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# EIGHTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

ELMER D. MERRILL  
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING  
DECEMBER 31, 1919



MANILA  
BUREAU OF PRINTING  
1920



# EIGHTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE,

MANILA, *December 31, 1919.*

SIR: I have the honor to submit the following report on the operations of the Bureau of Science covering the fiscal year ending this date:

Dr. Alvin J. Cox, Director of the Bureau since January 22, 1914, retired from the Government service on May 20, 1919, under the terms of Act No. 2589, after having energetically served the Bureau of Science first as a chemist and later as Assistant to the Director, Acting Director, and Director, for a period of thirteen years, having first been appointed on April 25, 1906, as a chemist. I was appointed Acting Director on May 21, 1919, and served in that capacity until December 12, when my appointment as Director of the Bureau was confirmed by the Philippine Senate.

In June, 1919, I prepared for your information a brief report on the Bureau of Science, and on its conditions and needs as found by me on taking over the duties of Acting Director. In preparing the present report on the operations of the Bureau for 1919 I am gratified to record that steps have already been approved which will lead to a distinct betterment in existing conditions in reference to the technical personnel of the Bureau; and, if this policy be continued, it is confidently believed that various essential lines of investigation, where work has stopped for lack of such technical personnel, can be rehabilitated and the work extended during the coming year.

For several years there has been a steady decline in the number of technical men employed in the Bureau of Science. It is hardly necessary to enter into a discussion of the combination of circumstances which has resulted in the loss of the services of these men, but this loss has been caused in large part by conditions brought about by the late war and in part by the inadequate salaries offered to technical men. At no

time in its history has the Bureau been in so serious a condition as to technical personnel as it was during the latter part of 1919.

While the objects, purposes, and accomplishments of the Bureau of Science have perhaps not always been fully understood and appreciated to their full value locally, it will, I believe, be admitted by all competent individuals that the institution has made a remarkable record since its organization, both for the amount and the quality of the work accomplished and for the scientific and economic value of that work. It is not, however, my intention at the present time to attempt any justification of the idea underlying the organization and maintenance of the Bureau of Science, for the institution should stand on its own merits. It is believed that its value and utility to the Philippines and to the public at large are fully evident to any fair-minded, thinking individual. The present condition of the Bureau, however, is distinctly critical; for if there be much further depletion of the technical personnel, it will be practically impossible for the Bureau to fulfill its proper functions.

The annual reports issued in the past few years have been distinctly optimistic, but there has been justification for this optimism; for, while suffering a constant decrease in technical personnel and a steady loss of its older and experienced employees, the organization has remained sufficiently homogeneous that the essential routine work not only has been maintained in most departments but also has been distinctly increased in others, although as a natural corollary research work has been reduced to a minimum. There is, moreover, distinct evidence in the decrease in patronage from certain quarters that there is some loss in confidence on the part of the professional public in the work of the Bureau. This is only to be expected when in certain lines of work we can no longer command the services of properly qualified technical men. The fact must be thoroughly recognized that with the present depleted personnel the Bureau cannot (and should not be expected to) accomplish the amount of work that it could accomplish in previous years; and, further, that nothing is to be gained but adverse criticism even by attempting work in certain lines where technical experts are not available. Much work can be done with the present technical personnel, but there can be no amplification in the investigations carried on by the Bureau.

Due to advancement in Philippine industries there has been

a distinct increase in the ordinary routine work in most departments of the Bureau. With this rather radical increase in some of the laboratories and with the reduced technical personnel, it is perfectly evident that new work (especially with reference to investigations) cannot be initiated; in many departments original investigation and research are, therefore, practically at a standstill.

Numerous problems in connection with the development and utilization of the resources of the Philippines, and others concerning the public health demand expert attention. Unfortunately, instead of being able to meet all these demands, the Bureau of Science at the present time is so depleted in personnel that work in a few departments has entirely ceased; while in others, when any of the few remaining employees of experience leaves on vacation or resigns, the work in his department either ceases or is at most carried on in an unsatisfactory manner. The technical personnel is so greatly reduced (entirely wanting in some departments) that the proper training and supervision cannot be given to incoming members of the subordinate personnel. A more definite idea of the depletion in the technical personnel of the Bureau of Science may be gained from the following statement:

Up to 1917 eight trained and experienced chemists were employed in the division of organic chemistry; at the present time we have but three technical employees in this important division. In the division of general, inorganic, and physical chemistry the average number of chemists employed up to 1914 was eleven, as compared with three at the present time. In the biological laboratory conditions on the whole are equally unsatisfactory. This important department of the Bureau of Science has been for six years without a recognized and appointed chief. The numerous trained and experienced employees formerly connected with this laboratory have left the service, and in most cases it has been impossible to fill the vacancies thus caused. In the section of fisheries no productive work is being carried on at the present time because of the entire lack of technical employees. In the division of mines the average number of technical employees up to 1916 was six; during the past year but two technical employees were available.

To rehabilitate the work of the Bureau of Science and to make it a more efficient unit in the Government service, it is absolutely necessary that the services of additional experienced

technical men be secured in organic and inorganic chemistry, in mining and geology, in fisheries, and in the biological laboratory. It is perfectly evident that the director of such an institution as the Bureau of Science cannot from his own personal knowledge supply the diverse technical information demanded by other units of the Government service and by outside interests. He must, for very evident reasons, depend on the technical personnel of the Bureau for data regarding various technical matters, and the men composing this personnel must be of such training and experience as to demand the confidence not only of the Director of the Bureau but also of the public whom they serve.

An eminently fair trial has been given to the method of employing trained men who have had little experience. Most of these men have entered the service, gained their experience, and when they have reached a point of efficiency where they could legitimately demand a higher salary than they were receiving at the Bureau of Science they have almost invariably received this higher salary elsewhere. As a result, neither the Bureau of Science nor the Philippine Government service as a whole was in a better position than in the beginning; and, essentially, the Bureau was the loser, in that it spent several years in training individual men in practical work, thus acting more or less as an educational institution in practical work.

It must be fully realized that the present difficulties of the Bureau of Science are chiefly involved with the question of adequate remuneration. Owing to the radical change in conditions brought about by the late war and the radical increase in salaries of technical men in all advanced countries, trained and experienced individuals properly equipped to do the type of work required at the Bureau of Science cannot be secured for the salaries formerly paid to such trained men and at present authorized for the Bureau of Science. Too much emphasis cannot be placed upon the fact that, in order to maintain its efficiency and in order to rehabilitate its work, the salaries of technical employees in the Bureau of Science must be increased. A number of trained and experienced men would be willing to enter the Philippine Government service, but trained men of outside experience cannot be induced to enter the service for the present stipulated salaries. This applies not only to American scientists but also to Filipinos. During the past year several cases have occurred where technical Filipinos in the employ of the Bureau of Science have been offered



salaries double what they were receiving in the Bureau of Science, and their remuneration in the Bureau of Science in most cases was the maximum they could receive under the terms of the appropriation bill in force.

Certain special contracts have already been granted effective at some time during the coming year, when the various individuals report for duty. Thus authorization has been granted for the reemployment of Dr. Warren D. Smith, formerly chief of the division of mines; but even if he accept the appointment, he cannot report for duty before the middle of next year. The transfer of Prof. Frank G. Haughwout from the University of the Philippines to the Bureau of Science to carry on work in protozoölogy has been authorized effective January 1, 1920, thus rehabilitating this line of work in the Bureau of Science. Prof. C. S. Banks was reappointed entomologist in the Bureau of Science on September 25, 1919, by transfer from the College of Agriculture, involving the return from Los Baños of all entomological collections and equipment belonging to the Bureau of Science, thus rehabilitating the entomological work in the Bureau. A special contract has been authorized and offered to Dr. J. C. Witt, an inorganic chemist, now in the United States on leave of absence, which, if accepted by him, will result in his return to the Bureau in the early part of next year. Thus a start has been made in the rehabilitation of our technical staff, depleted by the combination of circumstances brought about by the late war. The policy of securing new men must be continued, by offering special contracts whenever necessary, until the Bureau shall be adequately manned with a properly qualified technical personnel to carry on efficiently the investigations demanded of it.

#### THE NEW SERUM LABORATORY AT ALABANG

In the appropriation bill covering the fiscal year 1919 an allotment of ₱200,000 was made to provide for the enlargement of the serum laboratory and for its transfer to Alabang. The transfer of the activities of the serum laboratory to some point outside the City of Manila had become absolutely essential on account of lack of space in Manila for the maintenance of the necessary animals. As the Bureau of Agriculture had removed all of its horses and cattle from the Alabang stock farm and was utilizing only a portion of the station for breeding poultry and swine, it was decided to transfer to the Bureau of Science a portion of the Alabang property, including the stables and the serum laboratory building formerly used by the Bureau

of Agriculture. An agreement was entered into between the Bureau of Science and the Bureau of Agriculture whereby about ₱40,000 of the allotment above mentioned would be expended at Alabang for the benefit of the Bureau of Agriculture, involving the transfer of certain equipment to land retained by the Bureau of Agriculture and the construction of certain buildings to replace those transferred to the Bureau of Science. Owing to local conditions there was considerable delay in commencing work at Alabang, partly due to the fact that it was exceedingly difficult to secure building materials, partly due to the fact that the Bureau of Public Works was short-handed, and partly due to the fact that when operations were commenced little transportation was available for transferring supplies from Manila to Alabang on account of the rice crisis in the Philippines. In spite of these delays considerable progress has been made at Alabang. The roads and the land in the vicinity of the buildings have been cleared of brush and talahib grass; the large stable is in course of being repaired and, where necessary, posts and other parts have been replaced, partitions and feeding troughs have been repaired, and a new manger has been constructed to accommodate about twenty horses.

All of the work that the Bureau of Science undertook to accomplish on behalf of the Bureau of Agriculture is progressing well and should be completed in the near future, while actual work has been commenced on the alteration and repair of the old serum laboratory building and on the necessary new construction. All the required machinery has been ordered and, unless some unforeseen or unavoidable delay should occur, will be available for installation at Alabang in the early part of 1920. It is hoped that the work at Alabang can be completed and the work of the serum laboratory entirely transferred to Alabang before the middle of the coming year. When completed the Alabang serum laboratory should be a model of its kind and should enable the Bureau of Science to fulfill all demands made upon it for serums, vaccines, and other biologic products.

