philippines, including those located on the Agricultural College campus at Los Baños, Laguna; and the Bureaus of Plant Industry, Animal Industry, Forestry and the Weather Bureau, also of the Department of Agriculture and Commerce, are all equipped with facilities for research. As for medical sciences, the laboratories at San Lazaro Hospital, and the Cebu and Culion Leprosaria of the Bureau of Health, Department of Public Instruction, have facilities for research workers devoted to studies on malaria, leprosy, and tuberculosis and other communicable diseases. In research along medical sciences, the Philippine General Hospital, the San Juan de Dios Hospital and some of the other public and private hospitals are equipped with laboratories and facilities for medical research. The Bureau of Public Works of the Department of Public Works and Communications, and the College of Engineering of the University of the

Philippines, are branches of the Philippine Government having equipment useful for research in engineering.

As part of the survey that the Council is making in order to promote effective cooperation in research at home and abroad, an inquiry was made of the existence of special research equipment that are in the possession of the laboratories of the members and associates of the National Research Council of the Philippine Islands. Although the return of the replies to the questionnaire is not complete at this writing, the list below and the illustrations herein published show some of the available facilities found in the different laboratories in the Philippine Islands. This partial inventory of special equipment for different types of research would be also of interest to foreign research workers visiting in the Philippine Islands to undertake scientific investigations under tropical conditions. The equipment are given under the name of the member or associate.

AFRICA, CANDIDO.—*School of Hygiene and Public Health Laboratory, University of the Philippines.*

Dark Filer Illumination Apparatus for observations of siprochaeter, etc.
Camera lucida for drawing objects under the microscope
Clickers for rapid counting
Warm stoge
Miniature electric incubators adaptable for microscopes
Electric incubator adaptable for varying temperature
Promi Projection apparatus for studying movements of protozoa

ALVIR, ANTONIO DELGADO.—*Salacot Mining Company Laboratory, 30 Escolta.* Flotation cell (Kraut)

BUENCAMINO, VICTOR.—*Veterinary Hospital, 1026 Felix Huertas.*

Veterinary Hospital with full equipment for the treatment of small and large animals; small biological laboratory for the manufacture of anthrax serum and spoke vaccine. Dairy Industry.

CARREON, MANUEL. L.—*Bureau of Education.*

Form board and maze puzzle
Stanford-Binet intelligence scale (Philippine revision). Mechanical aptitude test

CLEMENTE, LEOPOLDO.—*Department of Zoology Laboratory, University of the Philippines.*

Frigidaire for breeding flies
Cages for mice, rats, etc.
Aquaria for fishes, and other aquatic animals

CRUZ, CORNELIO CASTOR.—*Department of Geology Laboratory, University of the Philippines.*

Drawing table with glass top and illuminator

ELICAÑO, VICTORIANO, AND LAVA, VICENTE.—*Consolidated Mines Laboratory, 181 David.*

Furnace for gold and other assays

Assay Balance, high-grade analytical balances, technical balance

ESPINOSA, JOSE C.—*Division of Tests and Standards Laboratory, Bureau of Science.*

Equipment for the testing of paper

FELICIANO, JOSE MARIA.—*Department of Geology Laboratory, University of the Philippines.*

Petrographic microscope

FRONDA, FRANCISCO.—*Department of Animal Husbandry Laboratory, College of Agriculture, Los Baños.*

Incubators for hatching eggs, battery brooder and battery laying cages

GARCIA, ARTURO.—*Department of Anatomy Laboratory, College of Medicine, University of the Philippines.*

Equipment for ordinary anatomical research

GARCIA, FAUSTINO.—*Department of Pharmacology Laboratory, University of the Philippines.*

Equipment for pharmacodynamic study of drugs

JESUS, PABLO I. DE.—*School of Hygiene and Public Health Laboratory, University of the Philippines.*

Laboratory equipment and supplies for chemical examination of water

Weston illuminometer for measuring light intensity

Basal metabolism apparatus

Different apparatus for measuring humidity, air movement, and turbidity of water

Different types of apparatus for malaria control in the School Laboratory and in the School Experimental Malaria Station at Calauan, Laguna

LARA, HILARIO.—*School of Hygiene and Public Health Laboratory, University of the Philippines.*

Calculators for statistical analysis and computation

Mechanical sorter for analysis of data

Statistical tables for analysis

Health units for study and investigation of health phenomena

MARAÑON, JOAQUIN.—*Bureau of Science Laboratory.*

Micro-Keldahl apparatus for nitrogen determination

Van Slyke apparatus for amino nitrogen

Micro-chemical balance apparatus for micro-determination of carbon and hydrogen

Gas-volumetric determination of nitrogen (micro-Dumas method)

Micro-analytical determination of methoxyl and ethoxyl

MIRANDA, LUIS.—*San Miguel Brewery Laboratory.*

All of our equipment in the San Miguel plants are specially adapted for research work along the manufacturing lines of the San Miguel and could be used by the Government after due approval of the General Manager.

NAÑAGAS, JUAN CANCIO.—*Department of Anatomy Laboratory, College of Medicine, University of the Philippines.*

Complete instruments for craniometry

Anthropometric instruments

Topographic tracing stage and ocular for the study of exact position of the body structures

Fixing, staining and mounting equipment for human tissue

Embalming and injecting equipment

OCFEMIA, GERARDO.—*Department of Plant Pathology Laboratory, College of Agriculture, Los Baños.*

Insect-proof chambers for use in insect-transmission experiments of bunchy-top of abaca, Fiji disease of sugar cane and other virus diseases

PAGUIRIGAN, DOMINGO B.—*Tobacco Research Section Laboratory, Bureau of Plant Industry.*

High-powered binocular microscope

Flue-curing barn with heating capacity from 38° to 66°C.

Paper bursting strength tester

Paper measuring caliper

QUISUMBING, EDUARDO.—*Division of Botany Laboratory, Bureau of Science.*

Herbarium fully equipped for research in systematic botany, and mycology (systematic and applied)

Botanical laboratory for morphological and cytological research

ROTEA, SANTIAGO YATCO.—*Division of Animal Products Laboratory, Bureau of Animal Industry.*

Refrigerator (separate rooms for meat products and milk products) and a 15 h.p. boiler

Meat Section—

1 small animal killing floor

1 smoke house, drier

1 set equipment for canning corned beef

1 set sausage equipment

2 hand sealing machines

2 experimental retorts and two petroleum stoves

Milk Section—

1 pasteurizer, 1 viscolizer, 1 cooler, 1 cream separator, 1 small butter churn, 1 small cheese vat, and 1 set Babcock tester

SANTOS, ALFREDO C.—*School of Pharmacy Laboratory, University of the Philippines.*

Equipment of various types for organic micro-analysis

SANTOS, FRANCISCO O.

Equipment for:

(a) Biochemical laboratory

(b) Analytical laboratory

(c) Sugar laboratory

TEODORO, ANASTACIO L.—*Department of Agricultural Engineering Laboratory, College of Agriculture, University of the Philippines.*

Henry Froude-Hydraulic Dynamometer (For accurate determination of brake horse power of any kind of engine up to 300 h.p.)

VALENZUELA, PATROCINIO.—*School of Pharmacy Laboratory, University of the Philippines.*

Lloyd's Extractor and Concentrator, capacity 20 kilos

Machines for grinding drugs (large scale). Copper stills. Shaking machine

Apparatus for phytochemical investigations

WADE, WINDSOR.—*Leonard Wood Memorial Laboratory, Culion.*

Usual pathological apparatus

ROSARIO, MARIANO V. DEL.—

Equipment for different types of chemical assays of drugs and pharmaceutical preparations

ALDECOA, ELADIO R.—*College of Oral and Dental Surgery Laboratory, Manila.*

Microscopes; ultra-violet apparatus; X-ray apparatus

ALINCASTRE, CECILIO.—*Ma-ao Central Laboratory, Occidental Negros.*

Ordinary sugar laboratory apparatus, including those for grain classification, filtrability comparison, sediment test, and colloid or dye value of sugar

AQUINO, DIONISIO.—*Department of Soil Technology, College of Agriculture, Los Baños.*

Laboratory for soil analysis

Burgess—Parr turbidimeter

Colorimeter, Duboscq. Bausch & Lamb.

Bouyouco's stirring apparatus (for soils work)

Studen pH indicator for hydrogen ion concentration determination, etc.

CAPINPIN, JOSE.—*Department of Botany Laboratory, College of Agriculture, Los Baños.*

(Rotary); Sensitive Balance.

CELIS, JESUS P.—*Department of Physiology and Pharmacology, Laboratory, University of Sto. Tomas.*

A time-marker and electric shock distributor from Storage battery, interrupted at definite intervals by a Metronome-Mercury-key.

CONCEPCION, FELIX IRA.—*San Juan de Dios Hospital Clinical Laboratory.*

Equipment for the study of alkali reserve; ultra-opaque microscope; refractometer; equipment for amino-acids

Microtomes, vacuum apparatus, animal cages, etc.

DOMANTAY, JOSE Y SISON.—*Department of Zoology Laboratory, University of the Philippines.*

Sets of aquaria for breeding purposes

JESUS, ZACARIAS DE.—*Veterinary Research Laboratory, Pandacan.*

Extensive lot with spacious sheds for experimental large and small animals

HIZON, PRIMO Y HIPOLITO.—*Hizon Laboratory.*

Strong iron pressure chamber used for the preservation of tobacco

HOCSON, FELIX.—*School of Pharmacy Laboratory, University of the Philippines.*

Sets for the determination of specific gravity by different methods

MESA, ALEJANDRO DE.—*School of Forestry Laboratory, Los Baños.*

Insectary for breeding insects and other entomological equipment

NOLASCO, JOSE O.—*Bureau of Health Laboratory, Culion Leper Colony.*

Equipment for pathological and bacteriological research

OCAMPO, MARIANO.—*Department of Physiology and Biochemistry, College of Medicine, University of the Philippines.*

Metabolimeter; tissue respiration apparatus; blood and urine analysis outfit.

PARAS, ERNESTO M.—*Bureau of Health Laboratory, Culion Leper Colony.*

Van Slyke Manometric Blood Gas Apparatus; Van Slyke Deaminizing Apparatus; Bausch-Lamb Calorimeter.

REYES, GAUDENCIO.—*Division of Plant Pathology, Bureau of Plant Industry.*

Root study boxes which can be tilted to make roots grow to glass sides by geographic response. Glass sides facilitate observation of the incidence and progress of fungous attacks, securing of necessary soil and root samples, root inoculations, insect attack, effects of chemicals, moisture, and temperature relations, etc.

Larger boxes would be better for studies involving more prolonged growth and observation

ROBLES, MANUEL M.—*Bureau of Animal Industry Laboratory, Manila.*

Equipment for manufacture of tissue vaccines and production of sera from large animals (cattle and carabaos)

RODRIGUEZ, JOSE NATALIO.—*Leprosy Treatment Stations Laboratory, Bureau of Health, Cebu.*

Ordinary bacteriological laboratory, including equipment for making skin sections.

Portable outfit for determining basal metabolism

Laboratory equipment for blood chemistry

RUIZ, MARIANO V.—*Bureau of Science Laboratory.*

Factory and laboratory (1) complete outfit for soap manufactures or oven-tank 750 gallons capacity, soda tank, mold, cutter, etc.

(2) Complete outfit for ink, pomade, polisher, cosmetics, paste and mucilage, double effect distilling apparatus, etc.

RUSTIA-SISON, FELIXBERTO.—*Private Clinical Laboratory, Arias Building.*
2 X-ray apparatus; complete dental equipment

TIONGSON, JUAN L.—*Department of Electrical Engineering Laboratory, University of the Philippines.*
One 1½ h.p. Garden tractor
One 2 h.p. kerosene engine
One 15 h.p. tractor
One thresher

URBINO, CORNELIO M.—*Malaria Field Laboratory, San Jose del Monte, Bulacan.*
Microphotographic apparatus
Nitrogen distilling apparatus

VALENZUELA, ABELARDO.—*Bueruu of Animal Industry, Dairy Products Laboratory.*
Dairy equipment such as pasteurizer, viscolizer, cooler, cream separator, churner, etc. Canning equipment, such as vacuum sealer, closing machines, autoclaves, corn beef stuffer, etc.

VELMONTE, JOSE E.—*Department of Rural Economics, College of Agriculture, Los Baños.*
Calculating machine, adding machine

ILLUSTRATIONS

(Photographs taken by do Photographers of the Division of Publication, Department of Agriculture and Commerce.)

PLATE 1

FIG. 1.—Animal House on the roof of the School of Hygiene and Public Health, University of the Philippines.

FIG. 2.—Statistical and Epidemiological Laboratory of the School of Hygiene and Public Health, University of the Philippines.

PLATE 2

FIG. 3.—Different types of apparatus for measuring turbidity: U. S. Geological Survey turbidity scale, including color scale also, 6 × 12 × 24 cm. Silica turbidity standards (scaled), 7 bottles of 7 × 23 cm. Jackson turbidimeter, 3.5 × 31 cm. and 16 × 28 cm.

FIG. 4.—Dust sampler, Palmer water spray type 17 × 24 × 49 cm.

PLATE 3

FIG. 5.—A cabinet with (1) Kahn shaking machine, and an ordinary shaker on top and Hyrac vacuum apparatus below with 6 racks copper, Prop. No. C. M. 3840; (2) Apparatus shaking, Electric Ser. No. 200 for bottles or test tubes 110 V. D. C.—Prop. No. S. H. P. H. 5134; and (3) Pump, vacuum, Cenco Magavae for 110 V. D. C. No. 1795. Prop. No. 4459.

FIG. 6.—Centrifuge, 110 V. D. C. electric with Rheostat and Electric connections, Prop. No. 4483.

PLATE 4

FIG. 7.—(1) Sterilizer, Arnold Rectangular, 14½ × 27½ × 16½" high double doors stand and burners, Prop. No. 4541.
(2) Sterilizer, Hot Air, Prop. No. 4679.
(3) Sterilizer, Hot Air, Inside 12" × 24" Prop. No. 1610.
(4) Sterilizer, Hot Air Asbestos Wall, Prop. No. 1221.

PLATE 5

FIG. 8.—Paris green screener, 34 × 80 × 117 cm.

FIG. 9.—Benedict—Roth basal metabolism apparatus.
19 × 46 × 80 cm.
36 × 43 × 6 cm.

PLATE 6

FIG. 10.—Other Apparatus Available in the Biostatistical and Epidemiological Laboratory.

FIG. 11.—Mechanical Devices for Statistical Work—Counting Sarter, Punching, and Verifying Machines.

PLATE 7

FIG. 12.—Kjeldahl distilling apparatus, wall type, for six distillations, 24 × 90 × 75 cm. Water bath for eight evaporating dishes. 35 cm. × 65 × 35.

FIG. 13.—Chemical Hygiene Laboratory, Department of Sanitary Engineering, Industrial Physiology and Chemistry. Laboratory room measures 9.2 × 20 × 4.5 meters. Picture shows reagents, distilling sets, nessler tubes, analytical balances, tortion balances, dessicators, part of La Motte roulette comparator, etc.

PLATE 8

FIG. 14.—A general view of the Urban Health Demonstration Unit.

FIG. 15.—Children's Corner at the Urban Health Demonstration Unit.

PLATE 9

FIG. 16.—Vacuum Machine.

FIG. 17.—Sharple's Super centrifuge.

PLATE 10

FIG. 18.—Compressed air machine.

FIG. 19.—High-Low Temperature Incubator with ventilation system.

PLATE 11

FIG. 20.—Incubator and Water Bath with a cabinet of microscope.

FIG. 21.—Different instruments used in ventilation: barometer, anaeroid, P. Faura type, 6 × 16 cm. Anemometer, 4.5 × 10 cm. Ventilation indicator, 16 × 36 × 22 cm. Sling psychrometer, 2.5 × 3 × 43 cm. Holdane's carbon dioxide apparatus, 9 × 20 × 33 cm. Stationary hygrometer, wall type, 7 × 12 × 43 cm.; Katathermometer (not taken), 3 × 26 cm.

PLATE 12

FIG. 22.—Grinding mill for drugs in large quantities.

PLATE 13

FIG. 23.—Lloyd's Extractor and concentrator, capacity 20 kilograms.

FIG. 24.—Half micro Molecular weight apparatus of Sucharda and Bobranski.

PLATE 14

FIG. 25.—Apparatus for the determination of carbon and Hydrogen by Pregl.

FIG. 26.—Apparatus for the determination of Halogen by Pregl.

PLATE 15

FIG. 27.—Determination of Nitrogen by Micro Dumas.

FIG. 28.—Determination of Methoxyl groups by Zeisel Pregl.

PLATE 16

FIG. 29.—Micro-balance.

PLATE 17

FIG. 30.—Frigidaire: Length, 54 cm.; Width, 25 cm.; Height, 64 cm.

FIG. 31.—Animal House of the Department of Zoology: Length, 4.20 meters; Width, 2.65 meters; Height, 3.25 meters.

PLATE 18

FIG. 32.—Animal Cages: Length, 118 cm.; Width, 22 cm.; Height, 67 cm.

FIG. 33.—Aquarium: Length, 195 cm.; Width, 27 cm.; Height, 33 m.

PLATE 19

FIG. 34.—1. (a), (b), (c) Camera lucida
2. (a) and (b), Stage micrometer.
3. (a) and (b) Micro stage incubator 220 volts.
4. Incubator, electric, for micro stage.
5. Darkfield Illuminations Outfit.
6. Projection Apparatus (for slides)
7. Incubator, Freas, Electric, 110 R. D. C.

PLATE 20

FIG. 35.—Display shelf containing different apparatus used in malaria work:

Doffers 15 × 23 × 16 mm.
Measuring cups, two sizes, 9 × 19 cm., 4 × 8 cm.
Larva cups, 13 × 26
Bed net, folded, 8 × 33 × 50 cm.
Hand blomer, 15 × 50 × 25 cm.
Knapsack blomer, 15 × 35 × 39 cm.
Model of mosquito head, 20 × 35 × 47 (Property of the Rockefeller Foundation)

Dissecting set, small pieces, including needle, lancet, etc.
Binocular lens, 4 × 11 × 20 cm.
Dissecting microscope, 13 × 20 × 12 cm.
Water thermometer, 3 × 3 × 20 cm.
Drugs—quinine, plasmochin, atabrine, etc.
The containing shelf measures 50 × 280 ×80 cm.

FIG. 36.—Slue Curing Barn for Tobacco.

PLATE 21

FIG. 37.—Another view of the Slue Curing for Tobacco.
FIG. 38.—Interior view of the Slue Curing Barn for Tobacco.

PLATE 22

FIG. 39.—Thickness gage and Tearing tester.
FIG. 40.—Sizing tester and Recording thermo-hydrometer.

PLATE 23

FIG. 41.—Mullen Tester for bursting strength.
Scopper tensile strength machine for quick testing.

PLATE 24

FIG. 42.—Scopper tensile strength machine.
FIG. 43.—Scopper folding tester.

PLATE 25

FIG. 44.—(1) Cheese Presser
(2) Cheese Vat
(3) Churn Home Butter
(4) De La Val Cream separator—Hand operated

FIG. 45.—Jennfen Pasteurizer.
Bristol recorder thermometer
Sanitary centrifugal milk pump
Junior Viscolizer Besoeb
De Luxe jr. cooler

PLATE 26

FIGS. 46 and 47.—Laboratory of Consolidated Mines, Inc.
Showing furnace for gold, etc., assays. Equipped with assay balance, high grade analytical balance, technical and rough balances and other ordinary laboratory apparatus.

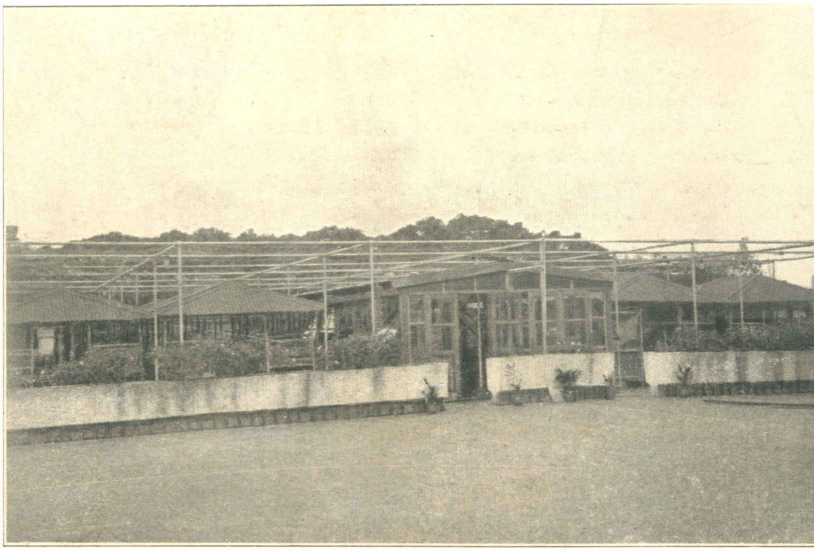

Fig. 1

Fig. 2

Plate 1

Fig. 3

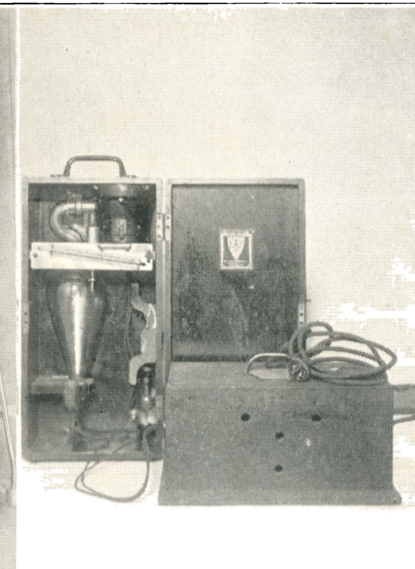

Fig. 4

PLATE 2

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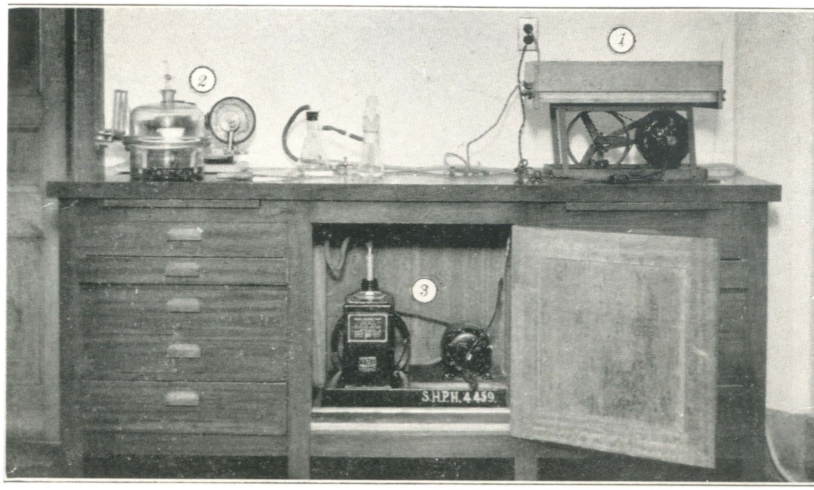