During the latter part of the year, on account of the work accomplished at Alabang, it became possible to transfer from Manila to Alabang some of the horses belonging to the serum laboratory, the total number of horses maintained there in December, 1919, being thirty. The maintenance of these animals at Alabang involves weekly trips on the part of the personnel of the serum laboratory for the purpose of injecting this stock, for all of the horses maintained there are being immunized. It would be possible to transfer more horses there, but for the

fact that all of the animals maintained in Manila are now producing serums and are being bled from time to time. The maintenance of the animals at Alabang has resulted in a considerable financial saving, for on account of the grazing possibilities at Alabang they can be maintained there in good condition for about one-third of the cost of maintaining them in Manila, where all forage has to be purchased.

#### PENSIONADO STUDENTS

Under the terms of Act No. 2785, providing for pensionados to be sent to the United States and other countries for the purpose of advanced work, five fellowships were granted to the Bureau of Science. It is perhaps unfortunate that such provision was not made at an earlier date; had this been done a trained or partly trained technical personnel would have been available by this time to fill the vacancies at present existing in the Bureau of Science.

The original draft of the bill providing for pensionado students in the United States was prepared by the former Director of this Bureau, and at that time the idea was advanced that individuals should be sent only for advanced technical training in the sciences and industries. The scope of the bill was amplified and, perhaps as a result, fewer positions were granted to the Bureau of Science than was distinctly desirable. The individuals accepting fellowships from the staff of the Bureau of Science are Dr. Crisanto Pañganiban, for advanced work in serology; Dr. Onofre Garcia, for advanced work in bacteriology; Mr. A. S. Argüelles, for specialized advanced work in inorganic chemistry; and Mr. Ramon Abarquez, for work in organic chemistry. A fellowship was also granted to Mr. Victoriano Elicaño, for advanced work in geology and mining, which he was unable to accept, the vacancy thus caused being filled by the appointment of Mr. Ramon Feliciano, for work in chemistry. The latter was formerly employed as a junior chemist in the Bureau of Science and was already in the United States, having been granted a private fellowship from Commissioner Teodoro Yangco which, due to unforeseen circumstances, Mr. Yangco was obliged to cancel. For this reason and because of Mr. Feliciano's known ability, a Government fellowship was granted to him so as to enable him to complete the course he had planned to take in Columbia University. The four men from the staff of the Bureau of Science who were granted fellowships in the United States left Manila in July and August and have all reported progress in the courses outlined for them. These men

retain their positions in the Bureau, and their absence at this time tends to emphasize the depletion of its technical personnel. While this is perhaps unfortunate for the time being, yet it will ultimately prove to be to the distinct advantage of the Bureau and of the Government service as a whole. It is, however, to be regretted that more fellowships were not assigned to the Bureau of Science.

The return of the pensionados now in the United States will relieve the pressure on the present available technical force at the Bureau of Science to a slight degree only. In ichthyology, entomology, botany, general zoölogy, geology and mining, bacteriology, pathology, chemistry, and serology, we could, to the very great advantage of the Bureau of Science, and of the Government service as a whole, utilize the services of young men, graduates of the local universities, who have had the advantage of advanced work in foreign scientific centers.

In the vast majority of individual cases in past years where technical men have been brought from the United States for the purpose of carrying on specialized work in the Philippines they have remained in the service only a few years, then returning to the United States. In each individual case the technical man has naturally accumulated a greater or less fund of specialized knowledge with reference to Philippine problems and conditions. In general it is impossible for an individual to record much of the accumulated information in such form as to make it available to his successors. Each individual commencing any line of technical work in the Philippines or, for that matter, anywhere else, is of necessity obliged to spend a great deal of time and energy in acquainting himself with local conditions and studying the various aspects of the problems before attempting to solve them. It is my belief that it will be infinitely better for the Philippine service as a whole (if selection be made among properly qualified Filipinos), if these individuals be given a certain amount of specialized preliminary training in Manila and then be allowed to undertake advanced work in the United States or other foreign countries for the purpose of giving them an opportunity to gain the experience and the specialized knowledge necessary properly to undertake work on research problems. If a reasonable number of such men can be trained in the sciences the probabilities are very great that their services can be retained by the Government for an indefinite period, and it is axiomatic in most of the sciences that the longer an individual follows his own specialty the

better equipped he will be to supply specialized data to other individuals. Natives of the Philippines are naturally acquainted with local conditions in the Archipelago; and, other things being equal, well-trained individuals having been given the opportunity to take advanced work in a foreign country should be so equipped on their return to the Philippines that they can undertake and prosecute research without the necessity of spending several years in becoming acquainted with local conditions and with local problems demanding solution. The Bureau of Science could readily utilize the services of a large number of technically trained Filipinos to-day if such were available, and it is earnestly hoped that future provision will be made for increasing the number of pensionados in the sciences and in the industries.

#### COÖPERATION

Following the general policy established in previous years, coöperation with other institutions has been carried on as far as possible during the past year. The Bureau of Science has always been in close relations with the Philippine Health Service through the biological and serum laboratories, and cordial relations have been maintained between the two institutions during the past year. A great deal of information has been supplied to various representatives of the Bureau of Commerce and Industry with reference to Philippine products and their utilization. The usual botanical work has been done for the Bureau of Forestry and for such other Government units that have required data of a botanical nature. In order to make available the great mass of economic data contained in the records of this Bureau all possible assistance has been given to the Bureau of Forestry in the preparation of a series of publications on the minor forest products of the Philippines. This work is being done primarily by Dr. William H. Brown, and the actual preparation of the manuscript is being done at the Bureau of Science. Several bulletins have been published during the past year by the Bureau of Forestry, and others are in an advanced stage of preparation; the undersigned is joint author with Doctor Brown of an extensive bulletin regarding Philippine palms and palm products. Mr. A. D. E. Elmer has availed himself of the office, library, and herbarium facilities during the past year in the preparation of his forest flora of Mount Maquiling for the Bureau of Forestry.

In August a general plan was proposed by Dr. H. W. Wade on the subject of organization, development, and coördination of the pathological and related laboratories in the Bureau of

Science, Philippine Health Service, the University of the Philippines, and the Philippine General Hospital and allied hospitals. The memorandum was prepared on the basis of intimate coöperation between the institutions involved and an interlocking control over the laboratory work. The plan provided for all necessary routine work and for research as well, and involved the establishment of the biological division of the Bureau of Science as the actual controlling center of all biological work of the Government, including the establishment of branch laboratories at provincial points.

While in general the plan met with the approval of the authorities of the Philippine Health Service, the Bureau of Science, the Philippine General Hospital, and the University of the Philippines, difficulties later developed in reference to the matter of part-time employment of technical men between the Bureau of Science and the College of Medicine and Surgery, the result being that the plan was not accepted. This is unfortunate, as its general acceptance would undoubtedly have led to the solution of our difficulty in securing the services of properly trained technical men both in the biological laboratory and in the other Government units involved. We have, however, developed the plan in part by submitting an outline for the establishment of provincial biological laboratories during the coming year as technical personnel becomes available for equipping these laboratories. In spite of the fact that it has so far been found impracticable to establish more intimate relationships with other Government units in Manila that are interested in problems concerning the public health, nothing has been lost; and it is sincerely hoped that the plan as outlined may at some time in the future be adopted, either in whole or in part.

In continuation of our coöperation with other than local Government units, the courtesies of the Bureau of Science have been extended to Mr. H. A. Lee, plant pathologist of the United States Department of Agriculture, who was in the Philippines during a part of the year prosecuting his investigations of the citrus canker. Assistance has also been extended to Dr. W. H. Weston, who has remained in the Archipelago during the past year studying a particular disease of corn on behalf of the United States Department of Agriculture. The facilities and data available in the division of mines have been placed at the disposal of Dr. Roy E. Dickerson, a geologist who has been working in the Philippines during the past year for certain oil interests in the United States, gathering data on the extent

and availability of the oil deposits in the Philippines. In reference to commercial interests in the Philippines chemical laboratory space and equipment were temporarily leased on liberal terms to Mr. E. A. Seidenspinner in order that he might prosecute to advantage certain chemical work in connection with the coconut-oil industry, it being impossible for him to secure the necessary equipment at the time to establish a private laboratory in Manila.

During the past year a very large amount of information has been supplied to other Government units, and the Bureau of Science is constantly in receipt of communications indorsed from other bureaus to this institution for attention. Ever since the Bureau was established it has been the policy of the institution to supply all possible data on subjects regarding which inquiries may be made either from local Government units, from individual residents of the Philippines, or from institutions and residents of foreign countries. Owing to the investigations carried on in previous years and the data available in the collections and files of this Bureau, it is usually possible for the Bureau of Science to supply more or less data regarding an infinite number of subjects. There has been a distinct increase in requests for assistance from other Government units in the Philippines during the past two or three years. Frequently the information requested can be supplied with comparatively little trouble on the part of the various technical employees of the Bureau. Sometimes, however, inquiries are of such a nature that a considerable search has to be made in the technical literature or in the files of the Bureau for the data desired. These requests have always taken a considerable amount of time on the part of the technical employees; but there is manifestly no remedy for this, as in general it is to the best interest of the Government service as a whole that all possible information be supplied when legitimate specific requests for assistance are made.

#### BIOLOGICAL LABORATORY

*Personnel.*—Dr. John A. Johnston, who previous to his detail to the United States Army had been acting chief of the biological laboratory, retired from the Government service on May 1, his services not having been available to the Bureau at any time during the past year. Dr. H. W. Wade has continued his work with the College of Medicine and Surgery, University of the Philippines, on the same basis as during the preceding year. Dr. Ildefonso Tobillo, temporary scientific assistant,

resigned April 15. Dr. Onofre Garcia was granted a Government fellowship for advanced study in the United States and left Manila August 8, 1919. Mr. Henry L. Begley, assistant bacteriologist, resigned on May 31 but was reinstated in the same position on June 23. Drs. R. A. Fajardo, A. Garcia, M. Dizon, M. Basaca, and Mr. A. M. Kapauan were appointed as scientific assistants at various dates and Doctors Fajardo, Garcia, and Basaca were later promoted to the positions of junior bacteriologists. Doctor Dizon resigned effective December 31, 1919.