Fig. 5

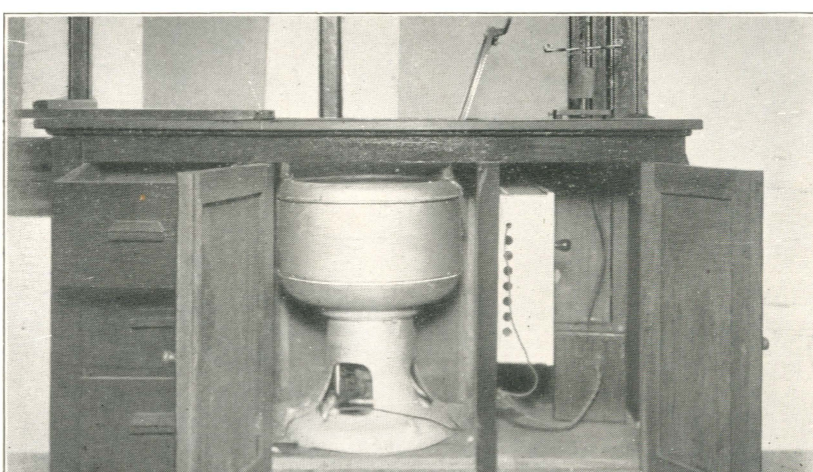

Fig. 6

Plate 3

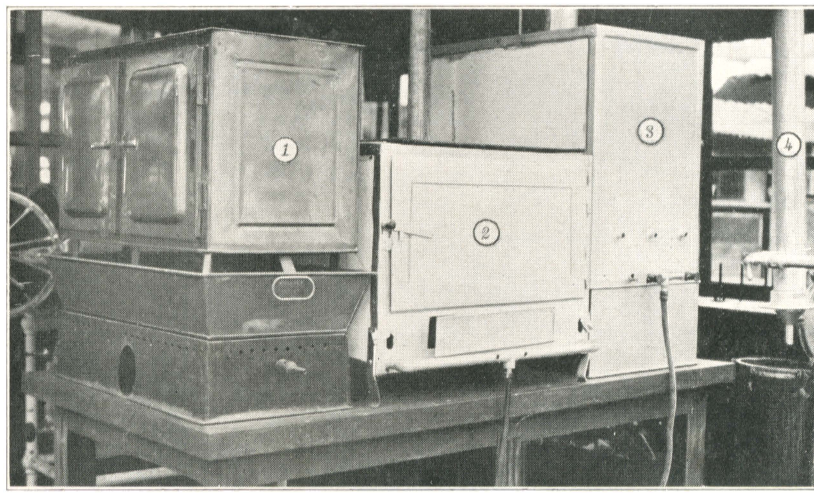

Fig. 7

PLATE 4

920

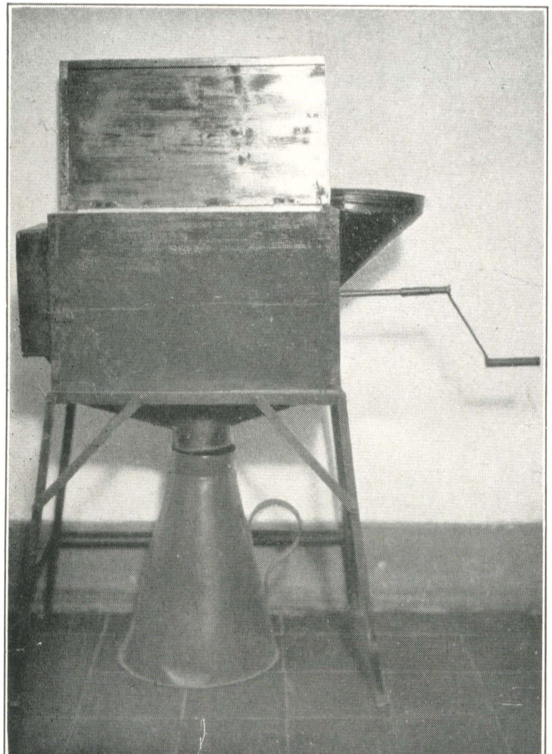

Fig. 8

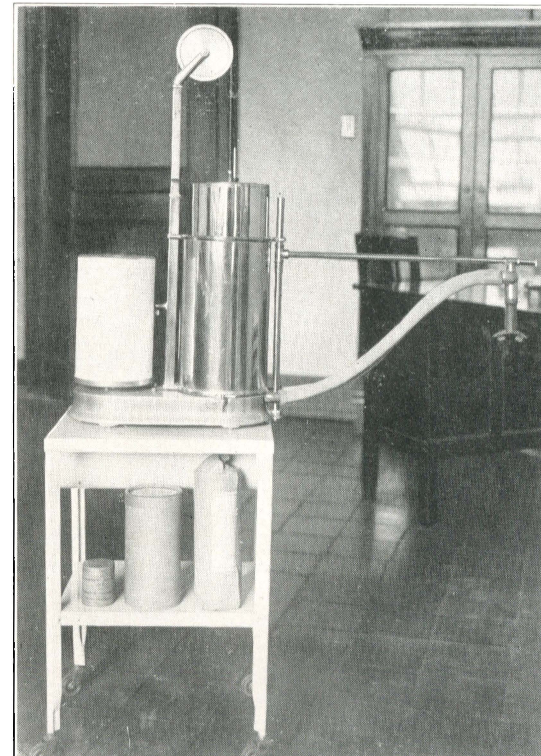

Fig. 9

PLATE 5

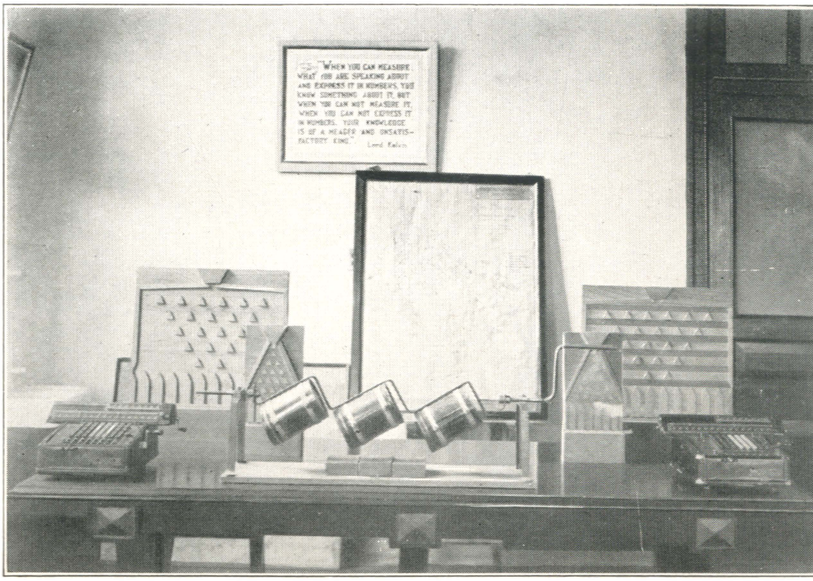

Fig. 10

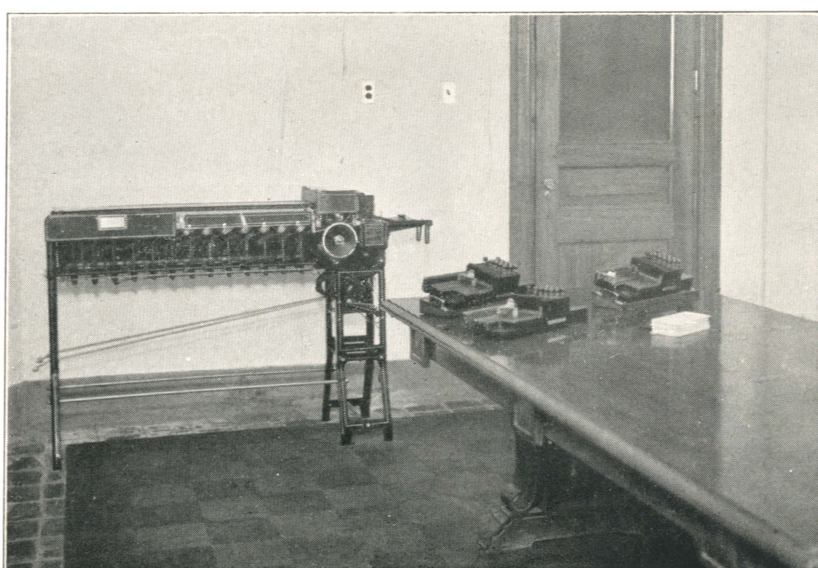

Fig. 11

PLATE 6

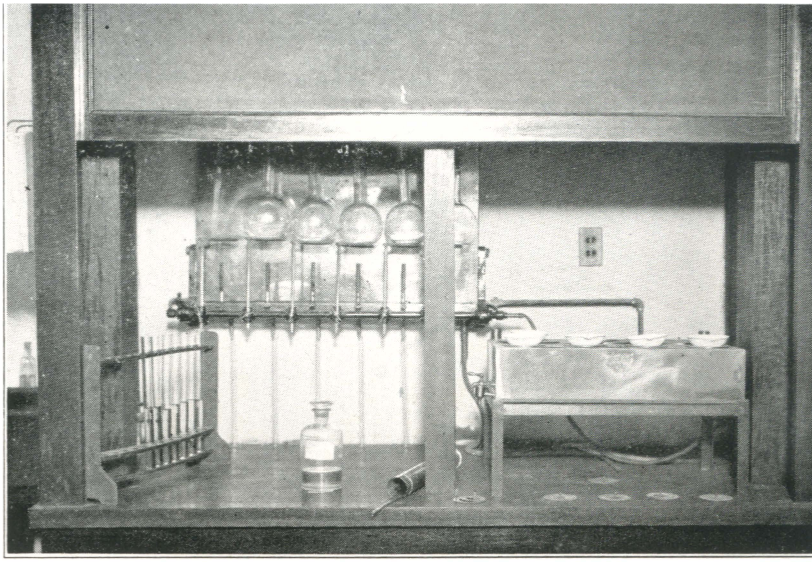

Fig. 12

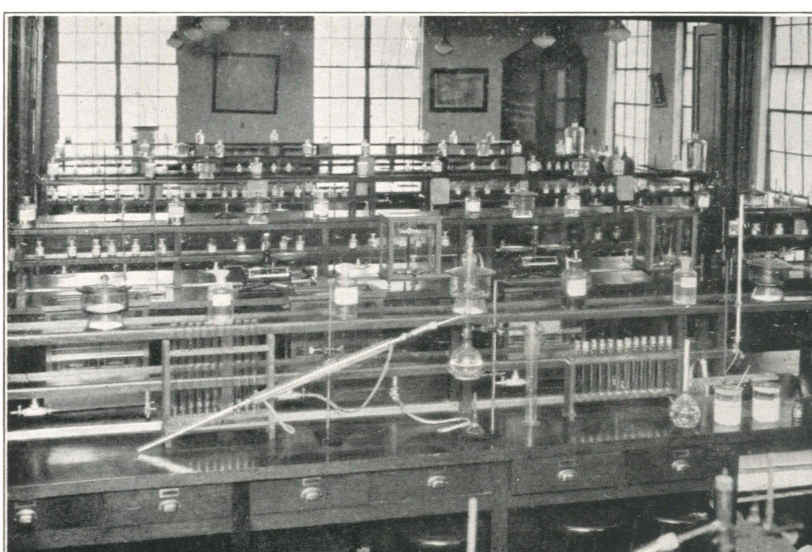

Fig. 13

PLATE 7

926

Fig. 14

Fig. 15

Plate 8

9/28

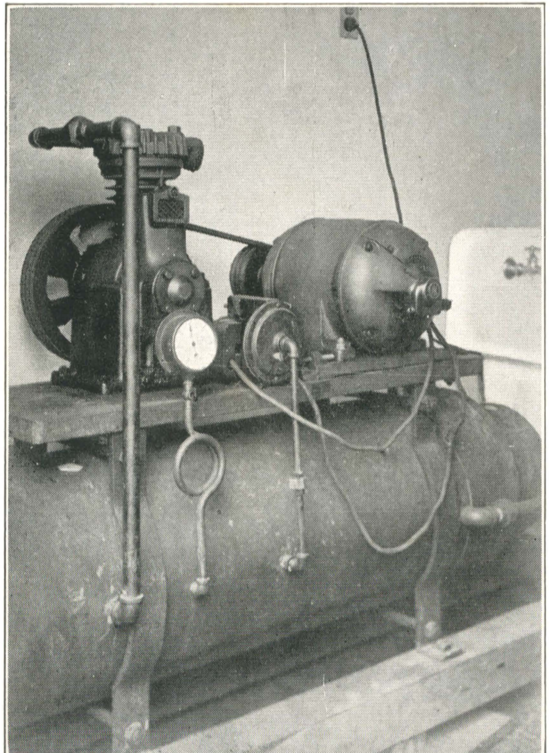

Fig. 16

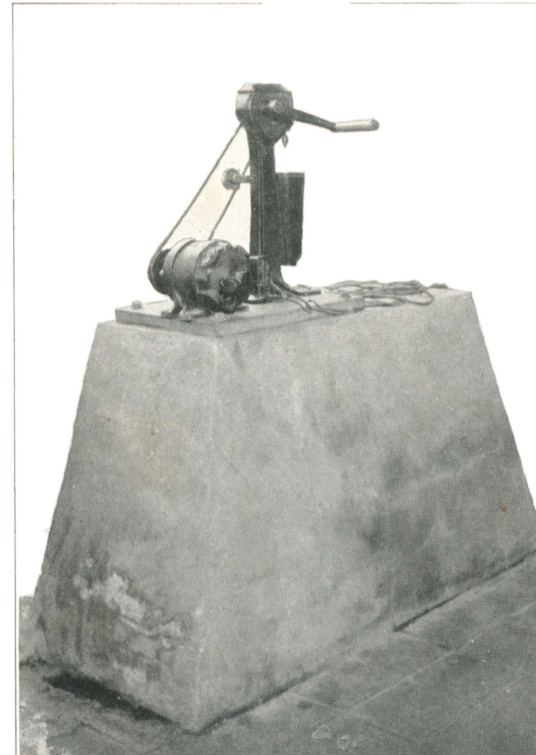

Fig. 17

PLATE 9

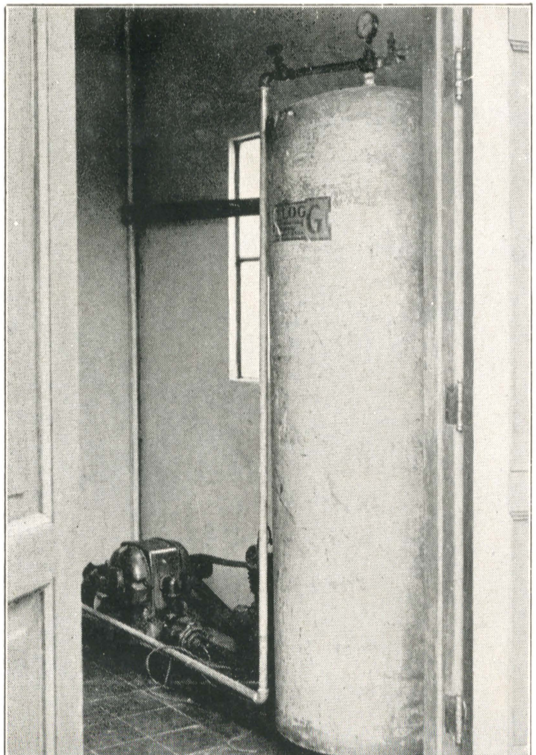

Fig. 18

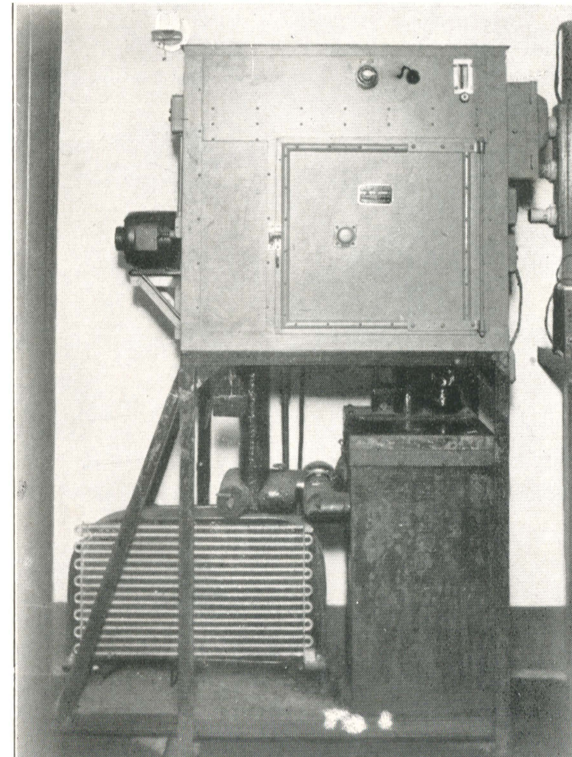

Fig. 19

PLATE 10

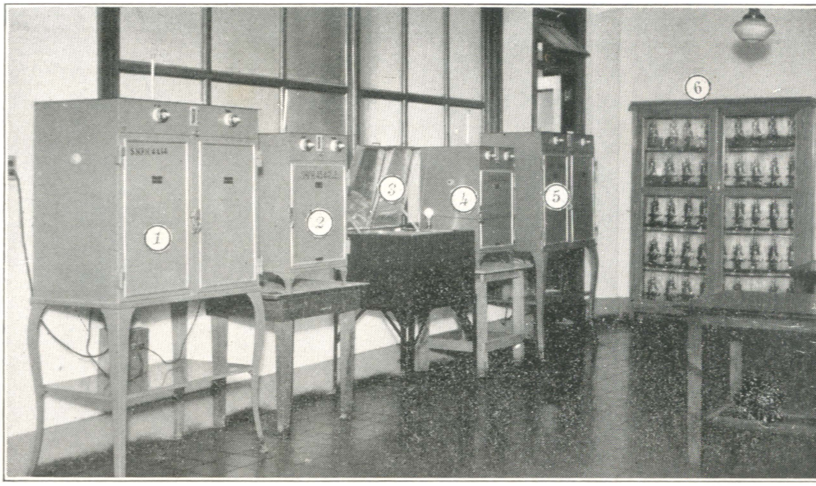

Fig. 20

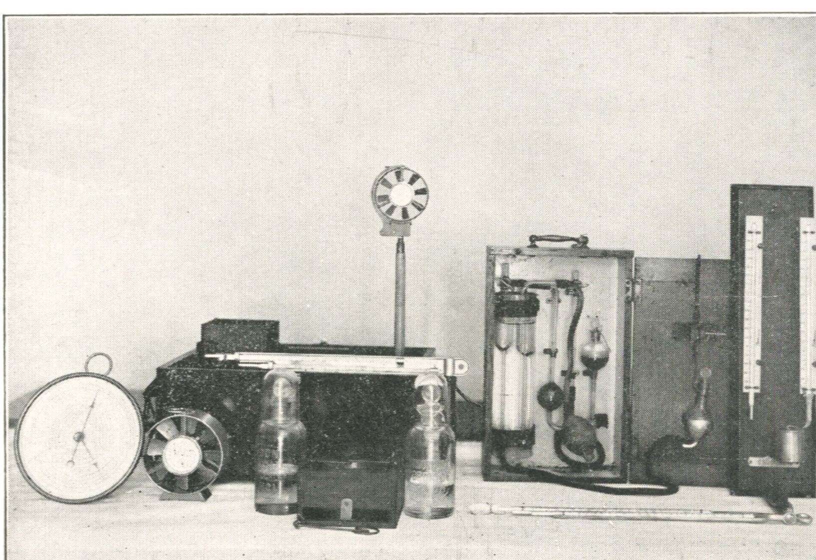

Fig. 21

PLATE 11

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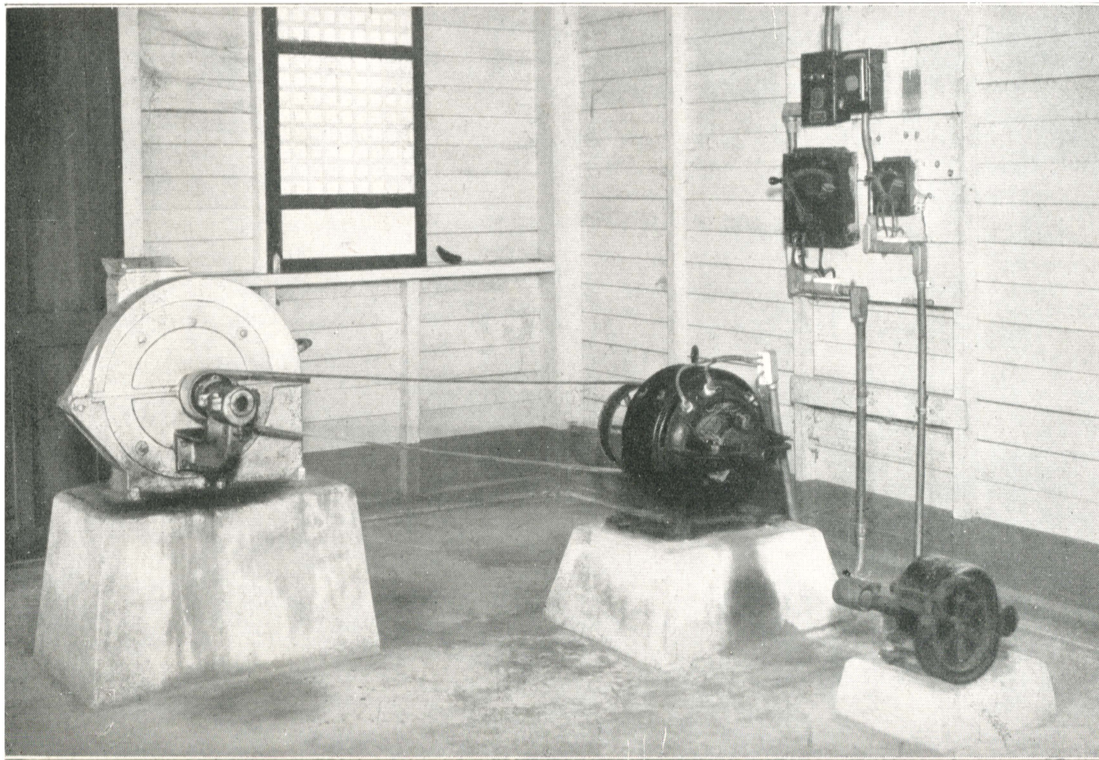