*Routine.*—The general routine examinations have been carried on as during the preceding year, involving examinations of water, milk, foodstuffs, blood, sputum, and the detection of various intestinal parasitic worms, protozoa, and the organisms causing dysentery, diphtheria, typhoid, plague, leprosy, and cholera. Special emphasis has been given to the matter of cooperation with the Philippine Health Service in the detection of typhoid, bacillary dysentery, and diphtheria carriers. Cholera became fairly prevalent in Manila during the months of July and August, which resulted in a great deal of additional work on the part of the technical employees in the biological laboratory, especially in connection with the search for cholera carriers. The diagnostic work during 1919 in comparison with that of the two preceding years is indicated in the following table:

| Nature of examination.                      | 1917    | 1918    | 1919    |
|---|---------|---------|---------|
| Fæces .....                                 | 161,949 | 149,890 | 136,563 |
| Sputum .....                                | 822     | 887     | 635     |
| Blood .....                                 | 92      | 67      | 64      |
| Cultures .....                              | 10      | 9       | 2       |
| Widal test .....                            | 366     | 1,550   | 1,475   |
| Wassermann test .....                       | 778     | 497     | 326     |
| Leprosy .....                               | 888     | 338     | 56      |
| Urines .....                                |         | 37      | 11      |
| Gonococci .....                             | 16,715  | 13,888  | 98      |
| Waters .....                                | 2,319   | 3,156   | 4,064   |
| Histological examinations .....             | 11      | 11      | 6       |
| Rabies .....                                | 3       | 3       | 4       |
| Rats for plague .....                       | 113,799 | 90,008  | 97,477  |
| Foodstuffs .....                            |         | 62      | 250     |
| Milk .....                                  |         | 102     | 105     |
| Miscellaneous biological examinations ..... | 7,110   | 1,938   | 3,024   |

At the request of the Philippine Health Service a bacteriologist has been detailed on each of the leper collecting expeditions of the Philippine Health Service during the year, while



Doctor Wade has continued to serve as representative of the Bureau of Science on the committee for the examination of lepers. Bacteriologists have also been detailed to make biological examinations of waters for the Bureau of Public Works in connection with proposed projects for installing water-supply systems for various municipalities in the Archipelago.

*Investigations.*—Investigations are well advanced on a number of subjects. A great deal of attention has been devoted to the study of the bacteriology of diphtheria patients and diphtheria carriers. A survey of about twelve hundred school children has been completed; and pure cultures of *Bacillus diphtheriæ* have been isolated from twenty-eight individuals, two of which are of the virulent type and the remainder non-virulent, whereas strains of *B. diphtheriæ* isolated from diphtheria cases at San Lazaro Hospital are practically all of the virulent type. This has led to an investigation of the possible existence of racial immunity against diphtheria among the Filipinos, in as much as diphtheria does not occur so frequently here as in temperate countries.

Investigations have also been made regarding the possible bacterial causation of dysentery and similar diseases other than those known to be caused by amœbæ and the organism responsible for bacillary dysentery. It has been noted that in some cases of dysentery no amœba and no *Bacillus dysenterix* could be isolated by the ordinary standard technic. It is hence suspected that in some cases, at least, dysentery is caused by other species of bacteria, and investigations are being carried on with a view to determining the possible causative organism or organisms. Several bacteria have been isolated in pure culture, but so far we have not been able to demonstrate their relationship to the disease, although work on this phase of the problem is being continued.

*Recommendations.*—It is strongly recommended that a series of provincial laboratories be established at strategic points in the Philippines, which shall be available to employees of the Philippine Health Service, to private physicians, and to the public. It is believed that if a limited number of these laboratories were established and so placed that each might serve the maximum population, great assistance could be given to questions of public health. Under the present system of having all or practically all examinations made in Manila it is utterly impracticable, on account of the very nature of many of the organisms that cause disease, to send specimens to Manila for the purpose of examination because of the question of time involved.

The policy of detailing technical men for advanced study and investigation in the United States and Europe should be continued as properly qualified technical personnel becomes available. It is urgently desirable that the services of one or two highly trained and experienced bacteriologists be secured for research regarding various diseases of a bacteriological nature prevalent in the Philippines, and especially in connection with the problem of carriers of such diseases as cholera, bacillary dysentery, and diphtheria. In this connection the services of a helminthologist and protozoölogist are greatly needed for continuing the work on the parasites that occur in the intestines and in the blood which are the causative agents of diseases of certain types.

It is further highly desirable that provision be made for the employment of a highly trained pharmacologist to carry on investigations in connection with the standardization of drugs and especially the testing of the active principles of medicinal plants that occur in the Philippines or are peculiar to the Archipelago. The appointment of such a man need not be made to the biological laboratory, but the work should be done in coöperation with the employees of this office.

Finally, in the biological laboratory, as in other divisions of the Bureau of Science, increased remuneration for technical employees is absolutely necessary, if we are to retain the services of our present technical force and encourage the junior personnel to continue their studies and investigations until they shall have become properly trained and equipped for carrying on research problems such as are currently being presented in medical research work. In many cases investigations of the proper type involve many years of intensive study on the part of the individual, and every effort should be made to retain the services of competent and promising individuals now in the Bureau and to attract the highest type of individuals as vacancies occur or as positions may be authorized to which they can be appointed.

#### SERUM LABORATORY

*Personnel.*—Dr. Carlos Monserrat was transferred to the College of Medicine and Surgery on July 1, 1919; while Dr. Crisanto Pañganiban, who was granted a Government fellowship for advanced work in serology, left for the United States on August 9. The vacancies thus caused were in part filled by the appointments of Drs. José Andaya on July 16, and José Leveriza, December 3, as scientific assistants, the former

having been promoted to the position of junior bacteriologist on December 16.

On account of the transfer of Doctor Monserrat to the College of Medicine and Surgery and the departure of Doctor Pañganiban to the United States as a pensionado student for advanced work in connection with the manufacture of serums and vaccines, the staff of the biological laboratory has been short-handed; the time of the remaining personnel being largely occupied with the greater amount of routine work entailed by the increased output of biologic products, and with the necessary work in connection with the repairs and alterations at Alabang, comparatively little time could be devoted to experimental work. In addition to the work accomplished in the preparation of dry smallpox vaccine, of antivenom serum, of antipneumococcus serum and vaccine, and of cholera vaccine, all of which was undertaken during the past year, one technical paper, entitled: "Experience with methylene blue-eosin lactose agar in searching for *Bacillus dysenteriae* in stools," was published.

*Routine.*—The demand for serums and vaccines has steadily increased, and the Bureau has been able to meet the demand for all products except antidysenteric serum. To meet the increased demand the stable space at the Bureau of Science has been utilized to its maximum, the lack of stable space being practically the only limiting factor in the manufacture of vaccines and serums.

In the early part of the preceding year 13 horses were maintained for the purpose of preparing serums of all classes; during 1919 this number was increased to 53, of which 30 are now maintained at Alabang, these animals being secured from the condemned stock of the United States Army through the courtesy of the local military authorities, and from the city of Manila through the courtesy of the city officials. With the completion of the work at Alabang and as soon as possible after the activities of the serum laboratory are transferred to Alabang it is planned to increase the number of horses to approximately 200, if necessary, in order that a sufficient amount of serums and biologic products can be prepared to meet all demands.

As soon as sufficient data become available regarding the actual cost of manufacturing serums and vaccines under conditions existing at Alabang, a general revision of the prices charged for the finished products will be necessary. There

has been a radical increase in the prices of animal feed, containers, packing boxes, and labor. It will further be necessary to maintain a power plant at Alabang, which will tend also to increase the cost of preparation of biologic products. There will be an actual decrease in the per capita cost of maintaining animals at Alabang as compared with the cost of maintaining them in Manila, the data at present available indicating that a horse can be maintained at Alabang for about one-third the amount of money it takes to maintain one in Manila.

The activities of the serum section are best evident from the attached figures giving the actual amount of various products issued during 1919. These figures show the increased output of biologic products as compared with the output of the two preceding years.

*Comparison of amount of serums and vaccines bottled and disposed of at the Bureau of Science in 1917, 1918, and 1919.*

| Product.                                | 1917      | 1918      | 1919      | Increase. | Decrease. |
|---|-----------|-----------|-----------|-----------|-----------|
| Antitetanic serum.....units.....        | 1,862,000 | 2,989,000 | 5,244,000 | 2,255,000 | -----     |
| Antidysenteric serum.....cc.....        | 12,037    | 48,060    | 67,740    | 19,680    | -----     |
| Normal horse serum.....do.....          | 6,560     | 7,430     | 6,810     | -----     | 620       |
| Vaccine virus.....units.....            | 1,181,685 | 4,204,968 | 9,465,417 | 5,260,449 | -----     |
| Gonococcus vaccine.....ampules.....     | 2,368     | 2,170     | 2,364     | 194       | -----     |
| Other vaccines.....do.....              | 15,368    | 5,016     | 7,715     | 2,699     | -----     |
| Autogenous vaccines.....treatments..... | 46        | 37        | 57        | 20        | -----     |
| Pasteur treatments.....do.....          | 217       | 249       | 453       | 204       | -----     |
| Wassermann reactions.....               | 331       | 497       | 331       | -----     | 166       |

The largest increases are shown in the production of tetanus antitoxin and of smallpox vaccine—the former with an output of 5,244,000 units, or an increase of 2,255,000 units over that of the preceding year; and the latter, an output of 9,465,417 units, an increase over that of last year of 5,260,449 units. For the first time in the history of the serum section it has been possible to meet the full demand for smallpox vaccine without delay. This is in part due to increased facilities whereby space for more animals was provided, but our success in meeting all demands for smallpox vaccine required by the Philippine Health Service was largely made possible by the coöperation of the Philippine Health Service in supplying the Bureau of Science with a definite monthly estimate of the vaccine needed, providing for a margin of safety in case of emergency. This system of supplying preliminary estimates of the amount required has proved to be eminently

successful in the case of smallpox vaccine, and it is sincerely hoped that this system of tentative estimates will not only be continued but will also be extended to other biologic products so far as possible and that the system will be adopted by other branches of the Government which are regularly using the products of the serum laboratory.

The production of tetanus antitoxin, normal serum, anti-plague serum, antipneumococcic serum, as well as that of all bacterial vaccines, and the material necessary for the Pasteur treatment, exceeded the demand. The demand for antidysenteric serum increased to such an extent that it was impossible to meet it from the stock prepared during the year, in spite of the fact that the production of this serum in 1919 exceeded the output of the preceding year by 20,000 cubic centimeters. In view of the fact that the demand for antidysenteric serum in the past three years has increased from 12 liters in 1917 to 48 liters in 1918 and 67 liters in 1919, the production in each of the preceding years being insufficient to meet the demand, steps have already been taken to increase the output to about 30 liters per month. A sufficient number of animals has been secured for this purpose, and their immunization is well under way at the present time. These animals should all yield potent serum in May, 1920, the month that usually marks the beginning of the seasonal outbreak of bacillary dysentery. Providing the transfer of the serum section of Alabang can be completed in May, 1920, over 30 liters of serum will be available in June, 1920, and approximately a similar amount will be available each succeeding month.