Fig. 22

PLATE 12

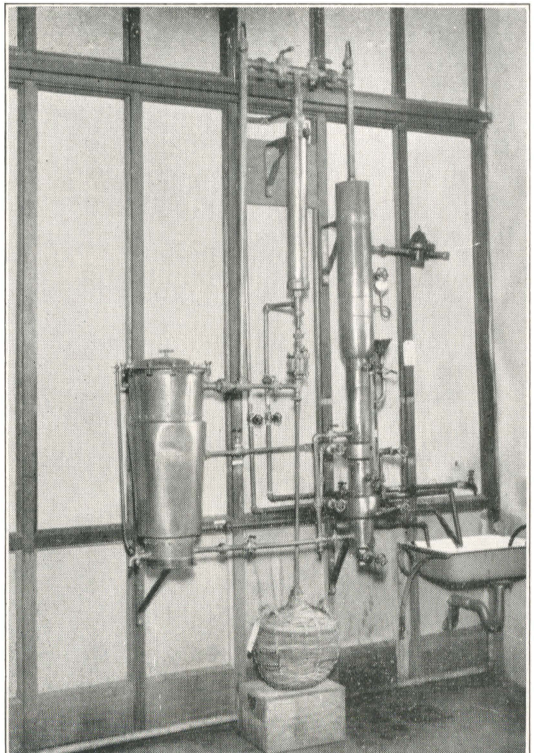


Fig. 23

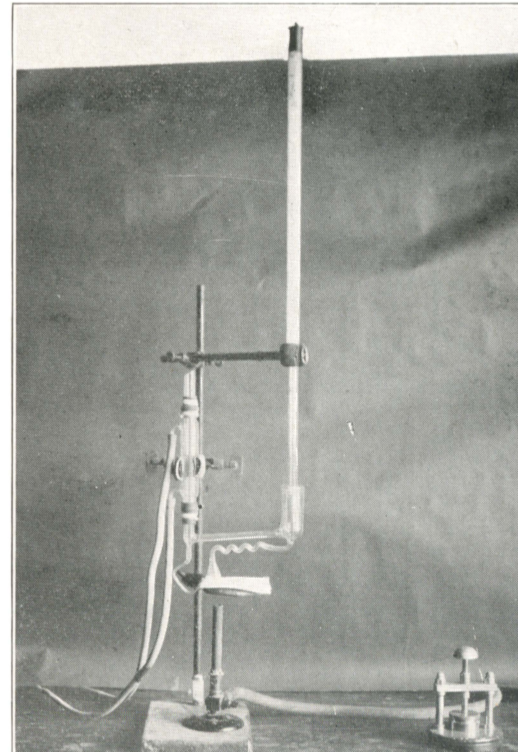


Fig. 24

Plate 13

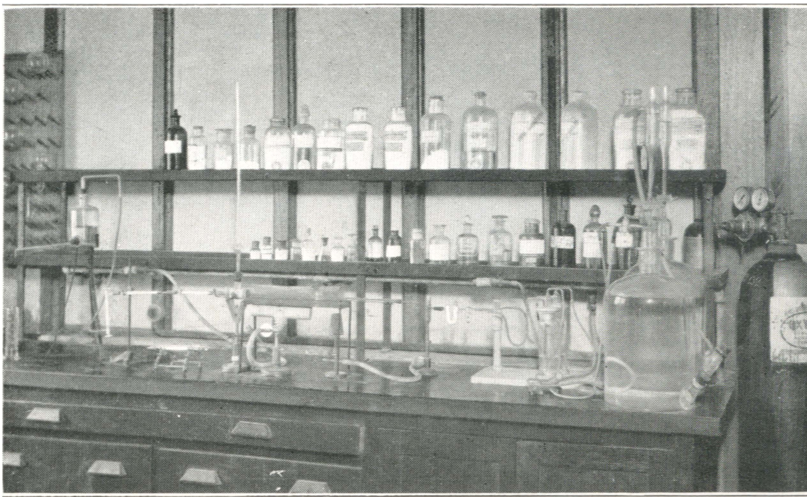


Fig. 25

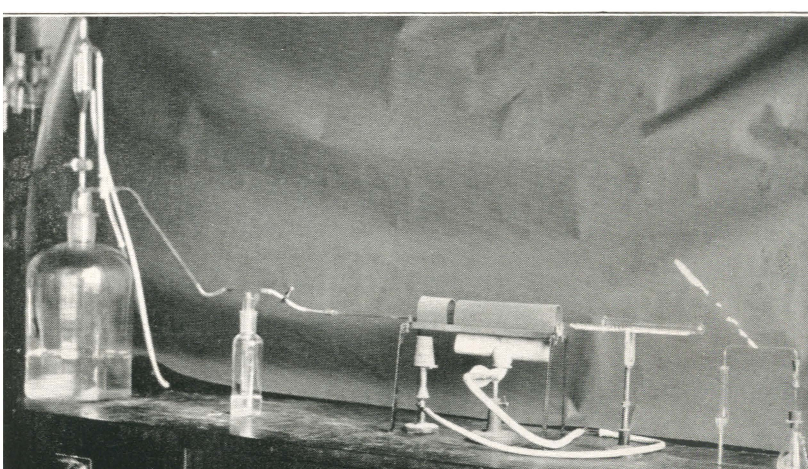


Fig. 26

PLATE 14

94n

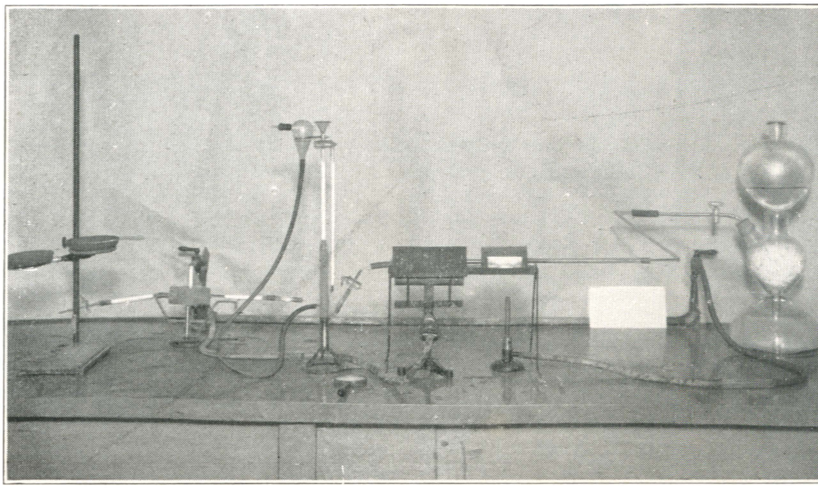


Fig. 27

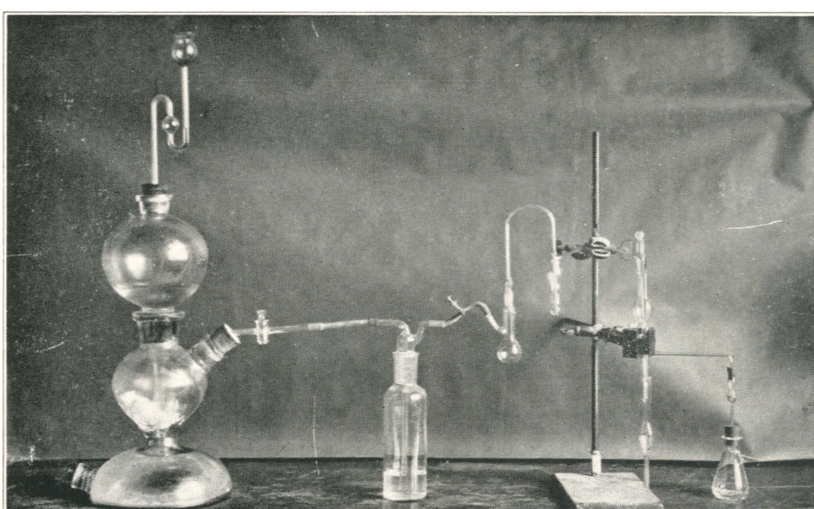


Fig. 28

Plate 15

942

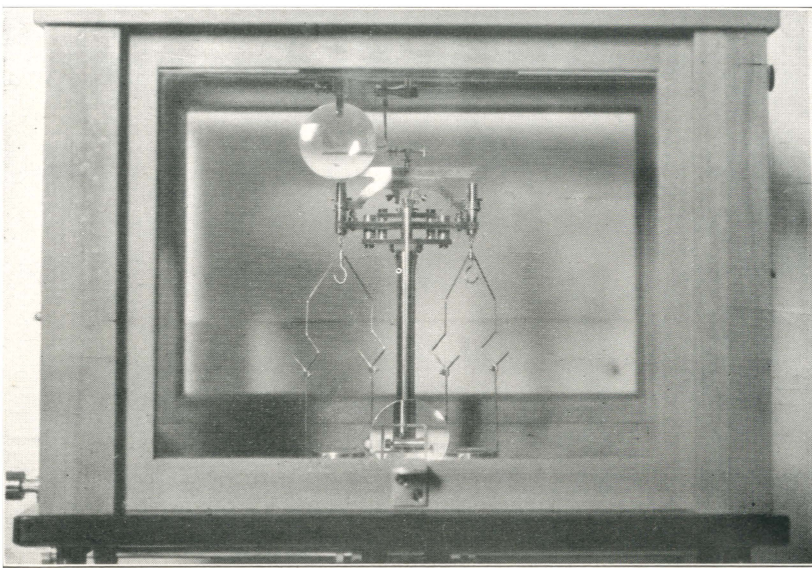


FIG. 29

PLATE 16

944

Fig. 30

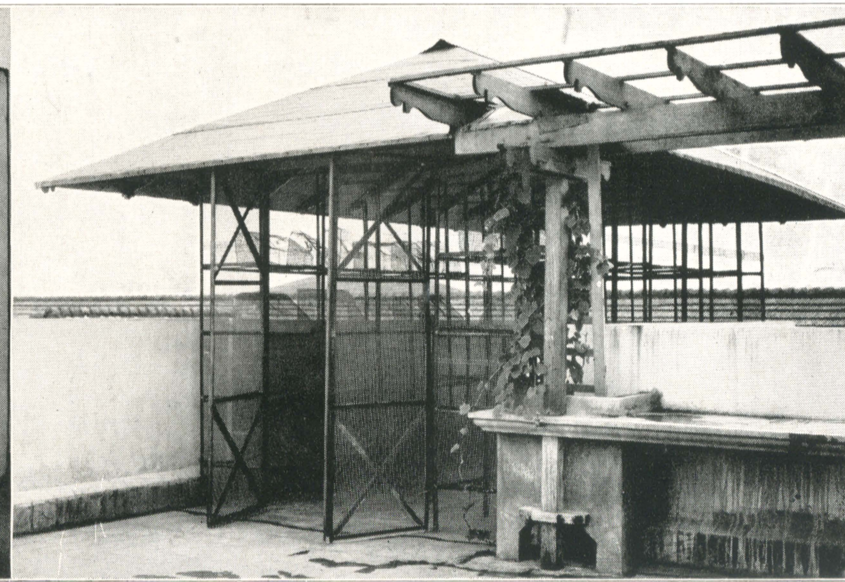


Fig. 31

PLATE 17

946

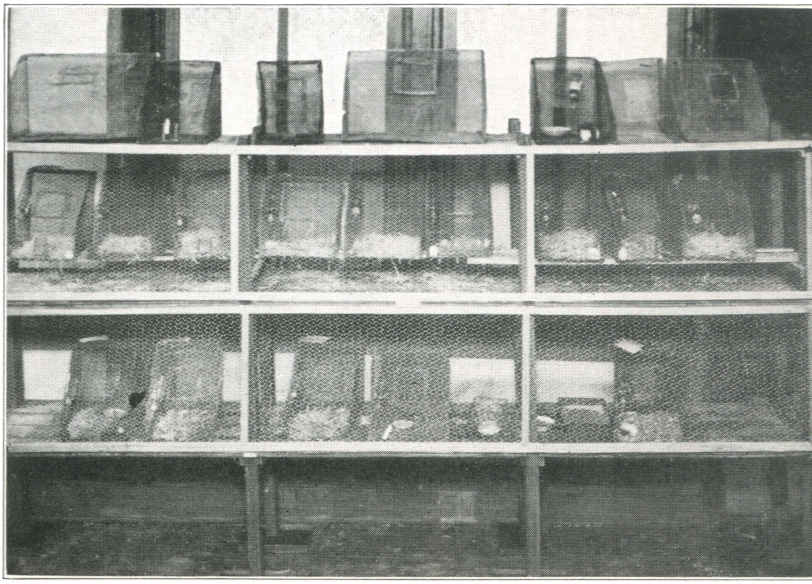


Fig. 32

Fig. 33

Plate 18

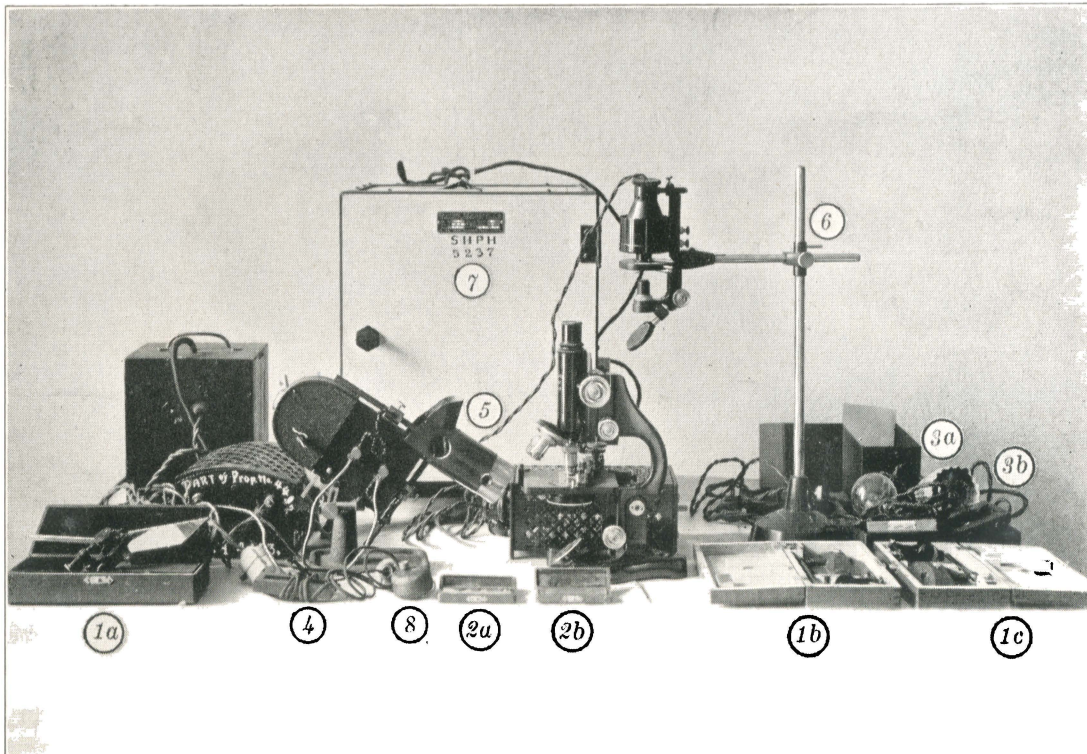


Fig. 34

PLATE 19

9(

Fig. 35

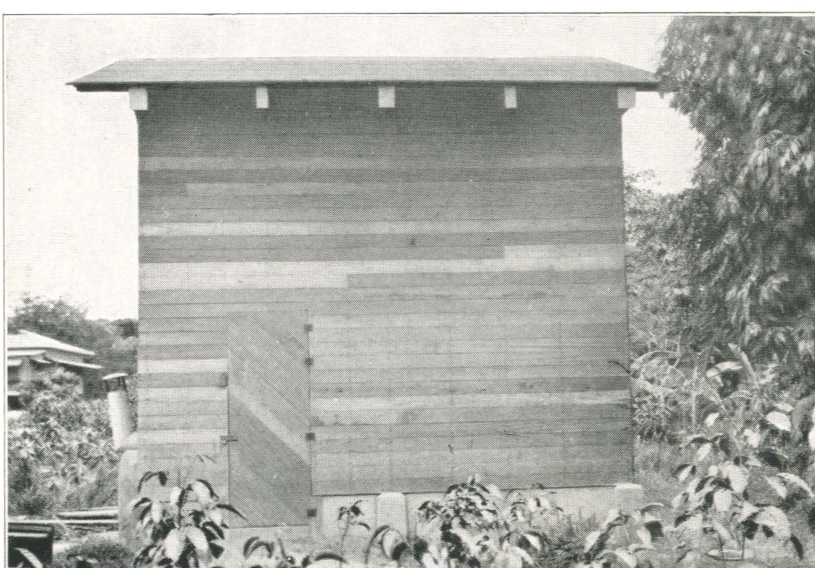


Fig. 36

PLATE 20

Fig. 37

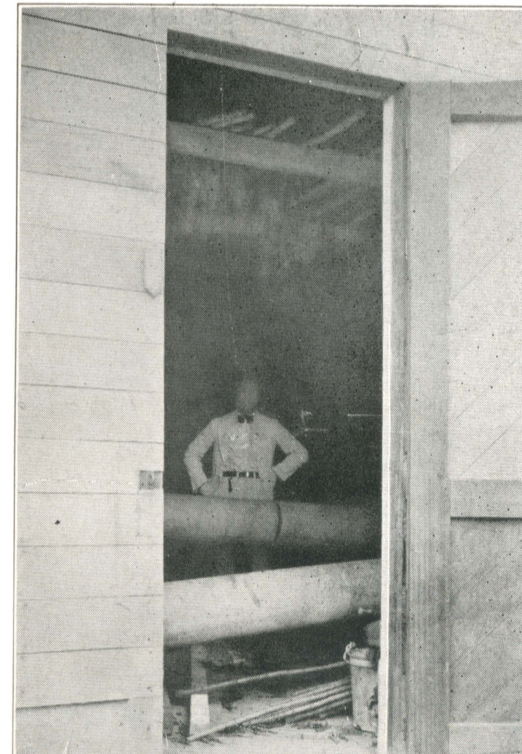
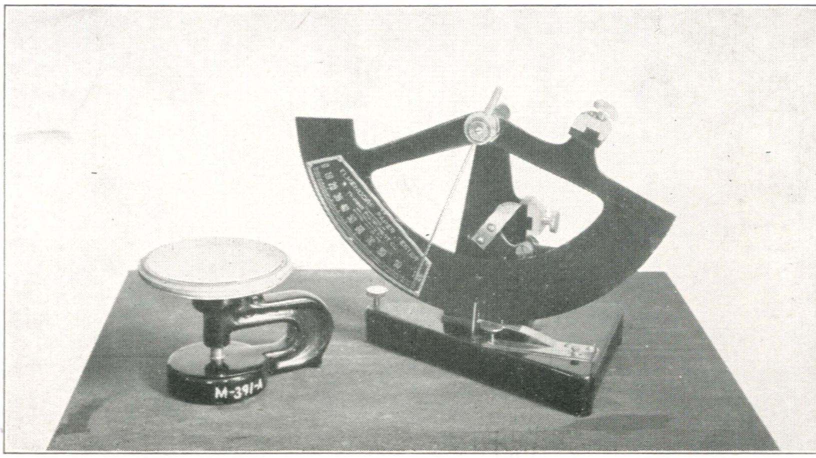


Fig. 38

PLATE 21

9124



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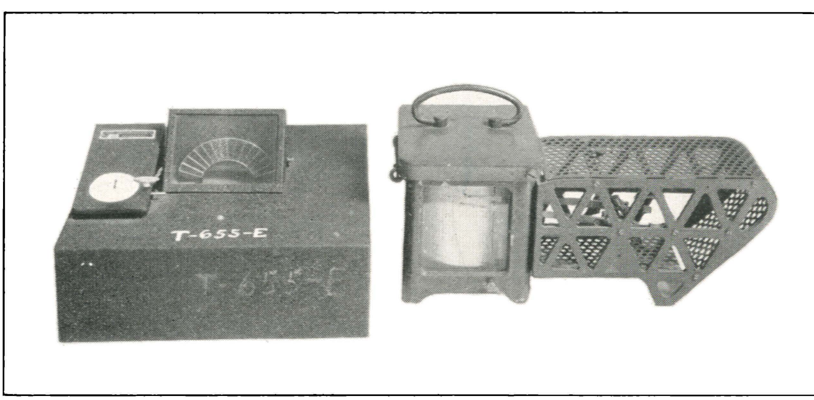