*Investigations.*—During the past year a fairly thorough study was made of Philippine cobra poison. The king cobra, locally known as *alupong*, is fairly common in many parts of the Philippines and is apparently the snake responsible for most deaths in the Archipelago caused by snake bite. The biologic properties of the cobra venom were studied, and an experimental lot of antivenom serum was prepared. The preservation of this and other serums in dried form was worked out so as to enable physicians in remote parts of the Archipelago, who do not have ice at their disposal, to keep on hand a sufficient amount of serum for emergency cases.

At the request of the Philippine Health Service a series of experiments was made in drying and preserving smallpox vaccine so that it can be shipped to remote places and kept without ice. Although these experiments have not as yet been completed, a sufficient amount of information has been secured

to indicate that this method of preserving and shipping small-pox vaccine may become of very great practical value in the immediate future.

Cholera vaccine and antipneumococcus serum and vaccine have been added to the list of products regularly prepared by the serum laboratory. The cholera vaccine manufactured by the Bureau of Science was placed at the disposal of the cholera vaccination committee of the Philippine Health Service, of which committee Doctor Schöbl is a member. The preliminary investigations concerning dosage and sequelæ have produced very satisfactory results. In a series of over one hundred men who were inoculated the reaction following inoculation was very mild, in most cases being restricted to local symptoms. Even injections of 15,000 millions produced no unpleasant after-effects and none of the individuals inoculated was in any way incapacitated as the result of the inoculation.

#### BOTANY

*Personnel.*—The personnel of this section remains practically as it was during the preceding year. Dr. H. S. Yates, mycologist, who was on leave of absence in the United States at the beginning of the year, reported for duty on April 21, 1919. The undersigned resigned his position as professor of botany in the University of the Philippines on March 31, accepting a special contract on a full time basis with the Bureau of Science as botanist; was designated Acting Director of the Bureau of Science on the retirement of the former director on May 21, 1919; and on December 12, 1919, was appointed on a special-contract basis as Director of the Bureau and botanist.

*Systematic investigations.*—In continuance of the previous policy of exploring those parts of the Archipelago that were unknown or, at least, only slightly known from a botanical standpoint, extensive field work has been prosecuted in Bulacan Province, Luzon; in the southern part of Surigao Province and in the vicinity of the large iron deposit, and in the Province of Zamboanga, Mindanao; on the neighboring small islands of Siargao, Dinagat, and Bucas Grande; and in Antique and Capiz Provinces, Panay. The field work has been done by Mr. Maximo Ramos and Mr. R. C. McGregor, of the Bureau staff; and by Messrs. A. Martelino and J. Pascasio, who were temporarily employed for this purpose during the school vacation.

Extensive collections made in Ilocos Norte Province during the latter part of 1918 were studied; and all of the collections made during 1919 have been mounted, identified, and distributed

into the general herbarium, except the Zamboanga collections which were received in December and which are not as yet arranged for study. The latter material, accordingly, has not been included in the report for work accomplished during the year 1919.

The work on the systematic enumeration of Philippine plants, commenced in 1918, has been steadily prosecuted. The preliminary bibliographic data were practically completed during the preceding year. The necessary critical revision of the bibliographic data with the addition of the Philippine and extra-Philippine distribution of each individual species, the habitats, citations of specimens, and the addition of all known native names is being prosecuted as rapidly as possible under existing circumstances. This work is being accomplished by families in sequence, and the manuscript for the final revision is now about one-third completed; when finished it will provide a convenient summary of our present knowledge of the Philippine flora. This is progressing rather slowly as the time available for it on the part of the undersigned is limited, and most of the work has to be done outside of office hours, on holidays, etc. About sixty reviews of botanical articles on the Indo-Malayan flora were prepared for publication in Botanical Abstracts.

Doctor Yates has continued his work on Philippine fungi with a view to completing a bibliographic enumeration of all known Philippine forms with their essential synonyms, hosts, distribution, etc. He has also carried on considerable field work in Zamboanga in connection with disease of the Hevea rubber and, further, in reference to the study of timber-destroying fungi in connection with their hosts.

Dr. Leon Ma. Guerrero has continued his work on the compilation of data regarding Philippine medicinal plants and at the present time is engaged in the preparation of a manuscript résumé of all available data.

Extra-Philippine material submitted for identification includes 81 specimens forwarded by the Forestry Service, British North Borneo; about 1,100 specimens from southern China, collected by Mr. G. W. Groff and Mr. C. O. Levine; about 500 numbers from Sumatra, collected by Messrs. H. H. Bartlett and C. D. La Rue; and about 377 numbers from Guam, collected by Mr. Peter Nelson with the assistance of funds supplied by the New York Botanical Garden, the income of the C. B. Robinson Memorial Fund.

All of this material has been identified and incorporated in the herbarium of the Bureau of Science. The first set of the

Borneo material was mounted for the Bureau of Science; a second set was mounted and returned to the Forestry Department at Sandakan; and all remaining duplicates have been retained at the Bureau of Science to be used for exchange purposes. The first set of the Sumatran collection was also incorporated in the herbarium of the Bureau of Science, the first three sets of duplicates at the request of the collectors being sent to the Rijks Herbarium, Leiden; the Gray Herbarium at Cambridge, Massachusetts; and the United States National Herbarium, Washington. The remaining duplicates from this collection are to be sent out by the Bureau of Science on its general exchange account. The Guam collections made by Mr. Peter Nelson from funds supplied through the undersigned from the New York Botanical Garden have been identified, the first set has been mounted for the Bureau of Science, the second set has been mounted and returned to the Guam Experiment Station, and all remaining duplicates have been forwarded to the New York Botanical Garden, as that institution supplied the funds to assist Mr. Nelson in his field work.

A considerable amount of time was devoted to a critical study of the species of plants described by Loureiro in his *Flora Cochinchinensis* which was published in 1790. Loureiro described as new a total of 185 genera, while of the 1,294 species described about 630 were considered by him to be new. Comparatively little of Loureiro's botanical material is extant, and consequently his species must in most cases be interpreted from the published descriptions alone. Most of his species were from southern China and Indo-China, regions botanically closely allied to the Philippines. Unfortunately Loureiro's descriptions are frequently imperfect and often inexact, so that the task of properly interpreting his species is an exceedingly difficult one. In order to establish a basis for more critical work on this important problem, all of Loureiro's descriptions were critically studied and so far as possible the species were reduced to those of other authors. This involved a rearrangement of Loureiro's species under the modern system of classification.

In preparing the manuscript of my commentary on Loureiro's *Flora Cochinchinensis* all available data regarding the status of each species and its relationship to those of other authors have been included. The manuscript approximates 730 typewritten pages and of this six copies were prepared. One copy has been sent to the Museum of Natural History, Paris; one to the Botanical Department of the British Museum; one



to the Canton Christian College, Canton, China; one to the United States Department of Agriculture, Washington, D. C.; and one to the Institut Scientifique, Saigon, Indo-China. With this manuscript as a basis for future work it is hoped that sufficient data can be assembled eventually to warrant the completion of this commentary for publication. Preliminary work of a similar nature has been commenced on Rheede's Hortus Malabaricus and Burman's Flora Indica. The completion of these tasks will be of very great value in connection with all taxonomic work on the Indo-Malayan flora, especially with reference to cases of nomenclature.

*Physiology.*—Dr. W. H. Brown has continued his work for the Bureau of Science on detail from the University of the Philippines, as in the preceding year. His extensive work on the Vegetation of Philippine Mountains has been completed and issued as Publication No. 13 of the Bureau of Science series. During the past year he has been largely engaged in the preparation of a series of bulletins for the Bureau of Forestry on the minor forest products of the Philippines. In the preparation of this manuscript he has had the coöperation of the undersigned in all groups, and in special subjects the coöperation of Dr. Leon Ma. Guerrero and Mr. R. C. McGregor of this Bureau.

*Herbarium.*—The herbarium has increased from about 196,200 to about 206,600 specimens. The total actual additions, including only the material mounted and distributed into the herbarium during the year, are 10,416 as compared with 10,086 during 1918. Of these, 3,961 were received in exchange and about 2,095 were received from Borneo, Sumatra, China, Hainan, and Guam for identification. The collections from the Bureau of Forestry were slightly in excess of those submitted during 1917, totaling 418 numbers. The largest amount of material received during the year consisted of three shipments from the Botanical Garden at Buitenzorg, Java, approximating 1,966 specimens, chiefly from Sumatra and Java, with some material from other islands in the Malay Archipelago. This number of specimens was nearly equaled by a most valuable exchange received from the British Museum, comprising 1,944 specimens from British India. This Indian material is especially valuable, as it consists of duplicates from the collections of the earlier botanical explorers of British India and Ceylon, including material collected by such botanists as Roxburgh, Wight, Wallich, Buchanan-Hamilton, Gardiner, Moon, Hooker and Thomson, and others. From a historical

standpoint this exchange is perhaps the most valuable single one ever received by the Bureau of Science, as the collection contains a very large amount of cotype material. From the Botanic Garden at Brisbane, Australia, 687 specimens were received, largely from tropical northeastern Australia with some material from New Guinea and from Fiji; from the Botanical Garden at Sydney, 180 specimens of Australian plants were received; and from the Botanical Garden at Singapore, 117 specimens. Doctor Kanehira sent 150 specimens from Formosa and Botel Tobago, partly in exchange and partly for identification. New exchanges were consummated with the Arnold Arboretum for Wilson's Chinese plants, about 600 specimens being received from this source; with the Forestry Service at Kuala Lumpur, Federated Malay States, from which source 70 specimens were received; and with Professor Kawagae, Kagoshima, Japan, who forwarded 178 specimens of Japanese plants. The Philippine accessions total 3,360, while the material received from extra-Philippine sources in exchange and for identification totals 6,050.

A large amount of duplicate material has been sent to institutions in various parts of the world in exchange, totaling about 26,681 specimens. Much of this material has been sent to institutions with which the Bureau of Science has been in exchange relations for many years. New exchanges were arranged with the Kagoshima College of Agriculture in Japan; the Institut Scientifique at Saigon, Indo-China; the Forestry Service at Kuala Lumpur; and the University of California. About 300 mounted sheets have been loaned to specialists for study, and about 1,000 duplicates have been sent to specialists for identification.

#### ENTOMOLOGY

On September 25, 1919, the division of entomology was rehabilitated in the Bureau of Science by the transfer of Prof. C. S. Banks from the College of Agriculture, at Los Baños, to the Bureau of Science. Professor Banks was formerly entomologist in the Bureau of Science, but for the preceding five years was officially connected with the College of Agriculture. During the larger portion of this time the entomological literature and collections belonging to the Bureau of Science were deposited at the College of Agriculture, Los Baños, under his supervision, while active entomological work of the Bureau of Science ceased. With the return of Professor Banks to the Bureau of Science all of the collections, equipment, and books belonging to the Bureau of Science have been returned to Manila.