Fig. 40

PLATE 22

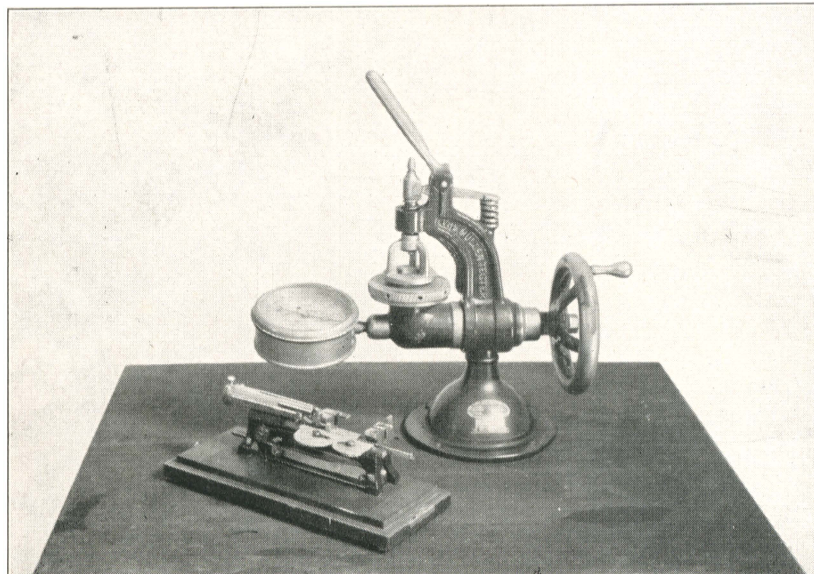

Fig. 41

Plate 23

98

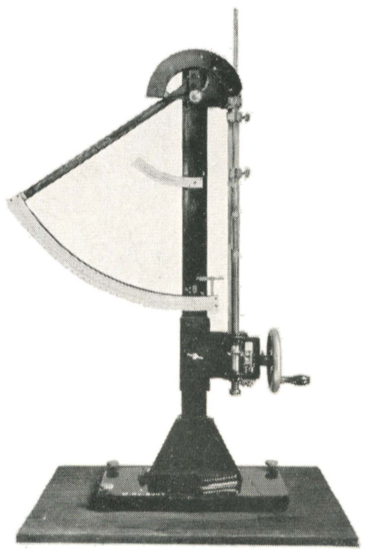

Fig. 42

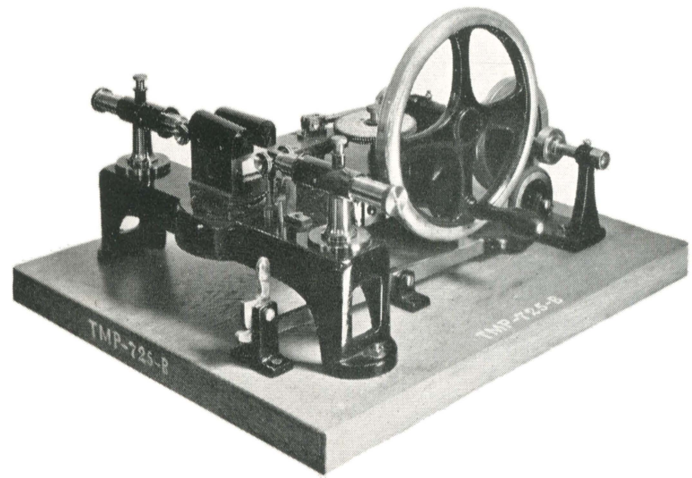

Fig. 43

PLATE 24

420

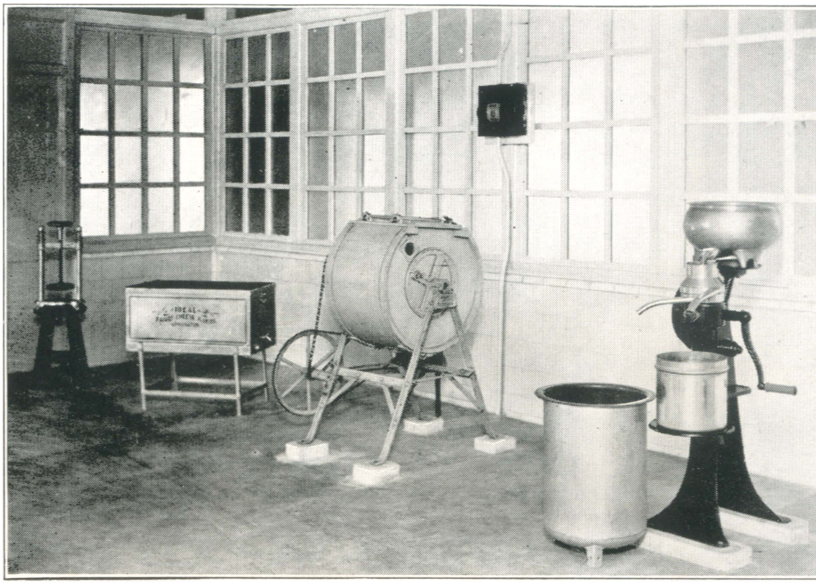

Fig. 44

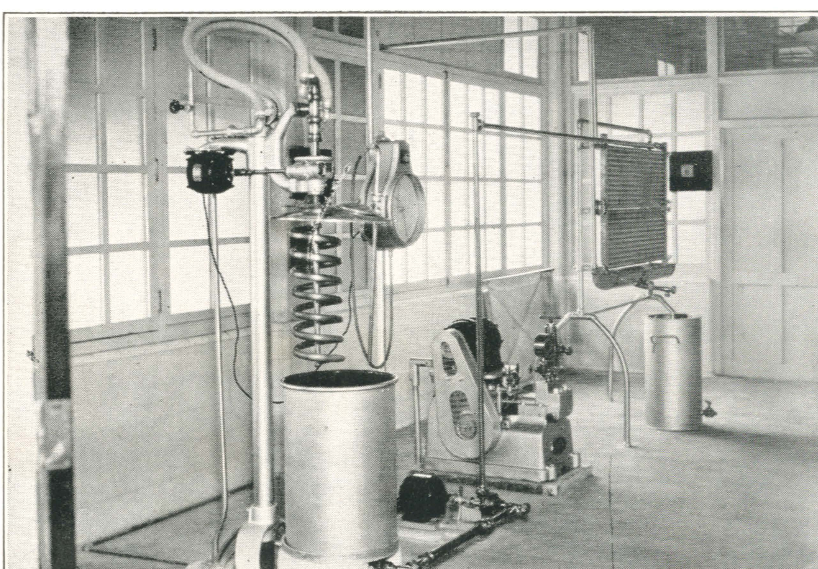

Fig. 45

PLATE 25

962

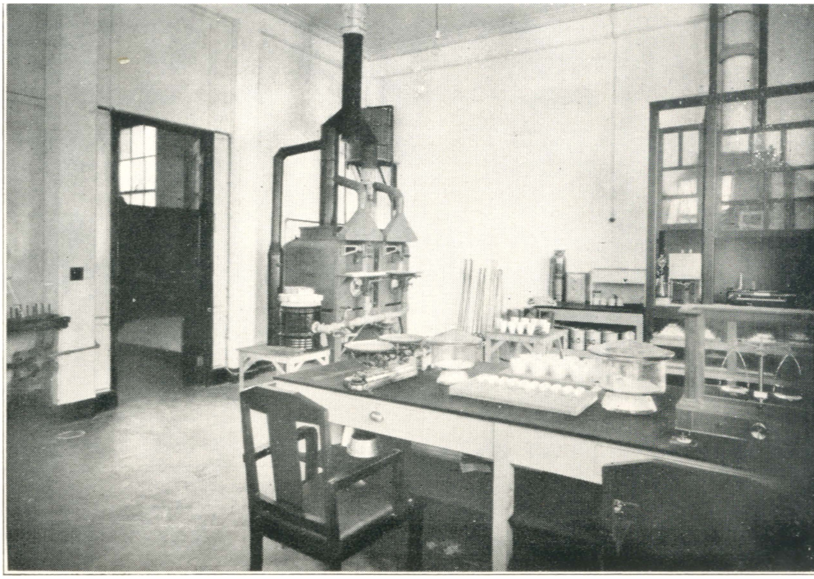

Fig. 46

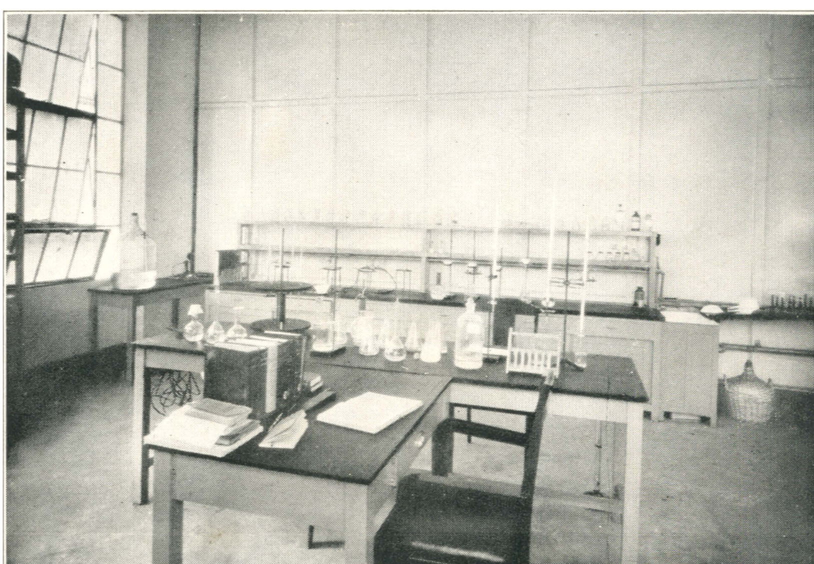

Fig. 47

PLATE 26

964

APPENDIX A

CHARTER MEMBERS OF THE NATIONAL RESEARCH COUNCIL OF THE PHILIPPINE ISLANDS

TOMAS ABELLO, *Assistant Professor of Physics, College of Liberal Arts, University of the Philippines, Manila.*

WALLACE ADAMS, *Chief, Division of Fish and Game, Department of Agriculture and Commerce, Manila.*

FELIPE T. ADRIANO, *Technical Director, Magnolia Dairy Products, San Miguel Brewery, Manila.*

VALENTIN AFABLE, *President, Afable Medical College, Manila.*

CANDIDO M. AFRICA, *Associate Professor of Parasitology and Head of the Department, School of Hygiene and Public Health, University of the Philippines, Manila.*

RAFAEL H. AGUILAR, *Chemist, Bureau of Science, Manila.*

JOSE M. ALBERT, *Professor of Pediatrics and Head of the Department, College of Medicine, University of the Philippines, Manila, and Chief of Clinics, Philippine General Hospital.*

VICENTE ALDABA, *Chief, Fiber Research Section, Bureau of Plant Industry, Manila.*

MARCOS M. ALICANTE, *Soil Technologist, Bureau of Science.*

ANTONIO D. ALVIR, *Superintendent, Salacot Mining Company, 30 Escolta.*

ANGEL S. ARGUELLES, *Director, Bureau of Science, and Chairman, Division of Chemical and Pharmaceutical Sciences, National Research Council of the Philippine Islands.*

MANUEL V. ARGÜELLES, *Proprietor and Director, Laboratorio Argüelles, Professor of Bacteriology, National University and Educational Institute of the Philippine Islands.*

H. O. BEYER, *Professor of Anthropology and Sociology and Head of the Department, University of the Philippines, Manila.*

WILLIAM H. BROWN, *Botanist and Former Director of the Bureau of Science, Manila.*

VICTOR BUENCAMINO, *Director, Bureau of Animal Industry, and Acting Under-Secretary of the Department of Agriculture and Commerce, Manila. Chairman, Division of Government, Foreign and Educational Relations, National Research Council of the Philippine Islands.*

FERNANDO CALDERON, *Director, Philippine General Hospital, and Dean, College of Medicine, University of the Philippines, Manila.*

JOSE S. CAMUS, *Director, Bureau of Plant Industry, Manila.*

MANUEL CARREON, *Chief, Measurement–Research Department, and Superintendent, Academic Division, Bureau of Education, Manila.*

FELICIANO CLARA, *Head, Pathology Section, Bureau of Plant Industry, Manila.*

AMANDO CLEMENTE, *Professor of Chemistry and Head of the Department, University of the Philippines, Manila.*

LEOPOLDO S. CLEMENTE, *Assistant Professor of Zoology and Head of the Department, University of the Philippines, Manila.*

ISABELO CONCEPCION, *Professor of Physiology and Head of the Department, College of Medicine, University of the Philippines, Manila.*

EDWIN COPELAND, *Technical Adviser, Department of Agriculture and Commerce, Manila.*

CORNELIO C. CRUZ, *Assistant Professor of Geography, University of the Philippines, Manila.*

HUGH MCCALLUM CURRAN, *Professor of Forestry, School of Forestry, University of the Philippines, Los Baños, Laguna.*

HAROLD CUZNER, *Professor of Silviculture and Physiography, School of Forestry, University of the Philippines, Los Baños, Laguna.*

PLACIDO DACANAY, *Chief, Division of Forest Studies and Research, Bureau of Forestry, Manila; Associate Professor of Forest Policy and History, School of Forestry, University of the Philippines, Los Baños, Laguna.*

ELIAS S. DOMINGO, *Chief Alienist, Insular Psychopathic Hospital, Bureau of Health, Mandaluyong, Rizal.*

JOSE EDUQUE, *Professor of Surgery and Head of the Department, College Medicine, University of the Philippines, Manila.*

VICTORIANO ELICAÑO, *Mining Engineer, Consolidated Mines, Inc., 181 David, Manila.*

RAFAEL B. ESPINO, *Professor of Plant Physiology and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

JOSÉ C. ESPINOSA, *Chemist, Bureau of Science, Manila.*

TRANQUILINO G. FAJARDO, *Plant Pathologist, Bureau of Plant Industry, Manila.*

LEOPOLDO A. FAUSTINO, *Assistant Director, Bureau of Science, Manila; Chief, Division of Mineral Resources, Department of Agriculture and Commerce, Manila.*

JOSE M. FELICIANO, *Associate Professor of Geology and Geography and Head of the Department, University of the Philippines, Manila.*

RAMON FELICIANO, *Pharmaceutical Chemist, Universal Drug Store and Professor of Chemistry, National University, Manila.*

ARTHUR F. FISCHER, *Director, Bureau of Forestry, Manila, and Dean, School of Forestry, and Chairman, Division of Agriculture and Forestry, National Research Council of the Philippine Islands.*

FRANCISCO M. FRONDA, *Assistant Professor of Poultry Husbandry, and Secretary of the College of Agriculture, University of the Philippines, Los Baños, Laguna.*

ARTURO GARCIA, *Professor of Anatomy and Head of the Department, College of Medicine, University of the Philippines, Manila.*

FAUSTINO GARCIA, *Professor of Pharmacology, College of Medicine, University of the Philippines, Manila.*

GUMERSINDO GARCIA, *Practising Surgeon, 1101 Lepanto, Sampaloc, Manila, and Chairman, Board of Medical Examiners.*

ANGEL K. GOMEZ, *Professor of Pathology and Bacteriology, and Assistant Dean, College of Veterinary Science, University of the Philippines, Pandacan.*

LIBORIO GOMEZ, *Professor of Pathology and Bacteriology and Head of the Department, College of Medicine, University of the Philippines, Manila.*

LUIS GONZAGA, *Assistant Professor of Chemistry, University of the Philippines, Manila.*

BIENVENIDO M. GONZALEZ, *Professor of Animal Husbandry, and Dean, College of Agriculture, University of the Philippines, Los Baños, Laguna, and Vice-Chairman, National Research Council of the Philippine Islands.*

LEON MA. GUERRERO, *Botanist, Professor of Plant Histology, University of Sto. Tomas, Manila.*

LUIS GUERRERO, *Professor of Medicine and Head of the Department, College of Medicine, University of the Philippines, Manila.*

ARISTON HERMANO, *Chemist, Bureau of Science, Manila.*

EUGENIO HERNANDO, *Chief, Division of Epidemiology, Bureau of Health, Manila.*

EDWARD R. HYDE, *Dean of the College of Engineering, University of the Philippines, Manila.*

PABLO I. DE JESUS, *Assistant Professor of Hygiene, School of Hygiene and Public Health, University of the Philippines, Manila.*

TIMOTEO DAR JUAN, *Chief Chemist, Manila Railroad Company; Chemist, Bureau of Science, Manila.*

PEDRO T. LANTIN, *Assistant Professor of Medicine, College of Medicine, University of the Philippines, Manila.*

CASIMIRO LARA, *Chief Physician, Culion Leper Colony, Culion, Palawan.*

HILARIO LARA, *Secretary, School of Hygiene and Public Health; Professor of Hygiene and Preventive Medicine, and Head, Department of Epidemiology, Statistics and Public Health Administration, University of the Philippines, Manila.*

WALFRIDO DE LEON, *Professor of Sanitary Bacteriology and Immunology, and Head of the Department, School of Hygiene and Public Health; Chief, Department of Laboratories, Philippine General Hospital, Manila.*

LEONCIO LOPEZ-RIZAL, *Chief, Division of Administration, Bureau of Health, Manila.*

R. F. LUCE, *Former Director, Bureau of Coast and Geodetic Survey, Manila.*

CRISTOBAL MANALANG, *Chief Pathologist, Culion Leper Colony, Culion, Palawan.*

JOAQUIN MARAÑON, *Plant Chemist, Bureau of Science, Manila and Associate Professor of Botany, University of the Philippines, Manila.*

RICHARD C. MCGREGOR, *Chief, Division of Publications, Department of Agriculture and Commerce, Manila.*

NEMESIO B. MENDIOLA, *Professor of Agronomy and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

GONZALO MERINO, *Chief, Plant Sanitation Division, Bureau of Plant Industry, Manila.*

LUIS MIRANDA, *Assistant Production Manager, San Miguel Brewery, Manila.*

HERACLIO MONTALBAN, *Ichthyologist, Fish and Game Administration, Bureau of Science, Department of Agriculture and Commerce, Manila.*

SALVADOR DEL MUNDO, *Chemist, Bureau of Science, Manila.*

JUAN NAÑAGAS, *Professor of Anatomy, College of Medicine, University of the Philippines, Manila.*

GEORGE B. O'BEAR, *Former Head of the Department of Physics, University of the Philippines, Manila.*

GERARDO O. OCFEMIA, *Associate Professor of Plant Pathology, and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

FAUSTINO Q. OTANES, *Assistant Chief, Plant Sanitation Division, Bureau of Plant Industry, Manila.*

DOMINGO B. PAGUIRIGAN, *Acting Chief, Tobacco Research Section, Bureau of Plant Industry, Manila.*

DANIEL DE LA PAZ, *Professor of Pharmacology, and Head of the Department, and Secretary, College of Medicine, University of the Philippines.*

ROBERT L. PENDLETON, *Professor of Soil Technology, and Head of the Department of Soils, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

EDUARDO QUISUMBING, *Acting Chief, National Museum Division, Bureau of Science, and Curator, Philippine National Herbarium, Manila, Chairman, Division of Biological Sciences of the National Research Council of the Philippine Islands.*

EMILIO QUISUMBING, *Consulting Engineer, Filipinas Building, Manila.*

MARIANO B. RAYMUNDO, *Seed Farm Manager, and Chief of Plant Propagation, Bureau of Plant Industry, Manila.*

CARMELO M. REYES, *Professor of Surgery and Gynecology, College of Medicine, University of the Philippines, Manila.*

FRANCISCO D. REYES, *Chief, Division of Tests and Standards, Bureau of Science, Manila.*

HERMENEGILDO B. REYES, *Former Chief, Industrial Engineering Division, Department of Agriculture and Commerce and Bureau of Science, and Professor of Electrical Engineering, College of Engineering, University of the Philippines, Manila, and Chairman, Division of Engineering and Industrial Research, National Research Council of the Philippine Islands.*

LUIS J. REYES, *Professor of Wood Technology and Forest Utilization, School of Forestry, University of the Philippines, Los Baños, Laguna.*

MARIANO V. DEL ROSARIO, *Director, School of Pharmacy, University of the Philippines, Manila.*

SANTIAGO Y. ROTEA, *Chief, Animal Products Division, Bureau of Animal Industry, Manila.*

BALDOMERO ROXAS, *Professor of Obstetrics, and Head of the Department, College of Medicine, University of the Philippines, Manila.*

HILARIO A. ROXAS, *Acting Chief, Fish and Game Administration, Bureau of Science, Department of Agriculture and Commerce, Manila, and Chairman, National Research Council of the Philippine Islands.*

MANUEL L. ROXAS, *Former Commissioner of Research, and Under-Secretary of the Department of Agriculture and Commerce, Manila.*

PAUL F. RUSSELL, *Field Director, International Health Division, the Rockefeller Foundation.*

GREGORIO SAN AGUSTIN, *Dean, College of Veterinary Science, University of the Philippines, Pandacan and Assistant Director, Bureau of Animal Industry, Manila.*

ALFREDO C. SANTOS, *Assistant Professor of Pharmaceutical Chemistry, and Acting Secretary, School of Pharmacy, University of the Philippines, Manila.*

FRANCISCO O. SANTOS, *Professor of Agricultural Chemistry, and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

JOSE K. SANTOS, *Professor of Botany, and Head of the Department, University of the Philippines, Manila.*

S. C. SCHWARTZ, *Major, Medical Corps, U. S. Army, and President, U. S. Army Medical Department Research Board, Bureau of Science, Manila.*

MIGUEL SELGA, *Director, Weather Bureau, Manila, and Chairman, Division of Physical and Mathematical Sciences, National Research Council of the Philippine Islands.*

HILARION S. SILAYAN, *Chief, Agricultural Extension Division, Bureau of Plant Industry, Manila.*

GREGORIO SINGIAN, *Professor of Surgery, and Head of the Department, University of Santo Tomas; Director, San Juan de Dios Hospital, and Director, Singian Clinica, Manila.*

AGERICO B. M. SISON, *Instructor in Medicine, College of Medicine, University of the Philippines, and Professor of Legal Medicine, University of the Philippines, Manila.*

ANTONIO G. SISON, *Professor of Clinical Medicine, College of Medicine, University of the Philippines, Manila, and Chairman, Division of Medical Sciences, National Research Council of the Philippine Islands.*

MANUEL D. SUMULONG, *Associate Professor of Veterinary Anatomy, College of Veterinary Science, University of the Philippines, Manila.*

FLORENCIO TAMESIS, *Assistant Director, Bureau of Forestry, Manila.*

VIDAL A. TAN, *Professor of Mathematics, and Head of the Department, University of the Philippines, Manila.*

ANASTACIO TEODORO, *Associate Professor of Agricultural Engineering, and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

NICANOR G. TEODORO, *Plant Pathologist, Economic Garden, Los Baños, Laguna.*

TEODULO TOPACIO, *Chief, Veterinary Research Council, Bureau of Animal Industry, Manila.*

JUAN P. TORRES, *Assistant Plant Breeder, Economic Garden, Los Baños, Laguna.*

MARCOS TUBANGUI, *Acting Chief, Division of Biological Products, Bureau of Science, Manila.*

LEOPOLDO B. UICHANCO, *Professor of Entomology, and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

PATROCINIO VALENZUELA, *Associate Professor of Pharmacy, School of Pharmacy, University of the Philippines, Manila, and Executive Secretary and Treasurer, National Research Council of the Philippine Islands.*

HERMINIO VELARDE, *Associate Professor of Opthalmology, and Otorhinolaryngology, College of Medicine, University of the Philippines, Manila.*

TORIBIO N. VIBAR, *Editor, Agricultural Life, Manila, and Former Chief, Division of Agronomy, Bureau of Plant Industry, Manila.*

DEOGRACIAS VILLADOLID, *Technical Assistant, Fish and Game Administration, Bureau of Science, Department of Agriculture and Commerce, Manila.*

VALENTE VILLEGAS, *Associate of Animal Husbandry Professor and Head of the Department, College of Agriculture, University of the Philippines, Los Baños, Laguna.*

WINDSOR H. WADE, *Medical Director, Leonard Wood Memorial, Culion Leper Colony, Palawan.*

AUGUSTUS P. WEST, *Chief, Division of Chemical Research, Bureau of Science, Manila.*

CLARK H. YEAGER, *Professorial Lecturer on Hygiene and Sanitation, School of Hygiene and Public Health, University of the Philippines, Manila.*

REGINO R. YLANAN, *National Physical Director, Philippine Amateur Athletic Association, Manila.*

APPENDIX B

ADDRESS DELIVERED BY HONORABLE MANUEL L. QUEZON, PRESIDENT OF THE PHILIPPINE SENATE, AT THE SECOND PHILIPPINE SCIENCE CONVENTION, MANILA, FEBRUARY, 17, 1933

Ladies and Gentlemen of the Philippine Science Convention:

Allow me to thank you for the privilege you have conferred on me to address a few words to you this morning.

Nothing is more encouraging, nothing more promising of a future full of hope for our people than the organization of the Philippine Scientific Society.

To me a great scientist is a sort of superman and I crave for my country no greater glory than to have men whose names may be placed in the list of great scientists.

It is not only the mind, but the character of a scientist that draws this admiration from me. Pasteur said: "The cultivation of science in its highest expression is perhaps more necessary to the moral condition than to the material prosperity of a nation."

No higher, no purer, no more unselfish motive can a man have than the scientist in his search for truth. His ideal is service and his compelling urge, love; love of truth, love of goodness, love of beauty, love of nature, love of man, and though he may not know it, or even deny it, love of Him who is the fountain of truth, of goodness, of nature and of men. The scientist, like the true and faithful lover, forgets self, and has only in mind the object of his love. The ego is not there. To add to the store of human knowledge for the progress, the betterment and happiness of men, the scientist will closet himself in his laboratory, traverse the confines of the earth, open up its bowels, fathom the depth of the seas, climb the highest mountains or soar into the very heavens. Hunger, thirst, privations of all kinds, hardships of all sorts, the most horrible sufferings, death itself, will not deter him from the pursuit of his end. No military hero in the annals of war is braver than Peary, Amundsen or Admiral Byrd, and no martyr of a cause more sublime than Walter Reed and Lazear Carrol, to mention only a few.

To be then a successful scientist, one must forget himself, devote his time and energy,—nay, his whole life,—to that department of science which he has chosen as his calling. He who engages in scientific work primarily for the purpose of making a living, for the dollars and cents his work may bring, will never be other than a pseudo-scientist. The test of the man who has in him the make-up necessary for a successful scientist is seen in the young fellow who, having saved the company for which he was working ₱300,000.00 in three years through research work, did not ask nor did he get any increase in his salary of ₱6,000.00 a year. I do not want to be understood as saying that the scientist should not be given his proper reward. As a matter of fact, in the Standardization Bill I wanted to put the employees of this government engaged solely in research work, in a class by themselves with a comparatively higher salary. All I want to say is that material reward should have no part in the aims of the scientist, but rather the joy that his own works give him and the satisfaction of a service well rendered.

Up until the beginning of this century many a man devoted to natural sciences and physics was a materialist. They thought that everything was matter and they tried to explain life in, and around us, as nothing more than the result of action and reaction of matter following certain laws. Fortunately, the latest discoveries regarding the composition of the human organism and the laws of nature, are proving to modern scientists that there is a force beyond and superior to matter.

After the discovery of the electron by Dr. Millikan, which supplanted the theory that the atom is the smallest particle or element of matter and after Dr. Einstein, to the astonishment of the world, enunciated his theory of the law of relativity, modern science has repudiated materialism and determinism. Dr. Eddington does not believe that "men are only a bit of star gone wrong" and Dr. Colton says "life is more than atoms and cosmic marvels." So, as science goes deeper and deeper into the secrets of nature and the mysteries of the complicated mechanism of the human body, it finds that there must be a "creative force back of phenomena," and "destiny of man's spirit."

Modern science, then, is contributing greatly to the knowledge of God and man's spirit. As Dr. Colton puts it: "consciously or unconsciously, research has set itself to prove that the universe is more than a fortuitous concourse of atoms—it has a soul." John Landon-Davies states it as his opinion in his book "Man and his Universe" that to find God has always been the endeavor of research.

Let me quote again from Dr. Colton:

> Research is not, then, an isolated effort. It extends beyond human experience, and beyond this relatively minor earth. But in another sense, and one of much more interest to us, personally, research business itself. Men engaging in it are not separated in any degree from their fellowmen in ideals of goodness, truth and "mutual aid". We are toiling all of us, in the interests of a Greater Good: a union of all who love in the service of all who suffer.

In these last words you have a most inspiring motto for your Society: "A union of all who love in the service of all who suffer."

This is, of course, the true character of a scientific society. It may be Philippine, Japanese, Chinese, English, but it is always international in its scope and general purpose.

Your immediate concern however, is or should be to build up a body of Filipino men and women devoted to scientific research, for the purpose of solving our own problems of health, sanitation, agriculture, industry, and others.

Ladies and gentlemen, some fourteen years ago we began sending abroad some mature men for advanced work and research. I am happy to see that due to this, in a large measure, we now have a scientifically trained personnel, schooled and devoted to the cause of science, sufficiently well equipped to solve our own problems.

In this connection, leaders of the Legislature are seriously considering the suggestion made by one of the Department Secretaries some years ago regarding the creation of a National Research Council similar to the ones they have in the United States, Australia, Japan and other countries. We feel that the time has come for the government to utilize to full advantage our scientific men and women, make them come out of their shell, so to speak, and advise us on matters pertaining to their respective fields.

In conclusion, allow me to congratulate you, members of the Philippine Scientific Society, for the work you are doing and I wish to assure you of my cooperation and support. Your field of service is wide and far-reaching, I know the country depends on you.

APPENDIX C

A MEMORIAL TO HIS EXCELLENCY GOVERNOR-GENERAL FRANK MURPHY

September 12, 1933

His Excellency
Governor-General Frank Murphy
Malacañang Palace, Manila

Dear Sir:

The scientists of the Philippines have for some time felt the need of an organization which could render to the Government and the people of the Philippine Islands effective service particularly for the solution of national problems requiring the light of science. For that purpose the undersigned were appointed by the Council and past presidents of the Philippine Scientific Society to present to you a memorial on the proposed creation of a National Research Council of the Philippine Islands.

We represent more than 200 technical men and scientists, many of whom, by their researches and activities, have already shown value of their work to the country. We also represent all the scientific and technical societies in the country. We all realize that efforts to solve national scientific problems heretofore put forth have been sporadic, disconnected and desultory. We have all along felt the need of an all-embracing national organization capable of securing from its different branches the most reliable, the best possible expression of opinion bearing on important national questions demanding the services of science. Recognizing that at this critical period of our development, it is the duty of the scientists to organize themselves into a unit so that they shall be in a position not only to help the Government, particularly on legislation requiring the light of science and technology, but also to shape the policies for national development in production, the improvement of public health and the promotion of the general welfare of the country, both in so far as the problems of today are concerned and also as to those which would lay down a solid and sound foundation for national defense and give the proper direction to the development of the country as a biological entity. The importance of science to the life of the nation lies particularly in the fact that it can advise because of its knowledge of immutable biological and physical laws, desirable future actions that the nation should not fail to take if it really desires to insure the welfare of the majority.

The nation is now faced with national problems requiring urgent and immediate solution, such as the reduction of morbidity and mortality brought about by faulty diet and by diseases whose etiology, prevention and cure are not yet well understood; nutrition problems which call for accurate knowledge of food requirements under tropical conditions, as well as of the nutritive properties of common foodstuffs about which, so far, we have inadequate information; the successful prevention and control of communicable diseases that will depend upon accurate understanding of their causes, their sources of infection and their modes of spread; the improvement of our physical well-being so as to make us a sturdier and more vigorous people; the study of Philippine medicinal plants so as to make possible the publication of a National Pharmacopoeia; the diversification of production to solve our ever becoming more serious unemployment problem and to prevent the impending catastrophe, which like Damocles' sword hangs over the head of our agricultural industries, because of the one-sided development brought about by a free trade arrangement with the mother country. The problem of diversification also calls for more productive varieties of plants better adapted to our diversified conditions, as well as a more exact knowledge of fertilizer requirements of the Philippine soils, that would compensate for our higher wages as compared with those of our neighboring countries, which are our competitors. The Philippine Islands are yearly paying a heavy toll in damages caused to crops by regular outbreaks of destructive insect pests and plant diseases, and the Philippine Government is yearly spending large sums of money for their eradication and control. A scientific study of the life history and methods of control of these insects by biological methods would go a long way towards finding permanent and inexpensive methods of control which would save our crops from untold damage, thus saving the Government the necessity of adopting emergency measures and appropriating large sums of money for their eradication. We are equally confronted with engineering and chemical problems concerned with the lowering of the cost of production that would enable us to industrialize the country to produce articles of food, shelter and clothing that would stand competition against products imported from the outside. Finally we should not lose sight of the question of our national defense, which we must certainly study, as well as other equally important problems concerning our forests, our mines, our fishery and the very earth we are every day treading upon and such research work as will reveal to us the beautiful things that nature has lavished on the Philippine nation. Everybody recognizes the great importance of improving the means and raising the standard of living of the average Filipino so that he may enjoy a higher measure of happiness and comfort, such as he has a right to expect of a Christian nation under a democratic form of government. For the solution of these momentous national questions, the searchlight of science is essential.

The popularization of science and the diffusion of scientific information which finds application to every-day life would be another service that could be rendered by the Council.

The scientists of the Philippines whom we represent, realizing the responsibilities devolving on them to help the people, the Legislature, and the Government of the Philippine Islands to the best of their ability, have therefore decided to form an organization that will place them in a position in and by which they can give such help most effectively. Hence, they have thought of forming a National Research Council similar to those now in operation in America, England, France, Australia, Canada, Japan and others, which countries, when in the most critical periods of their respective histories, founded such scientific organizations and have since then maintained them because of their proved usefulness. The scientists of the Philippines stand ready to bear any sacrifice in the service of the people, but they recognize their limitations and ask the Legislature, through you and the other leaders, to make it possible for them to form this organization. For this reason they ask that legislation giving them a charter be enacted. They also ask for a nominal support in the form of an annual appropriation amounting to twenty thousand pesos to give life to the organization at the start, a support which, considering the scope of the work outlined, would barely defray the preliminary expenses of the organization. The plan of the Council after it has been chartered is to use the money requested to start a research information bureau for the coordination of all activities that are now going on. The Council soon after would seek to interest commercial and industrial concerns in its work and would solicit from them their financial support, on a strictly business basis. Commercial and industrial concerns and companies have many problems to solve. Instead of installing their own laboratories, they would find it to their advantage to contribute to research laboratories in existence, particularly in the Government bureaus and university departments, the work to be undertaken by members of the Council, without additional compensation but all expenses for materials and special equipment to be paid from the funds contributed by said industrial and commercial concerns.