*Routine.*—Since the entomological work was commenced in September, the usual amount of routine work has been done, consisting of identifying material submitted (more especially with reference to insect pests in connection with agricultural and forestry problems), and imparting information concerning silk culture.

*Investigations.*—Immediately after the return of Professor Banks to the Bureau of Science, he was detailed to the National Coal Company to investigate the prevalence of malaria at Malangas, Mindanao, and to institute temporary measures for its suppression. This involved considerable local investigation at Malangas. Measures were outlined for restricting the breeding of the malaria mosquito, which were at once put into effect by the local officials with the result that malaria, at least in the principal settlement, has diminished to a very notable extent within the past few months, as evidenced by the favorable reports made by the secretary and manager of the company. We are reliably informed that since the antimalaria campaign was inaugurated at Malangas early in October there have been but 15 deaths in a population of 2,500, and only 6 of these resulted from malaria. This is a distinctly favorable contrast to the record of 300 deaths previous to September, more than half of which were due to Malaria.

*Entomological collections.*—Soon after returning from his field work in Mindanao, Professor Banks proceeded to the College of Agriculture, at Los Baños, and packed the entomological collections and equipment for shipment to Manila. This work, owing to the character and quantity of material involved, occupied practically all of his time until shortly before the end of the year. The entire shipment was received at the Bureau of Science in the latter part of December, and the collection is now in process of being arranged. The pinned specimens came through in perfect condition, while the material preserved in alcohol was practically intact, there being a very slight amount of breakage with no loss of specimens. During the five years that this collection was deposited at the College of Agriculture practically no additions were made to it due to the fact that, although somewhat over 28,000 specimens were collected by Professor Banks and his students while he was at Los Baños, these all accrued to the College of Agriculture collection. The latter collection contains a considerable quantity of material which should naturally be in the central entomological collection of the Government, especially the types of insects described by various

entomologists; it is hoped that an arrangement can be made with the University authorities for depositing such types in Manila and for acquiring certain other material from the College of Agriculture collection by a series of exchanges between the Bureau of Science and the College of Agriculture. Such an exchange of duplicate material will manifestly be to the mutual benefit of these institutions.

In the Bureau of Science entomological collections there are now approximately 350,000 specimens, including many types. No part of the Government natural-history collections has had the misfortune to be so peripatetic as has the insect collection; and, with the reestablishment of entomological work in the Bureau of Science, it is hoped that this important line of investigation can be prosecuted more efficiently in the future than has been possible in the past. It is believed that at least one collector should be regularly employed by the Bureau of Science for field work in entomology in the provinces, as there are many rich regions in the Philippines that have not as yet been explored by any entomologist or insect collector. This exploration should be carried on with the purpose of making the Government entomological collection as complete as possible, not only for the scientific value of such a collection but also because a knowledge of the insect fauna of the Philippines is a prerequisite to the study of economic entomology in relation to agriculture, forestry, and many diseases of men and domesticated animals.

*Personnel.*—The reestablishment of the division of entomology in the Bureau of Science is so recent that no attempt has been made to build up its personnel. The need for trained entomologists is certainly greater now than it was in 1910, when there were three technical entomologists and four trained laboratory assistants in the Bureau of Science. Agriculture, because of its recent spontaneous renaissance, demands much research in entomology which is not now being done in any branch of the Government for lack of properly qualified and trained individuals.

*Silk culture.*—It is practically beyond question that silk culture has a distinct future in the Philippines. During the past five years the Bureau of Science, having no entomologist on its staff, has merely attempted to maintain a breeding stock of silkworms. It was impossible under existing circumstances to give this matter proper supervision; but the different strains of silkworms obtained in previous years have been kept intact, although there is some evident deterioration. It is hoped that these strains may

now be restored to their original vigor and that a series of careful experiments may form a part of the coming year's program in the division of entomology.

*Mosquito work for the city of Manila.*—The work of mosquito eradication in the city of Manila was prosecuted by Professor Banks during his connection with the College of Agriculture, at Los Baños. Practically all residents of Manila will agree that the work should be extended and that it should be more strictly supervised than has been possible in the past five years. With the supervising entomologist residing at Los Baños, a distance of 65 kilometers from Manila, a close watch on the progress of the work has been impossible. Mosquito eradication is a very important sanitary function, and it is hoped that this can be efficiently prosecuted during the coming year.

*Recommendations.*—The greatest single need for the division of entomology at the present time is the services of at least one additional properly trained entomologist, and an effort should be made to secure the services of such an individual at the earliest opportunity. At least one preparator is urgently needed, and if opportunity permits the services of a silk expert should be secured to develop the commercial possibilities of an industry the returns from which in silk-producing countries have nearly doubled since 1914. Permanent quarters for the division of entomology must be provided, and it is to the best interests of the division that this be secured with as little delay as possible. Certain alterations must be made in the silk house. Provision must also be made for new Skinner cabinets and a sufficient number of insect boxes to provide for the expansion of the collections. A definite plan for entomological exploration should be adopted, and the services of at least one collector should be secured.

#### FISHERIES

With the retirement of Mr. E. H. Taylor from the Philippine Government service on July 13, 1919, the productive work in the section of fisheries ceased, and no further investigations of value will be possible until the services of additional technical men shall have been secured. Previous to his retirement from the service Mr. Taylor completed his manuscript on Philippine herpetology, including all data available up to the end of June. Work on the final revision of the manuscript is being prosecuted as opportunity is available, and it is hoped that in the near future the data may be submitted to the printer and issued as a special publication of the Bureau of Science.

On the retirement of Mr. Taylor correspondence was commenced with various individuals in the United States with a view to securing the services of a trained and experienced ichthyologist to continue the important work of the section of fisheries in the Bureau of Science. Among the individuals communicated with was Mr. Alvin Seale, formerly chief of the section of fisheries, who intimated that if satisfactory arrangements could be made he would be willing to return to the Philippines and resume his duties in the Bureau of Science. However, owing to the fact that Mr. Seale was retired under the provisions of Act No. 2589, it was found impracticable to reinstate him in the service. The general tenor of the letters received from other specialists in the United States indicates that the number of trained individuals available for work in ichthyology in the United States is strictly limited, with none experienced in tropical ichthyology other than Mr. Seale; and it is exceedingly difficult for the various institutions in the United States to secure and retain the services of properly qualified individuals. In other words, the demand for technical men in ichthyology is greater than the supply. Letters received from a few individuals indicate that if satisfactory arrangements can be made we may possibly be able to secure the services of at least one man for work on the fishery problems in the Philippines. I am personally of the opinion, in view of the great importance of the fishing industry in the Philippines, that the division of fisheries in the Bureau of Science should be made a much more important one than has been the case in the past.

At no time in the past history of the division has more than one technical man been provided for this specialized work, with the natural result that attention could be given only to very few of the problems demanding solution. We do not need the services of a systematic ichthyologist so much as we do the services of an individual competent to undertake investigations regarding the economic aspects of Philippine fishery problems. Among these problems may be mentioned the preservation by improved methods of fish and fish products for food; the dissemination of data regarding improved methods of catching fish; an exploration of the waters in and about the Philippines with a view to locating new fishing banks, and also with a view to utilizing more fully the resources of those already known; and a study of the breeding habits of certain migratory fishes, especially those entering fresh water, with a view to recommending legislation for their protection during the breeding season.

There is an infinite number of minor problems that need attention in connection with the fishing industry in the Philippines. The division of fisheries should, then, be expanded and the services of several technical men be secured; it is my belief that money expended in the investigation of the economic aspects of Philippine fisheries will be well expended. The additional funds necessary will be chiefly those for the payment of adequate salaries.

#### ORNITHOLOGY AND TAXIDERMY

Practically all of Mr. McGregor's time during the past year has been occupied with duties in connection with the editorial work on the Philippine Journal of Science and special publications of the Bureau of Science. The ornithological work has been developed so far as opportunity has permitted on the lines followed in previous years. A report on the collection of birds made in Panay in 1918 is nearly completed, and considerable progress has been made in the identification of older collections. A paper dealing with the relation of the Philippine avifauna to the flora has been written during the year. Collections have been made, especially at Obando, for the purpose of securing additional material for the study of the food of birds; stomach contents available have been examined and valuable records obtained, although much remains to be done before any definite report on this line of work can be published.

Taxidermic work has been prosecuted as in past years, this consisting of mounting birds, mammals, and antlers, and the tanning of various skins. This work is chiefly done by Mr. Andres Celestino and requires comparatively little supervision. There is a distinct increase in requests for this type of work; and it is highly desirable that additional space be provided for it, as the present quarters are very small and not well adapted to the purpose.

#### CHEMISTRY

Owing to the reduced technical personnel in both divisions of the chemical laboratory, the chemical work during the past year has been largely reduced to routine, although some investigation work has been done in both organic and inorganic chemistry as opportunity permitted. The pressure of routine work has been unusually heavy, due to the expansion of Philippine industries and the establishment of new industries that have required chemical work to a greater or less degree. The depletion of the technical force has been caused in large part by the local demands for trained chemists in connection with the expan-

sion of the oil and sugar industries in the Philippines. Commercial firms have not hesitated to offer twice the salaries paid to chemists in the Government service and, naturally, under these conditions it has been impossible to retain in the service some of our most experienced and competent chemists. The extent to which the chemical laboratory has been depleted is indicated by the following figures. In previous years the number of chemists usually employed in the division of general, inorganic, and physical chemistry has been from nine to eleven; at the present time, due to resignations and other causes, there are but three chemists available to handle the regular work of this division. In the division of organic chemistry the average number of chemists in previous years has been nine. There was a decrease to five in 1918 and, due to resignations presented the latter part of the past year, the number was reduced to three in December, 1919. With these radical reductions in the technical personnel it cannot be expected that the chemical work accomplished during the past year can compare favorably with that of previous years. Unfortunately, there has been a very radical increase in the routine work demanded of both divisions; and this factor, combined with the radical decrease of the technical personnel, has rendered any great amount of investigation work impracticable and impossible.

#### DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

*Personnel.*—Mr. A. E. W. King was granted leave on April 30, 1919. Dr. J. C. Witt, who resigned from the Bureau of Science in August, 1917, to accept a position with the Rizal Cement Company, was reinstated on March 24, 1919, as a temporary employee, but left for the United States on July 2, 1919, and was absent during the remainder of the year. Mr. Francisco Villanueva severed his connection with the Bureau on June 30, 1919. Mr. F. D. Reyes was granted leave of absence on November 6, 1919, with the probability that he will retire from the Government service at the end of his accrued leave. Mr. A. S. Argüelles was granted a Government scholarship for advanced study in the United States and left Manila on August 30, 1919. Mr. Francisco Rivera was given a temporary appointment as scientific assistant in chemistry on July 7, 1919.