This scheme is considered feasible inasmuch as some of the research work going on in our colleges and universities as well as in Government laboratories could be brought into closer contact with the problems of the industries and the members of the Council would be only too glad that their work should be thus closely related with the development of local industries. The Council could then give a long needed orientation to the researches now being undertaken by the different laboratories and bring them in closer coordination with the development of local industries and their requirements.

The same amount of money that the Government is now spending in scientific research work in the different Government laboratories, including those in the colleges and universities, would thus be most effectively utilized for the solution of the problems actually confronting the industries. The Council therefore would try to have some of the present laboratory facilities of the Government utilized in the solution of the problems of these industries, so that the latter would find that for the small amount that they might give in support of the work of the Council undertaken in their behalf, they would get a great deal more than otherwise for the money they put in, while on the other hand the Council would make it possible for scientists engaged in teaching and other routinary matters in goverment laboratories a chance to render additional service to the economic development of the country.

Another way in which the Council could serve, promoting the cause of science and technical development in the Philippines would be by taking over useful and promising inventions of local inventors; securing patents for them; and granting contracts for the exploitation of the patents on royalty bases, giving the inventor his due share. Such a step would go a long way in promoting invention locally.

The Research Council rather than interfere with the proper functions of the different technical and scientific bureaus of the Government, by creating an understanding and a definition of problems form a high level—and it could do so inasmuch as the Council would be composed of the most experienced scientific minds in the Islands and would refer all questions to competent committees composed of men versed in their particular lines—would supplement and make more useful the Government work. Recommendations for the solution of any national scientific problems affecting the different activities of the country would thus always be on a plane higher than the position that might be taken by any single governmental entity.

Finally, in presenting to you the cause of science and technology, the undersigned would call attention to the role that science and invention have played in the development of other countries, particularly citing the example of Java and Japan, where organization for research and invention are complete and have a well recognized influence in their industrial and agricultural development. The example of Japan is especially worth mentioning. Japan, who but a few years ago was considered by Occidentals as a mere imitator, has through her research laboratories swiftly passed from that stage of being a mere imitator to a position of leadership among the industrial nations of the world, so that Japanese products now of all and every kind compare and compete favorably with similar products of the most advanced countreis in the world. The Imperial Government of Japan is most liberal in its support of its scientific institutions, and the Research Council of Japan is a recognized entity the world over.

May we therefore request your whole-hearted support to the plan for the creation of the National Research Council of the Philippine Islands, and ask that if you shall find, as we hope you will, our move in the right direction, you please give your approval for the enactment of legislation that will give the scientists of the Philippines the opportunity that they are seeking, to serve the country to the best of their ability.

Very respectfully

(Sgd.) MANUEL L. ROXAS
President

(Sgd.) H. LARA
Past President and Council Member

(Sgd.) EDUARDO QUISUMBING
Vice-President

(Sgd.) ARTURO GARCIA
Council Member

(Sgd.) PATROCINIO VALENZUELA
Secretary-Treasurer

APPENDIX D

NINTH PHILIPPINE LEGISLATURE } H. No. 3276
Third Session }

[No. 4120]

AN ACT CREATING A NATIONAL RESEARCH COUNCIL IN THE PHILIPPINE ISLANDS FOR THE PROMOTION OF RESEARCH WORK ALONG SCIENTIFIC LINES.

Be it enacted by the Senate and House of Representatives of the Philippines in Legislature assembled and by the authority of the same:

SECTION 1. One hundred and fifty prominent scientists and technical men of the Philippine Islands to be selected by the Governor-General with the advice and consent of the Senate, as charter members; and their associates and successors duly chosen are hereby incorporated, constituted, and declared to be a body corporate by the name of National Research Council of the Philippine Islands.

SEC. 2. The purposes of this corporation are:

(1) In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, starting studies of problems of the national defense, and of contributing in other ways to the public welfare.

(2) To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientic and technical resources of the country for dealing with these projects.

(3) To promote coöperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all coöperative undertakings to give encouragement to individual initiative as fundamentally important to the advancement of science.

(4) To gather and collate scientific and technical information at home and abroad, in coöperation with governmental and other agencies and to render such information available to duly accredited persons.

SEC. 3. The National Research Council of the Philippine Islands shall, aside from the charter members mentioned in section one hereof, consist of members duly elected by the incorporators thereof in accordance with its constitution and by-laws and the said corporation shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation or otherwise; to provide for the election of members, division into classes, and for all other matters needful or usual in such institution.

SEC. 4. The National Research Council of the Philippine Islands shall hold an annual meeting at such place and at such time in the Philippine Islands as may be designated, and the Council shall, whenever called upon by any Department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Council shall receive no extra compensation whatever for any services rendered to the Government of the Philippine Islands.

SEC. 5. The said National Research Council of the Philippine Islands is hereby authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said Council in aid of scientific investigations according to the will of the donors.

SEC. 6. The National Research Council of the Philippine Islands shall, in carrying out its aims and functions, and its purposes and powers provided in this Act, be exempt from the payment of all internal-revenue taxes, fees, assessments and other charges of the Government.

SEC. 7. From and after the passage of this Act it shall be unlawful for any person within the jurisdiction of the Philippine Islands to falsely and fraudulently hold himself out as, or represent himself to be, a member of, or an agent for, the National Research Council of the Philippine Islands, for the purpose of soliciting, collecting, or receiving money or material; and any person who violates the provisions of this section, shall be guilty of *estafa* and shall be dealt with accordingly.

SEC. 8. To help the said National Research Council of the Philippine Islands in carrying out its work as provided in this Act, the Secretary of Agriculture and Commerce is hereby authorized and empowered to turn over to the said National Research Council such sums of money and extend such aid as the said Secretary may from time to time consider necessary, the money to come out of any available balance of the lump sum items of the appropriation authorized for the Department of Agriculture and Commerce or out of the money appropriated by Act Numbered Thirty-nine hundred and fifty-three, entitled "An Act to appropriate the sum of six hundred and eighty thousand pesos to be disbursed by the Secretary of Agriculture and Natural Resources for the promotion of new, and the improvement of existing industries, and for other purposes": *Provided*, That in no case shall the sum to be allotted for the purposes of this Act exceed twenty thousand pesos.

SEC. 9. The National Research Council of the Philippine Islands shall submit regularly an annual report to the Philippine Legislature and to the Governor-General, containing an accurate account of its work and activities during the corresponding fiscal year.

SEC. 10. This Act shall take effect on its approval.

Approved, December 8, 1933.

APPENDIX "E"

CONSTITUTION AND BY-LAWS

ARTICLE I—*Purposes*

In accordance with the provisions of section 2 of Act No. 4120, the purposes of the National Research Council are:

(1) In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, starting studies of problems of the national defense, and of contributing in other ways to the public welfare.

(2) To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

(3) To promote coöperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all coöperative undertakings to give encouragement to individual initiative as fundamentally important to the advancement of science.

(4) To gather and collate scientific and technical information at home and abroad, in coöperation with governmental and other agencies and to render such information available to duly accredited persons.

ARTICLE II—*Membership*

SECTION 1. The members of the National Research Council shall not exceed one hundred and fifty (150).

SEC. 2. The members appointed by the Governor-General and confirmed by the Philippine Senate in accordance with section 1 of Act No. 4120 shall be considered charter members.

SEC. 3. Members other than charter members shall be elected by the council.

SEC. 4. Membership in the Council shall be limited to citizens of the Philippine Islands or of the United States. This, however, shall not be construed as applying to membership in sections acting under the Council, whose members are not necessarily members of the Council; provided that members of such sections who are not citizens of the Philippine Islands or of the United States shall in no case form a majority of any such Sections.

SEC. 5. Membership in the Council may be lost by death, resignation, or separation for cause.

SEC. 6. Any member intending to leave the Philippine Islands for a period of more than one year shall make it known to the Council in writing whether or not he intends to return to the Philippine Islands. Any member absenting himself from the Philippine Islands for a period of more than one year without having so signified his intentions of returning shall be considered automatically as having resigned and his membership may be filled by the Council.

SEC. 7. Any member may be separated for cause upon written complaint by ten or more members after due investigation and hearing, and upon the unanimous vote of the members of the Executive Board.

ARTICLE III—*Divisions*

SECTION 1. The Council shall be organized in divisions as follows:

I. Division of Government, foreign, and educational relations.
II. Division of physical and mathematical sciences.
III. Division of medical sciences.
IV. Division of chemical and pharmaceutical sciences.
V. Division of biological sciences.
VI. Division of agriculture and forestry.
VII. Division of engineering and industrial research.

SEC. 2. The number of divisions and the grouping of subjects in Article III, section 1, may be modified by the Executive Board of the National Research Council.

SEC. 3. The divisions of the Council, with the approval of the Executive Board, may establish sections any of which may include members chosen outside the membership of the Council.

ARTICLE IV—*Administration*

SECTION 1. The affairs of each division shall be administered by a chairman and an executive committee which will be composed of the chairmen of sections. The chairman of each division shall be ex officio member of the sections under the division.

SEC. 2. The affairs of the National Research Council shall be administered by an Executive Board which shall consist of three members at large and the chairmen of divisions. The chairman of the Executive Board and of divisions of the National Research Council shall continue respectively as members of the Executive Board and corresponding Divisions for one year beyond the expiration of their office as chairmen.

SEC. 3. The Executive Board of the National Research Council shall, for all legal purposes, constitute the Board of Directors with all the duties, powers and prerogatives of a Board of Directors, not otherwise provided for in this Constitution and By-Laws.

SEC. 4. The officers of the National Research Council shall consist of a chairman, a vice-chairman, an executive secretary, and a treasurer, who shall serve also as officers of the Executive Board of the Council. The offices of the executive secretary and the treasurer may be held by the same person.

SEC. 5. The chairman of the National Research Council, or, in case of his absence or inability to act, the vice-chairman, shall be the chief executive officer of the Council; shall preside over the meetings of the Council and of the Executive Board; shall refer investigations required by the Government of the Philippine Islands and other entities to the proper sections.

SEC. 6. The officers of the National Research Council and chairmen of divisions shall hold office for one year or until their successors are legally elected and qualified. A vacancy in the office of executive secretary and treasurer may, however, be filled by appointment by the chairman of the Board until the next meeting of the Board.

SEC. 7. The executive secretary shall take charge of all correspondence and the minutes of the meeting of the Council. It shall be his duty also to give notice to the members of the place and time of all meetings, of all nominations, and of all proposed amendments to the constitution.

SEC. 8. The treasurer shall attend to all receipts and disbursements of the Council. He shall be the custodian of the funds and property of the Council and shall present a general report of the financial status of the Council at the annual meeting.

SEC. 9. The Executive Board shall have the power to appoint fellows, associates and collaborators, fix their duties and their emoluments.

SEC. 10. Other duties of the officers of the Council and the duties of the divisions shall be fixed by the Executive Board.

ARTICLE V—*Nominations and Appointments*

SECTION 1. The Government bureaus or offices and the educational, scientific and technical institutions or societies to be represented in the National Research Council, shall be determined by the Executive Board.

SEC. 2. Representatives of the government bureaus or offices shall be nominated by the Secretary of the Department concerned at the request of the Executive Board and appointed by the chairman of the Executive Board to membership in the sections of the Council.

SEC. 3. Representatives of educational, scientific, and technical institutions or societies shall be nominated by the institutions or societies at the request of the Executive Board, and appointed by the chairman of the Board to membership in the sections of the Council.

SEC. 4. Membership in the sections shall be for a term of three years, except when appointed to fill unexpired terms, provided that the members first appointed shall be for periods of one, two or three years.

SEC. 5. The government representatives shall serve for the period of their appointment, provided that if they retire from the government office which they represent, they shall cease to be members of the sections and their successors shall be appointed for the unexpired term.

ARTICLE VI—*Elections*

SECTION 1. New members shall be elected at the annual meeting of the Council upon nomination by the Executive Board. Election shall be by secret vote. No member shall be elected who has received ten negative votes.

SEC. 2. Members of the Executive Board shall be elected by secret ballot at the annual meeting by members of the Council. A plurality of the votes cast for the respective membership in the Executive Board shall elect. The chairmen of each division shall be elected from not less than two nominees to be selected and submitted by the divisions concerned. The three members at large shall be elected from nominees made at the annual meeting. No cumulative voting will be allowed.

SEC. 3. The officers of the National Research Council shall be elected by the Executive Board as soon as the elected members may be convened and not later than ten days after the date of the annual meeting.

SEC. 4. Membership in the divisions shall be determined by the Executive Board.

ARTICLE VII—*Meetings*

SECTION 1. The annual meeting of the Council shall be held in February in the City of Manila, on a date to be determined by the Board.

SEC. 2. Special meetings of the Council may be called by the Executive Board or upon the request in writing of at least ten (10) members of the Council.

SEC. 3. Notice of Council meetings shall be sent to all members at least ten days before the meeting, provided that for special meetings its purpose be included with the notice.

SEC. 4. Fifty members present in any meeting of the Council shall constitute a quorum. No proxies will be allowed.

SEC. 5. A majority of the Executive Board shall constitute a quorum for the transaction of any business, provided that at least five days notice of the meeting shall have been given.

SEC. 6. At the annual meeting the order of business shall be as follows:

(1) Call to order by the chairman.
(2) Roll call.
(3) Approval of the minutes of the last meeting.
(4) Chairman's address.
(5) Report of the Executive Board.
(6) Unfinished business.
(7) Miscellaneous.
(8) Election of officers.
(9) New business.
(10) Election of new members.
(11) Adjournment.

ARTICLE VIII—*Publications and Reports*

SECTION 1. The Executive Board of the National Research Council of the Philippine Islands shall submit regularly an annual report to the Philippine Legislature and the Governor-General, through the Department of Agriculture and Commerce, containing an accurate account of its work and activities during the corresponding fiscal year.

SEC. 2. The report of the treasurer and the auditor appointed by the chairman of the council shall be incorporated in the annual report of the Executive Board.

SEC. 3. Publications of the National Research Council may include papers, bulletins, reports, memoirs, which may appear in the proceedings or memoirs of the National Research Council, in the publications of other societies in scientific and technical journals, or in a separate series of the National Research Council.

ARTICLE IX—*Amendments*

SECTION 1. This Constitution and By-Laws may be amended, repealed or altered, in whole or in part, by a two-thirds vote of the members present, at any regular meeting of the Council, or at any special meeting where such action has been announced in the call and notice of such meeting.

SEC. 2. Proposed amendment, repeal or alteration must be submitted in writing to the Executive Board. The Board may amend the proposition or recommend approval or disapproval thereof within thirty days from its receipt. The proposal together with the recommendation of the Executive Board must be sent to all the members of the Council at least twenty days before the date of the meeting at which it is to be considered.

APPENDIX "F"

NINTH PHILIPPINE LEGISLATURE }
First Session }

HOUSE OF REPRESENTATIVES
H. No. 876
Introduced by Representative Gallego

EXPLANATORY NOTE

The present bill has for its object the creation of a National Research Council in the Philippine Islands for the promotion and encouragement of research work along scientific lines.

Research work in the Philippine Islands is found in a unique situation for the simple reason that there is no institution either governmental or private which gives special attention to this line of activity. Added to this, there is no special incentive for those workers who, by peculiar inclination, undertake upon their own initiative, investigations which are not required of them. Such workers do not receive any encouragement at all, either in the form of public recognition, or in the form of extra renumeration. In more progressive countries, such workers performing accomplishments outside of the ordinary requirements of an employee are remunerated either by conferring on them certain special honors such as professorships or memberships in honorary societies, or in the knighthood. In other instances, special funds are available, so that they can be given proper facilities for carrying out the work of their special preference. They receive extra remuneration to enable them to devote their whole time and efforts to their work without being bothered with worries about financial difficulties and about providing for old age and for the members of their family. On the other hand, in the Philippine Islands, it is of common observation that scientists who have undertaken investigations, not ordinarily required of them by reason of their office are rated officially or socially among his colleagues in the same position as other so-called scientists who practice their science in a half-baked way, have not done any investigation of their own and in reality constitute a drag upon general progress. Such conditions discourage hard work and encourage laziness among scientists. This attitude should be modified as much as possible by wise and progressive governments. Our medical societies point out such defects and in so doing, they comply with their duty to the public.

It may be argued that some discoveries were made accidentally by the men usually working under very unfavorable circumstances and unsupported by any institution. Such cases are very few and at the present time, the most progressive countries will not rely upon such accidental discoveries for the promotion of progress. They create institutions which systematically encourage the development of initiative and of original ideas and support them by special grants. Of course, they exercise great care in the selection of the subject of research, so that the financial support is not misplaced and that properly trained individuals are selected. In all beginnings this point must be specially stressed and much more specially in the Philippine Islands where there is a strong current of destructive criticism from persons who, not understanding the width and depth of research, pose as know alls and pretend to pass on the merits or demerits of it. The result is, instead of making our men and pushing them on to world recognition, we unmake them and destroy their self confidence and, in so doing destroy our own individuality as a race and nation.