As a result of these changes there were at the close of the year but three chemists available to handle the work that was formerly assigned to eleven, the latter number being the regular force of the division.

*Routine.*—The routine work accomplished by the division is



best realized by an examination of the following general summary:

| Nature of material.  | Samples. |
|--|----------|
| Rocks and minerals.....  | 40       |
| Metals and alloys.....   | 16       |
| Soils, fertilizers, cements, and clays.....  | 6,940    |
| Road materials.....  | 6        |
| Stone, gravel, sand, and concrete.....   | 111      |
| Physical tests of wire, twine, textiles, steel, fiber, tar, asphalt, paper, etc..... | 29       |
| Water .....  | 187      |
| Standardization of weights and measures:   |          |
| Length .....   | 66       |
| Capacities .....   | 543      |
| Weights .....  | 502      |
| Coal analyses .....  | 25       |
| Calorimeter determination of fuels.....  | 23       |
| Paints, natural pigments, and varnishes.....   | 15       |
| Crude chemicals (preparation and analysis).....                                      | 20       |
| Refining of precious metals.....grams.....   | 320,798  |
| Miscellaneous .....  | 115      |

The total number of analyses and examinations shows an increase over that of the preceding year. The purification of gold bullion for the benefit of the local jewelry industry has been continued, the bullion refined at the Bureau of Science during the year approximating in value ₱306,534.

Instruction in cement testing for the civil engineering students of the University of the Philippines has been continued as in past years.

*Investigation.*—Thanks to the willingness and spirit of cooperation among the chemists in the division, in spite of the present shortage in personnel and in spite of the increased demands for routine work, investigations have been completed concerning the lumbang-oil industry in the Philippines, the mechanical properties of Philippine bast-fiber ropes, and Philippine raw materials for glass manufacture. The results of these investigations have so impressed the business community that both local and foreign firms are now directing their attention to the commercial possibilities in the utilization of modern methods of securing lumbang oil, while a small glass factory is now being erected near Manila for the utilization of Philippine raw materials in making glass.

The studies previously made on the efficiency of different fuels for lime burning have been of very great value in demonstrating the possibilities awaiting this industry in those parts of the

Philippines where coconut shells for fuel are available in sufficient quantities.

Preliminary investigations to determine the suitability of Los Baños white clay in the manufacture of fire bricks have given very encouraging results. Bricks were manufactured in sufficient number to line the fire chamber of one of the Bureau of Science boilers. These bricks have now been in service for over six months and so far have given very satisfactory results.

*Proposed investigations.*—To encourage the establishment of new industries in the Philippines the investigations discussed in the following paragraphs will be undertaken, provided a sufficient technical force is available. The object of such investigations will be to demonstrate the feasibility of utilizing local products in the manufacture of numerous articles at present imported, thus making the Islands more independent of foreign countries.

The work done in connection with the utilization of Philippine clays for manufacturing fire brick should be extended, and a determined effort should be made to encourage the manufacture of fire bricks in the Philippines from local materials that experimental work has shown to be satisfactory for the purpose. It should be thoroughly feasible to manufacture in the Philippines at least the fire bricks needed locally and thus avoid the importation of high-priced products from other countries.

In view of the great interest shown by commercial firms in the results obtained by the Bureau of Science in its investigations of lumbang oil, these investigations should be extended with the object of improving the present methods of extracting the oil.

Exposure tests and comparative analyses of all paints sold in the local market should be made in order that we may be able in the future to judge better of their quality and relative efficiency. This work will entail considerable expense, but it is believed that any expenditure incurred in this investigation will be fully justified.

A systematic soil survey of the Philippines should be made in order to obtain accurate data regarding soil conditions in different parts of the Philippines, provided the technical personnel is available for this work. It probably can be undertaken in coöperation with the Bureau of Agriculture, as suggested by the Director of Agriculture in his annual report for 1918.

No complete, systematic study of Philippine waters has been made, although a considerable amount of information is now available from the general work accomplished in preceding years.

The work begun by this division several years ago was of necessity discontinued due to the shortage of technical personnel during the past two or three years. The Bureau is in constant receipt of letters from private individuals, corporations, and various Government units requesting information as to the quality and nature of water supplies in different parts of the Islands. It not infrequently happens that, owing to the fact that we have no data regarding the water in certain districts, the Bureau of Science is unable to satisfy the requests. A complete and systematic sanitary survey, supplemented by water analyses carried on in the field, is of very great importance, and the work should be initiated as soon as practicable.

*Testing of balances, weights, and measures.*—It has been the experience of this division that at various times balances or scales and weights tested in this office and found to be correct for commercial and pharmaceutical purposes have been rejected by the officials of the Bureau of Internal Revenue. In order to avoid friction and misunderstanding in the future it is recommended that the following amendments be made in the Administrative Code:

SECTION 1527. On the 6th line insert the words, "by the Bureau of Science" after testing, to read as follows: "responsible for the inspection and proper testing by the Bureau of Science of all, etc."

SEC. 1528. Insert after the paragraph. "It should be understood, however, that in case of controversy, the Bureau of Science is the only institution called upon to pass final judgment on the accuracy of balances, scales, weights, measures, etc."

SEC. 1872 (e). Omit the word "and" in the last sentence and add "and the judgment in cases of dispute regarding the degree of accuracy of balances, scales, weights, and measures" to read "the certification of secondary standards according to law: and the judgment in cases of dispute regarding the degree of accuracy of balances, scales, weights, and measures."

#### DIVISION OF ORGANIC CHEMISTRY

*Personnel.*—As noted in the last annual report, the division of organic chemistry was short-handed during 1918. This condition has become distinctly worse during the past year, until now the division is reduced to three chemists—two Americans and one Filipino—and two inexperienced assistants. During 1910 to 1917, inclusive, the average number of chemists employed in this division was eight, the maximum being nine, in 1911, and the minimum being seven, in 1917. By resignations

the number was reduced to five in 1918, to four during the greater part of 1919, and to three in December, 1919, when the resignation of Mr. Hermenegildo Taguibao was accepted. Mr. Taguibao was a distinctly valuable employee and he served creditably for over ten years in the performance of specialized work. Mr. Miguel Reyes, a promising young assistant, also resigned in December, 1919. Both of these men received salaries from commercial firms approximately double the amount paid by the Government. In addition to these two resignations in the central office a still more serious one was the resignation of Mr. Carsten and his assistants in the sugar laboratory in Iloilo. The resignations of these men were presented the latter part of the year and as the result it was found necessary to close the Iloilo sugar laboratory on December 31, 1919, the middle of the milling season. All of the resignations indicated above were due to the inability of the Bureau of Science to meet the salaries offered to employees by private firms. Dr. G. A. Perkins, who had been appointed as organic chemist the latter part of the preceding year, arrived from the United States and reported for duty on March 18, 1919.

*Activities.*—It is scarcely necessary to emphasize the importance of the work in this division. It is exceedingly specialized and requires the services of highly trained chemists, experienced in food and drug analysis, which is a part of the routine work of the division, while at the same time they must be able to carry on the general work in organic chemistry.

The routine analyses increased from 2,011 in 1918 to 3,185 in 1919. The type of routine work carried on in this laboratory is best indicated by the classification of chemical analyses performed during the year as follows:

|   | Samples. |
|---|----------|
| Meats and manufactured meats.....                 | 332      |
| Lards .....                                       | 37       |
| Milk and its products.....                        | 338      |
| Grain products.....                               | 47       |
| Vegetables, etc.....                              | 77       |
| Fruits and fruit products.....                    | 40       |
| Sugars and related substances.....                | 91       |
| Condiments and flavoring extracts.....            | 185      |
| Edible vegetable oils other than coconut oil..... | 7        |
| Coconut and its products.....                     | 415      |
| Tea, coffee, and cocoa products.....              | 94       |
| Alcoholic beverages.....                          | 158      |
| Non-alcoholic beverages.....                      | 194      |
| Petroleum and products.....                       | 26       |
| Gum, resins, and similar materials.....           | 7        |
| Paper and similar materials.....                  | 10       |

|   | Samples. |
|---|----------|
| Urines, fæces, etc.....                               | 337      |
| Paint oils and castor oil, etc.....                   | 9        |
| Essential oils.....                                   | 18       |
| Toxicological analyses.....                           | 15       |
| Preservatives and coloring matters.....               | 31       |
| Chemical and pharmaceutical preparations.....         | 119      |
| Miscellaneous chemical analyses and examinations..... | 605      |
| Total .....   | 3,192    |

In addition to the routine analyses performed by the employees of the division a number of reagents necessary for the operations of the division were manufactured as well as the required amounts of book varnish, Fehling solution, label varnish, anti-anay solution, normal sodium hydroxide solution, food extracts and stains of various kinds, and tikitiki extract.

The attached table shows graphically the total number of samples submitted to this division for analysis from 1910 to 1919, inclusive. The number of specimens submitted in 1919 shows an increase of more than 33½ per cent over the number submitted during the previous year. During the year the demands made upon the division for routine analyses increased to such an extent that it was absolutely impossible to undertake any investigation work, as routine work takes preference over all other duties of the division; with a very limited personnel it naturally follows that, as routine work increases, so must investigational work decrease. It has long been the policy of the Bureau of Science to investigate the organic resources of the Philippine Islands with a view to their exploitation; but, under existing conditions, it has become absolutely impossible for the division of organic chemistry to perform the needed analyses for the various Government units and for commercial firms and at the same time undertake the investigation of any problem of importance in applied research.

The increase of the routine work in the division of organic chemistry is in large part accounted for by the advance in Philippine industries and the establishment of new commercial agencies in the Islands. Serious curtailment of the work will be necessary in 1920, unless additional assistants are secured. Either the interbureau work must be decreased to the distinct detriment to public health in connection with the food and drug inspection work and the analyses of samples submitted, or most or all commercial work must be stopped, as any further increase in requests for analyses cannot be met with the serious depletion in the technical personnel of the division. It would be distinctly

*Comparative table of routine work performed and supplies manufactured and disposed of during the past ten years by the Division of Organic Chemistry, Bureau of Science.<sup>a</sup>*

| Year.     | Number samples (not units). | Comparison with previous year. |        |           |        | Cash.      |                | Government interbureau work. | Personnel of division. |   |
|-----------|-----------------------------|--------------------------------|--------|-----------|--------|------------|----------------|------------------------------|------------------------|---|
|           |                             | Increase.                      |        | Decrease. |        | Cash work. | Cash received. |                              |                        |   |
|           |                             | Samples.                       | Pesos. | Samples.  | Pesos. |            |                |                              |                        |   |
| 1910..... | 1,482                       | 17,815                         |        |           |        | 1,391      |                | 16,424                       | 7                      | 1 |
| 1911..... | 1,670                       | 14,236                         | 188    |           | 3,579  | 3,069      | 1,678          | 11,167                       | 7                      | 2 |
| 1912..... | 1,921                       | 15,673                         | 251    | 1,437     |        | 3,047      |                | 12,626                       | 6                      | 2 |
| 1913..... | 1,639                       | 17,272                         |        | 1,599     | 282    | 1,980      | 1,067          | 15,292                       | 6                      | 1 |
| 1914..... | 1,294                       | 8,231                          |        | 345       | 9,041  | 2,110      | 130            | 6,121                        | 6                      | 2 |
| 1915..... | 3,650                       |                                | 2,356  |           |        | 478        | 675            | 3,172                        |                        | 2 |
| 1916..... | 1,761                       |                                |        | 1,889     |        | 359        | 807            | 1,402                        |                        | 5 |
| 1917..... | 1,719                       |                                |        | 42        |        | 623        | 1,301          | 1,096                        |                        | 4 |
| 1918..... | 2,011                       |                                | 292    |           |        | 989        | 1,281          | 1,022                        |                        | 1 |
| 1919..... | 3,135                       | 27,256                         | 1,174  |           |        | 1,263      | 933            | 1,925                        | 21,763                 | 2 |

<sup>a</sup> Figures for the Iloilo Laboratory not included.

unfortunate should it become necessary to refuse to accept commercial work, as the Bureau of Science is the only institution in the Philippines equipped to do certain types of analyses. Expanding Philippine industries demand that provision be made for doing the necessary chemical work in connection with these industries. During the past year, with four chemists during a part of the period and three during the other part, it was impossible to carry on the routine work required of the division during office hours and a considerable amount of overtime was required of various employees. It is urgently necessary that the services of at least two additional experienced chemists be secured.

*Manufacture of tikitiki extract.*—The work of this section has continued as usual, the total production and distribution of 50 cubic centimeter bottles being as follows:

|  | Bottles. |
|--|----------|
| To the "Liga Nacional Filipina para la Protección de la Primera Infancia"..... | 7,679    |
| Sold to the general public.....  | 914      |
| Total .....  | 8,593    |

This is a slight increase over the total amount produced during the preceding year.

*Research and investigation.*—Owing to the depleted personnel of the division as indicated above, pure research has ceased to exist in this division, while investigations as to the possible commercial utility of certain Philippine products have been greatly curtailed for the same reason. A slight amount of work has been done on the investigation of medicinal plants, the rancidity of vegetable oil, the application of the sulphur method of drying copra, and the food values of certain Philippine grains and legumes. There is urgent need of carrying on a thorough investigation of the medicinal uses of certain vegetable oils, particularly chaulmoogra and its relationship to the treatment of leprosy. In this connection it is highly desirable that seeds of the various Philippine species of *Hydnocarpus* and the oils therefrom be studied with a view to determining whether or not the local species will yield an oil having the same curative value as chaulmoogra oil. This is especially important in view of the limited amount of chaulmoogra oil available and the irregularity in its supply. A shipment of margosa seeds (*Melia azadirachta*) was received from India, and their products, including the oil, are being studied.

A soil survey, particularly of Negros Island, is at the present time of the greatest importance to sugar-cane growers.

The sugar haciendas in Negros have been cropped with sugar for many years without the use of fertilizers, and a soil survey of the leading sugar regions will definitely indicate to the sugar planters the depleted condition of the soil and the necessity of using commercial fertilizers.

There is a field for further investigation of the vegetable-oil industry, and the hydrogenation of Philippine oils; for commercial investigations of dipterocarp resins, oleoresins, gums, and similar products that are available in commercial quantities; for a comprehensive commercial survey of all petroleum products of Philippine origin, such as crude petroleum, asphalt, asphaltic rock, oil-bearing shales, etc.; for the commercial investigation and preparation of certain compounds of utility for the treatment of tropical diseases; for the extension of the work of devising constructive methods for conserving tropical fruits, vegetables, fishes, and meats by canning, drying, or salting; for a further chemical study of the effects of tropical conditions on the storage of foodstuffs and commercial products in large quantities, such as flour, copra, etc. A more extensive study should be made of the drying oils of the Philippines, particularly those already known to be available in commercial quantities, and the possibility of substituting such oils for imported linseed oil.

There is a demand for coöperation between the division and outside commercial interests; such as, extending aid to coconut planters in installing modern methods for the production of high-grade copra and to cigar factories in connection with the control or elimination of the cigarette beetle by chemical means, aiding the starch industry in the Philippines, extending aid to distillers in the application of distilling methods to the utilization of waste molasses, and further investigation of the nipa-sugar problem with a view to demonstrating the possibility of developing the manufacture of sugar from nipa sap on a commercial scale. The investigation of these and many other problems depends in a large degree on additions to the technical staff in the division of organic chemistry.

*Iloilo sugar laboratory.*—As noted above, the Iloilo sugar laboratory was closed on December 31, 1919, owing to the resignation of its complete personnel, consisting of Mr. Carsten, chemist in charge, and two Filipino assistants. It is very unfortunate that the laboratory should be closed at this time, as it served a distinct purpose in the Negros sugar district as a protest laboratory when differences existed between buyers and sellers. At the present time the sugar industry has so increased in the Philippines that plans should be devised for the establish-



ment of a complete sugar experiment station similar to the stations already established in Hawaii and in Java. Such an experiment station could well be established in Negros or near Iloilo, where sufficient facilities are available for experimental work with various classes of cane and where a soil and sugar laboratory properly equipped with a sufficient personnel would be at the service of the planters and others interested in the sugar industry.

During 1919 the staff of the Iloilo sugar laboratory completed a large amount of valuable field work in coöperation with the sugar planters in Negros. Mr. Carsten spent much time instructing planters regarding the best methods of planting and harvesting cane, and emphasizing their need for soil analyses and for the use of fertilizers of proper chemical composition to fit their requirements. He has fulfilled in every case the requests of both planters and buyers for umpiring polarizations in case of disputes as to grade of products. He has visited various small centrals and installed chemical control so far as he was able to do so, in some cases reducing the number of tons of cane required per ton of sugar to such an extent that the individual planters have saved many thousands of pesos. In addition to the routine work in the laboratory and the field work accomplished, two technical papers were prepared for publication in the Philippine Journal of Science. Mr. Carsten's resignation is a distinct loss to the Government service.

#### MINES

This division has been in a very unsatisfactory condition during the year owing to the greatly reduced technical personnel. Up to the year 1915-16, the average number of technical men employed in this division was six, but due to resignations the personnel became reduced in 1917 to one, but later was increased by the addition of Mr. Faustino. All of the work of the division has been carried on by Mr. Victoriano Elicaño, acting chief of the division, and his assistant, Mr. L. A. Faustino. The latter has had entire charge of the statistical work of the division during the past year. Mr. Ramon Abarquez, formerly assayer, was granted a Government fellowship in the United States for advanced work in metallurgy and mineralogy, and on his departure the work of assaying was temporarily assigned to Mr. E. E. Gutierrez, of the division of general, inorganic, and physical chemistry. The work of the drafting section has been carried on as usual under Mr. Moskaira.

*Publications.*—Up to 1916 the annual publication, entitled Mineral Resources of the Philippine Islands, was published.

That for 1917 was not issued for the reasons indicated by the Director of this Bureau in his annual report for 1918. It has been possible for us to secure the data desired and as a result the manuscript for Mineral Resources covering the years 1917 and 1918 has been completed and forwarded to the printer.

*Metallurgy and assaying.*—This work has been done in part under the direction of the division of mines and in part under the division of general, inorganic, and physical chemistry. The gold bullion assayed, weighed, or smelted in the Bureau of Science in the past year amounted to ₱332,377, representing about 100 assays. The total amount of gold refined during the year was ₱306,534, the number of assays made being 44. Assays of minerals and ores amounted to 123, while 129 samples of test cores from placer grounds were weighed. There has been a distinct increase in the requests for refining gold; and, when the Philippine Mint is established, it is hoped that provision will be made for gold refining by that institution, leaving the technical personnel of the Bureau of Science free to perform the more-needed research work. During the past two or three years, owing to conditions brought about by the war, the refining of gold for the local jewelry trade has been essential, and the Bureau of Science was the only institution equipped to do this work. Probably most of the gold utilized in the manufacture of jewelry in the Philippines during the past two or three years has been that refined at the Bureau of Science, and without this refined gold of local origin the manufacture of jewelry in the Philippines would have been very greatly curtailed.

*Artesian well examinations.*—Cuts from 141 artesian wells were examined during the year, this work having been done largely by Mr. Faustino, the variety of samples submitted giving him considerable experience in this line of work.

*General routine work.*—The usual number of inquiries from local prospectors, mining operators, and the public in general have been received. Identifications of minerals and the examination of rock specimens submitted have taken a great deal of the time of the limited technical staff. From the inquiries received in the division it is evident that there is a distinct increase in interest on the part of the general public in the Philippines in matters appertaining to mines and mining. A number of requests have been received from private and Government schools with the object of securing duplicate specimens of authentically named rock and mineral types, and the display exhibit of the division has been visited by a large number of pupils from various institutions in Manila.

*Mining industry.*—The gold-mining industry in 1919 was more active than in the preceding year. Negotiations for the building of a new cyanide mill in the Benguet region have been started, and arrangements have been made for the opening of the Napuangan and Balete mines in Masbate. The rebuilding and remodeling of established cyanide mills has caused the suspension of work in some districts, the result being evident in the lower gold production for 1919 as compared with that of the previous year. The Philippine Mining and Industrial Company has commenced operations on the Calambayanga iron deposits, and several thousand tons of ore have been shipped to Japan. On account of the high price of fuel, coal mining has received a large impetus during the year, the production of coal for 1919 being more than double that registered for 1918. The oil fields of Tayabas and Leyte are being critically examined by an American geologist for certain oil interests in the United States.