In view of the fact that the object of the present bill will fill a long felt necessity of our country in its forward steps toward scientific culture and progress, it is confidently hoped, that it will meet with the approval of the Legislature.

(Sgd.) MANUEL V. GALLEGO,
Representative, 1st District,
Nueva Ecija.

NINTH PHILIPPINE LEGISLATURE
First Session.

HOUSE OF REPRESENTATIVES
H. No. 876.
Introduced by Representative Gallego

AN ACT

CREATING A NATIONAL RESEARCH COUNCIL IN THE PHILIPPINE ISLANDS FOR THE PROMOTION OF RESEARCH WORK ALONG SCIENTIFIC LINES.

Be it enacted by the Senate and House of Representatives of the Philippines in Legislature assembled and by the authority of the same:

SECTION 1. A Research Council for the Philippine Islands is hereby created which shall consist of ten members to be appointed by the Secretary of Public Instruction with the advice and consent of the Philippine Senate. The members of said board shall hold office for a period of five years or until their successors are duly appointed.

SEC. 2. The duties of the Council shall be:

(a) To promote the undertaking of research work along different sciences by Filipinos.

(b) To supervise and coordinate all research works under the auspices of the Philippine Government or under the auspices of private individuals or institutions which may in any way obtain help from the Council, or which may request the Council for coordination.

(c) To formulate schemes of research on problems, the solutions of which, are of immediate benefit to the country.

(d) To select and train the appropriate personnel of research workers and scientific assistants.

(e) To obtain the necessary moral and material support from the government or from private sources for those persons who are engaged in certain line of research work.

(f) To suggest, discuss, criticise, and otherwise help individuals who are already undertaking research works in the Philippine Islands.

(g) To select scientific workers on the ground of preeminent accomplishments in the field of research so that they may be able to work or continue their research abroad.

SEC. 3. The Council is hereby authorized:

(a) To appoint research workers, scientific assistants and the necessary personnel to enable it to carry out its work, and fix their corresponding compensation.

(b) To receive, purchase, acquire, dispose property or money as a corporate body.

(c) To expend any appropriation set aside by the government or any other fund placed under its disposal.

(d) To require the services of any individual serving under the Philippine Government with the permission of the corresponding department heads. The research workers so selected may receive additional compensation out of any fund placed at the disposal of the Council.

(e) To make and issue such rules and regulations as it may deem necessary from time to time not inconsistent with the provision of this Act, to carry out its purposes.

SEC. 4. The amount of sixty thousand pesos (₱60,000.00) not otherwise appropriated is hereby set aside for carrying out the purposes of this Act.

SEC. 5. This Act shall take effect on its approval.

Approved.

APPENDIX "G"

EXPLANATORY NOTE OF H. No. 3276 *

NINTH PHILIPPINE LEGISLATURE }
Third Session }

HOUSE OF REPRESENTATIVES

H. No. 3276

Introduced by Representatives Gallego and Farol

EXPLANATORY NOTE

The organization of the National Research Council of the Philippine Islands should be authorized and fostered by the Philippine Legislature as a timely measure of national preparedness. The National Research Council of the Philippine Islands will be a cooperative organization of the scientific men of the Philippines. Its purpose shall be to bring into cooperation existing governmental, educational, industrial, and other research organizations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of Philippine industries, the employment of scientific methods in laying out the foundations for national defense, and such other applications of science as will promote the national security and welfare.

Its membership, however, shall be limited largely to scientific and technical men. Its ordinary membership will largely be composed of the members of the Council and the past presidents of the Philippine Scientific Society, representatives of scientific societies, representatives of certain other research organizations and institutions, representatives of government scientific bureaus, representatives of the educational institutions conducting research and instruction in science, and a limited number of members at large.

The National Research Council of the United States of America was a potent organization during the World War. Its accomplishments in terms of service and results to the country in organizing research and securing cooperation of military and civilian agencies in the solution of military problems during the World War is a matter of historical record. The President of the United States in 1918 recognizing the tremendous importance of the National Research Council to the country, by executive order perpetuated its existence and to-day it is an effective organization. It now devotes its energies to the promotion and support of scientific research in general and maintains close cooperative relations with Government scientific bureaus and private entities and their activities. It has helped the Government. Its reports have been accepted, its recommenda-

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* Act No. 4120 published as Appendix D to this report constitutes the House Bill No. 3276.

tions have been adopted, and the Government has shaped its course in general matters of importance in the light of the counsel which it received from the National Research Council.

We are to-day confronted with multitudinous problems of national importance and none of these problems could be solved by one man or one institution. Concerted efforts, combined forces and effective measures are necessary. The organization of the National Research Council of the Philippine Islands patterned more or less after that of the National Research Council of America is very timely and propitious.

The Council as is proposed will not maintain scientific laboratories. It will primarily be an organization which while clearly recognizing the indispensable value of individual investigations, will particularly exert efforts to bring together scattered work and workers, and to assist in coordinating, in some measure, scientific attack in any and all lines of scientific activity in the Philippines, especially, those problems which depend for successful solution on the cooperation of several or many workers and laboratories, either within the realm of a single science or representing different realms in which various parts of a single problem may lie.

The duties of the National Research Council of the Philippine Islands will be as follows:

1. The National Research Council of the Philippine Islands shall act as an official and scientific adviser of the Government on national problems as production, health, education, etc.

2. In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to industry, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense and contributing in other ways to the public welfare.

3. To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

4. To promote cooperation in research with the object of securing concentration of effort, minimizing duplication, stimulating progress and obtaining increased efficiency; but with careful avoidance of any hampering control or interference with individual freedom and initiative, as fundamentally important to the advancement of science.

5. To serve as a means of bringing Filipinos, Americans and foreign investigations into active cooperation with those of the civil branches of the Government.

6. To direct the attention of scientific and technical investigators to the immediate importance of industrial problems and to aid in the solution of these problems by organizing specific researches.

7. To gather and collect scientific and technical information, at home and abroad, in cooperation with the government and other agencies and to render such information available to duly accredited persons.

8. To prepare a national inventory of equipment for research, of the men engaged in it, and of the lines of investigations pursued in

government bureaus, educational institutions, research foundations, and industrial research laboratories.

9. To prepare reports by special sections suggesting important research problems and favorable opportunities for research in various departments of science.

10. To cooperate with educational institutions, by supporting their efforts to secure larger funds and more favorable conditions for the pursuit of research and for the training of students in the methods and spirit of investigation.

11. To cooperate with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

The administrative work of the Council will be carried on by a small group of officers and an Executive Board, which will act for the Board in the interval between its stated meetings. The Council itself will be composed of seven major division representing respectively, government, foreign, and educational relations; physical and mathematical sciences; medical sciences including veterinary and dental sciences; chemical and pharmaceutical sciences; biological sciences; agriculture and forestry; and engineering and industrial research. With these divisions are associated various technical sections, each with its special field of subject or attention. The Council will also maintain a Research Information Service to assist in the compilation and organization of scientific information and to respond to inquiries concerning sources of scientific material.

(Sgd.) MANUEL V. GALLEGO,
Representative, 1st District,
Nueva Ecija

(Sgd.) MEYNARDO M. FAROL,
Representative, 2nd District,
Batangas

ERRATA

We deeply regret the many errors that occur in this publication. They are largely due to the necessity of printing the work at intense speed. We hope, however, that no errors of fact have crept in, and we offer below some corrections which may serve to clarify the text.

Bulletin 2, page 12, line 9, *for* Section of Botany *read* Section of Systematic Botany
” ” ” 59, ” 29, ” *Clathrocystia* *read* *Clathrocystis*
” ” ” ” ” 30, ” Monfrey *read* Henfrey

Bulletin 3, page 82, paragraph 4, line 6, *for* House Bill No. 3276 *read* House Bill No. 3276 *
” ” ” 83, *after* line 10 *read* Act Numbered 4120, appendix D, creating a National Research Council in the Philippine Islands for the promotion of research work along scientific lines was approved on December 8, 1933
” ” ” 91, line 1, *for* Castro *read* Casto
” ” ” 96, paragraph 5, line 6, *for* imporant *read* important
” ” ” 100, ” ” ” 4, *for* 1587 *read* 1578
” ” ” 117, line 30, *after* Manila, 1857 *read* (2*a* edición)
” ” ” 119, ” 5, *for* 1951 *read* 1915
” ” ” 120, ” 9, *after* 1815 *read* (2*a* edición)
” ” ” 122, ” 32, *for* Manila *read* Madrid
” ” ” 123, *after* line 25, *read* Sta. Maria
” ” ” 124, line 20, *for* (1) Sistematico *read* (1) Catalogo sistematico
” ” ” 143, paragraph 6, line 4, *for* start up *read* start
” ” ” 149, line 15, *for* (1822) *read* (1722)
” ” ” 152, paragraph 4, line 10, *for* Diedo *read* Diego
” ” ” 153, line 12, *for* 1840 *read* 1849

Bulletin 4, page 227, paragraph 2, line 4, *for* epiric *read* empiric
” ” ” ” ” 3, ” 2, *for* upreme *read* supreme
” ” ” 237, ” 5, ” 5, *for* anthelmentics *read* anthelmintics.
” ” ” 247, ” 3, ” 4, *for* adaption *read* adoption
” ” ” 249, ” 3, ” 7, *for* fellowhips *read* fellowships
” ” ” 260, line 32, *for* M. Pascual *read* W. Pascual
” ” ” 267, under Sanitation, line 9, *for* 882 *read* 1882
” ” ” 271, line 11, *for* Psychophatic *read* Psychopathic
” ” ” ” ” 25, *for* Bay *read* Baby
” ” ” 272, ” 4, *for* Provincial *read* Provisional
” ” ” 284, ” 3, *for* Wililams *read* Williams
” ” ” 284, ” 13, *for* Ortigas *read* Artigas
” ” ” 287, ” 14, *for* rabite *read* rat-bite

Bulletin 4, page 288, lines 5, 6, *for* Tavtay *read* Taytay
” ” ” 302, line 12, *for* clinics-pathological *read* clinico-pathological
” ” ” 307, paragraph 4, line 4, *for* Ubardo *read* Ubaldo
” ” ” 308, ” 2, ” 7, *for* understook *read* undertook
” ” ” 324, line 4, *for* (1914) II 645 *read* (1914) v.2:645
” ” ” 334, paragraph 2, line 5, *for* dragons *read* dragoons

Bulletin 5, page 387, paragraph 1, line 3, *for* along *read* alone
” ” ” ” ” 3, ” 4, 5, *for* fish- and arrow *read* fish- and arrow-poisoning
” ” ” 407, ” 5, ” 4, *for* Hemano *read* Hermano
” ” ” 429, ” 1, ” 12, *for* out *read* on
” ” ” 429, ” 2, ” 6, *for* out *read* on
” ” ” 429, ” 3, ” 4, *for* molluscs *read* mollusks
” ” ” 430, ” 1, ” 1, *for* out *read* on
” ” ” 433, line 44, *for* molluscs *read* mollusks
” ” ” 439, paragraph 3, line 2, *for* done with *read* made of
” ” ” ” ” 4, ” 3, 4, *for* sewage disposals in *read* sewage from
” ” ” 449, ” 2, ” 5, *for* answers to *read* answers can be found to
” ” ” 449, ” 2, ” 9, *for* are not as yet *read* cannot be
” ” ” 453, ” 1, ” 2, *after* Birds” *read* and
” ” ” ” ” 2, ” 1, *for* along *read* in
” ” ” 457, ” 2, ” 6, *for* principle *read* principles
” ” ” 459, ” 3, ” 2, *for* along *read* among
” ” ” 479, ” 1, ” 3, *for* and *read* with
” ” ” 492, line 4, *for* Patology *read* Pathology

Bulletin 6, page 511, paragraph 2, line 15, *for* and on more *read* and which was on more
” ” ” 523, *after* line 1, *read* IN THE UNIVERSITY OF THE PHILIPPINES
” ” ” 548, paragraph 3, line 7 *after* page *read* 549
” ” ” ” line 13, *for* page gives *read* page 549 gives
” ” ” 573, paragraph 1, *before* line 1 *read* It is astonishing that holticulture, the most advanced stage in
” ” ” 596, ” 1, line 8, *for* Javanes *read* Javanese
” ” ” ” ” 3, ” 5, *for* cetrain *read* certain
” ” ” 597, ” 5, ” 6, *for* oil *read* soil
” ” ” 601, ” 2, ” 7, *for* Stranglay *read* Strangely

Bulletin 7, page 621, lines 34 and 40, *for* J. M. Alberto *read* J. M. Albert
” ” ” 622, line 14, *for* J. M. Alberto *read* J. M. Albert
” ” ” 626, ” 7, *for* TP375.54 *read* TP375.S4
” ” ” 634, ” 17, *for* R97.5:M *read* R97.5:M2
” ” ” 648, ” 20, *for* Nos. 35 and *read* Nos. 3 and
” ” ” 663, ” 22, *for* batchability *read* hatchability
” ” ” 689, ” 32, *for* ancylostoma *read* ankylostoma
” ” ” 690, ” 33, *for* ancylostomiasis *read* ankylostomiasis

Bulletin 7, page 695, line 31, *for* Gl.P54 *read* Q1.P54
” ” ” 721, ” 38, *for* v.1.27: *read* v. 27:
” ” ” 722, ” 32, *for* classification *read* clarification
” ” ” 726, ” 41, *for* P. E. Russell *read* P. F. Russell
” ” ” 728, ” 6, *for* R. E. Holt *read* R. L. Holt
” ” ” 730, ” 39, *for* service *read* serves
” ” ” 733, ” 36, *for* Q75.P5 *read* Q75.U5
” ” ” 738, ” 23, *for* R97.5:52 *read* R97.5:S2
” ” ” 743, ” 23, *for* viriable *read* variable
” ” ” 750, ” 11, *for* TP375.P53 *read* TP375.P52
” ” ” 763, ” 36, *for* F. Russell *read* P. F. Russell
” ” ” 765, ” 35, *for* 375-357 *read* 352-357
” ” ” 769, lines 16 and 17, *for* Manuel S. Roxas *read* Manuel L. Roxas
” ” ” 790, ” 37 ” 43, *for* R975.5:R4 *read* R97.5:R4
” ” ” 798, line 9, *for* metaboism *read* metabolism
” ” ” 803, ” 2, *for* autonomy in hooturians *read* autotomy in holothurians
” ” ” 807, ” 14, *for* vinicity *read* vicinity
” ” ” 817, ” 28, *for* 97.5:R4 *read* R97.5:R4
” ” ” 827, ” 28, *for* Phil. Zeta *read* Phi Zeta
” ” ” 828, ” 33, *after* Negros *read* Surgery and
” ” ” 839, ” 26, *for* JULIANO, Jose—Agricultural College, Laguna, *read* JULIANO, JOSE BUENCAMINO.—Agric. College, Los Baños, Laguna. Morphology. San Miguel, Bulacan, Feb. 10, 00. B. S. A., 23, M. Sc., 25, Univ. Philip.; Ph.D., Leland Stanford Junior Univ., 30____. Fellow Am. Assn. for the Advancement of Sci.; Botanical Soc. of America; The Soc. for the Advancement of Res.; Los Baños Biol. Club; Sigma Xi; The Am. Genetics Assn.; British Ecological Soc.; Ecological Soc. of Am.; Asso., National Res. Council P. I. Univ. of Philip. Pensionado to Leland Stanford Junior Univ., 28-30.

Bulletin 7, page 840, lines 8 and 17, *for* cyanophiric *read* cyanophoric; *for* santo *read* santol
” ” ” 841, line 27, *after* Nov. 29, 90 *read* B.Agr., U.P., 15; M. Sc., Audobon Sugar School, 17.
” ” ” 851, ” 15, *for* S177.P53 *read* S17.P53
” ” ” 853, ” 32, *after* May 8, 93 *read* B.S., Oregon Agric. Coll.21; M.S., Univ. Ill., 23
” ” ” 854, ” 38, *for* 51-51-84 *read* 51-84
” ” ” 855, ” 10, *for* R97.5:57 *read* R97.5:P57
” ” ” 856, ” 6, *after* Pampanga *read* B.S., 27, M.S., 28, Cornell Univ.
” ” ” 863, ” 7, *for* Sapinosa *read* Sapinoso
” ” ” 870, ” 20, *for* Swis and Turich *read* Swiss and Zurich

Bulletin 7, page 891, line 36, *for* Rodulf *read* Rudolf
" " " 901, " 31, *for* Vargas, Jorge G. *read* Vargas, Jorge B.
" " " 902-d, line 6, *for* Bolobo, alupang *read* Balobo, alupag

Bulletin 8, page 911, line 22, *for* Height, 33m *read* Height, 33 cm.
" " " 969, lines 2 and 3, *for* Department of Agriculture and Commerce, Manila and Chairman, National Research Council of the Philippine Islands *read* Department of Agriculture and Commerce, Manila
" " " 969, *after* line 5, *read* and Chairman, National Research Council of the Philippine Islands

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