*Field work.*—Owing to the limited personnel of the division the field work has been restricted in comparison with that accomplished in previous years. Trips to the different mining districts have been made by both Mr. Elicaño and Mr. Faustino; and as a result of the investigations made, sufficient data have been secured to warrant the publication of the Mineral Resources for 1917 and 1918. The mineral regions visited were those of the Benguet district, the Mancayan region, the Camarines region (especially the districts of Paracale and Mambulao), and the iron mines of Calambayanga Island which are now being exploited by the Philippine Mining and Industrial Company. A short trip was also made to Alabat Island. In Ilocos Norte the holdings of the Ilocos Asbestos Products Company were visited. The Masbate mineral district was inspected in July. In November an inspection trip was made to Bataan Province for the purpose of determining the character of certain lands that were in dispute between the Manila Iron and Steel Company and private individuals. The point in dispute was whether the land was agricultural or mineral. A short trip was also made to Los Baños in order to determine the nature and extent of the white-clay deposit found in the neighborhood of that town, this investigation having been made with reference to the development of the manufacture of fire bricks in the Islands, as those manufactured by the Bureau of Science from the Los Baños clay have given excellent satisfaction.

*Mining legislation.*—In view of the mining activity in the Philippines and especially in view of the fact that the Government itself is interested in certain propositions such as the

National Coal Company, now operating in Cebu and in Mindanao, it is urgently necessary that the mining laws of the Philippines be thoroughly revised in order to bring them into harmony with local conditions. With a judicious revision of the Philippine mining laws it is certain that mining activity in the Philippines will be increased.

*Recommendations.*—As noted in the previous reports of the Bureau of Science, the responsibility of this branch of the Bureau is entirely too great for the personnel available. With the beginning of 1920 there will be but a single technical employee left in the division of mines. In order that this division should assume its proper place in the Bureau of Science and in reference to the mining industry in the Philippines, it is urgently necessary that additional technical employees be secured. For the past two or three years the work of the division of mines has been practically reduced to the daily routine, as the few available men have had no opportunity for doing research or for carrying on intensive explorations in any part of the Archipelago. It is hoped that during the coming year additional technical men can be secured, although it is very doubtful if the proper type—that is, thoroughly trained and experienced individuals—can be secured for the salaries offered. A plan submitted to the Philippine Cabinet with a view to securing the return of Dr. Warren D. Smith on a special-contract basis as adviser and technical expert in the division of mines was approved, and negotiations with Doctor Smith are well advanced. It is hoped that he will be able to report for duty by the middle of the coming year, as through his interest and support the efficiency and value of the division of mines can doubtless be greatly increased.

#### LIBRARY

*Personnel.*—The librarian, Miss Mary Polk, was absent during the entire year beginning January 25 on accrued leave, the library being in charge of Miss Margaret C. Upleger, assistant librarian, who continued on a part-time basis between the University of the Philippines and the Bureau of Science on the same conditions as for the preceding year. Her administration of the library has been very satisfactory, and a great deal of necessary work in addition to the ordinary routine has been accomplished during the year.

*Binding.*—About 500 volumes remaining at the Bureau of Printing at the end of last year have already been received. Two thousand one hundred additional volumes were sent to the

bindery, of which 1,400 have been returned. For the most part the binding has been confined to serial publications.

*Accessions.*—The number of bound volumes accessioned during the year was 2,025, making a total of 44,243 bound volumes in the library at the end of the year. In addition to this the library contains 5,112 unbound volumes and 26,701 pamphlets and parts of volumes, making a total of 76,056, exclusive of maps, duplicates, and unclassified material.

*Classification and cataloguing.*—The amount of routine work accomplished during the past year was considerably more than that performed during the preceding year, as shown by the following table:

|  | Titles. |      | Volumes. |       | Parts. |      | Cards. |       |
|--|---------|------|----------|-------|--------|------|--------|-------|
|  | 1918    | 1919 | 1918     | 1919  | 1918   | 1919 | 1918   | 1919  |
| Classification and cataloguing.....          | 402     | 622  | 616      | 864   | 475    | 701  | 1,550  | 2,510 |
| Reclassification and cataloguing.....        | 121     | 68   | 406      | 166   | .....  | 139  | 444    | 198   |
|  | 523     | 690  | 1,022    | 1,030 | 475    | 840  | 1,994  | 2,708 |
| Printed cards prepared and filed.....        |         |      |          |       |        |      | 1,593  | 6,761 |
| Total cards filed in official catalogue..... |         |      |          |       |        |      | 3,587  | 9,469 |

The printed cards prepared and filed during the year for the most part appertain to serial publications. The 153 cuts indicated in the last annual report as unfiled have been entered and 110 additional ones added during the year, making a total of 5,484 half-tone and line etchings on file. During the year 160 cuts were loaned.

*Duplicates.*—The duplicate material, which has been accumulating for many years, was removed from the library and a large amount of time was devoted to the problem of listing these duplicates with a view to offering this material in exchange to other libraries for material that is lacking in the library of the Bureau of Science. This work was practically completed at the end of the year, and stencils were prepared giving the necessary data regarding the material available for exchange purposes in our duplicate publications. In order to simplify matters the duplicate material of literature on economics and education was sent to the College of Liberal Arts and the University of the Philippines, while that on agriculture, forestry, entomology, etc., was sent to the College of Agriculture, at Los Baños. Material that was considered to be of use to the Philippine Library and Museum was sent to that institution, including such publications as War Department reports, Census reports,

etc., such publications scarcely coming within the scope of the Bureau of Science library. Lists of the remaining duplicate material will be sent to various libraries in Europe, Asia, and America, with a view to initiating exchanges for material desired for the library of the Bureau of Science but not as yet available here. To complete this work much time has been spent in checking our sets of periodicals with a view to completing the lists of missing numbers. A copy of this list will be sent to each institution to which our list of available duplicates is sent.

An especial effort has been made to secure missing numbers of periodicals lost on account of the war. This applies more especially to the technical publications issued in Germany and Austria. While considerable material has been secured, there are still many incomplete files and it is highly desirable that the missing numbers be secured while still available.

*Trade catalogues.*—More than 800 new trade catalogues, for the most part continuations and replacements, were received and prepared for circulation. New catalogues of importance to our library patrons have been requested and classified. A list of all available trade catalogues has been prepared, and this was printed in the local newspapers and in the Manila Merchants' Association Review. This work was initiated to assist local merchants, and it is of very distinct value to the local business community.

*Expansion.*—For some time the library shelves have been overcrowded. At the time the entomological literature was returned from the College of Agriculture, it was discovered that no space was available for this large collection of books. Accordingly, with the removal of the duplicate material from the upper stacks, the entire library was extended and rearranged. The shifting of the books was a distinctly onerous task and occupied a period of about six weeks. The remedy is only temporary, as in a comparatively short time the annual accessions will cause the stacks to be badly crowded again. Eventually it will be necessary to expand the library, utilizing all of the second floor of the east wing for library purposes. This will involve the moving of the botanical and ornithological collections to other quarters, which must be provided.

*Library training.*—During the first semester of the college year three courses in library training were given to students of the College of Liberal Arts, and one to students of the College of Medicine and Surgery; and in the second semester, four to the former, and one to the latter. The enrollment in the professional courses has largely exceeded that of previous years

as a result of the local demand for trained library assistants and librarians.

*American Library Association War Service.*—The staff of the Bureau of Science library has continued its coöperation with the American Library Association War Service Library. On account of the fact that space was not available at the Bureau of Science when a shipment of 10,000 volumes was received in March, the work was transferred to Fort Santiago where quarters and the necessary assistance were provided by the military authorities. Up to the present time somewhat over 12,000 volumes have been received from the United States, these having been distributed to different Army posts in the Philippines, to various places in China where troops are located, to naval vessels, transports, and to boats of the Shipping Board fleet that visit Manila. After the transfer of this work to Fort Santiago it was handled by the military department, Mr. Sanial being detailed from the Bureau of Science to supervise the cataloguing of the books. Three members of the American Library Association devoted much of their time over a period of four months to completing this work. In the absence of Miss Polk, the acting librarian, Miss Upleger, assumed charge of the local work of the American Library Association, becoming the acting Philippine representative of this organization. Recent advices indicate that 35,000 volumes are still to be sent to Manila from the United States, and this supply is greatly needed because of the large demand for more reading matter on the part of soldiers leaving for the United States, and because of the transfer of Siberian troops to Manila.

#### PUBLICATIONS

The technical publications of the Bureau of Science record the results of investigations made by members of the scientific staff and others in such form that it may be available to the Bureau, as a whole, to other entities of the Government service, to private individuals in the Philippines, and to investigators and institutions generally in all parts of the world. A large amount of important data has thus been compiled in the past nineteen years, and it is very fortunate for the Bureau of Science at the present time that so much material regarding the results of its researches is now available. With the present depleted technical staff much of the work accomplished by the Bureau of Science at the present time is of more or less routine nature. We are able, however, to answer very numerous inquiries regarding the utilization of Philippine products by reference to the

work previously accomplished by members of the scientific staff, the result in general being recorded in the technical papers published in the Philippine Journal of Science.

Up to the end of 1918 the Philippine Journal of Science was issued in four sections. On account of increased cost in printing, a serious depletion in the technical personnel of the Bureau of Science, and a decrease in contributions from outside sources, it was felt that the four sections formerly published could not be maintained on the high standard established for the Philippine Journal of Science. Accordingly, beginning with 1919 the sections were discontinued and the publication has been issued monthly instead of bimonthly. The form of the Philippine Journal of Science remains the same, except that each year two volumes of six numbers, separately paged and indexed, are issued instead of the four sections formerly published. The following table shows the number of pages, plates, and text figures in Volumes 14 and 15, which were published in 1919:

|                    | Volume 14,<br>January<br>to June. | Volume 15,<br>July to De-<br>cember. |
|--------------------|-----------------------------------|--------------------------------------|
| Pages .....        | 677                               | 590                                  |
| Plates .....       | 49                                | 63                                   |
| Text figures ..... | 30                                | 32                                   |

Owing largely to change in form of publication from four to two volumes and some delay in the submission of the manuscript for the first number, the publication of the Journal was rather seriously delayed at the beginning of the year. The work was pushed, however, as rapidly as possible, and every attempt has been made to bring the issues up to date. By the close of 1919 the August number was issued and the remaining four numbers were in advanced proof and they should be issued without much further delay. In addition to the preparation of the copy and proof reading for the two volumes for 1919, copy for the first three numbers for Volume 16 for 1920 has been supplied to the printer, and manuscript for three additional numbers is in an advanced state of preparation. It is planned and hoped that in the immediate future the Philippine Journal of Science will be issued regularly and on time.

The proceedings of the Manila Medical Society have not been published since January, 1919, as the Medical Society has not furnished copy for the proceedings during the past year.

The technical papers published in the Philippine Journal of Science during the year 1919, Volumes 14 and 15, are as follows:



VOLUME 14, JANUARY TO JUNE

*No. 1, January, 1919*

- WELLS, A. H. The physiological active constituents of certain Philippine medicinal plants: III.
- SALEEBY, N. M. The treatment of human beriberi with autolyzed yeast extract.
- DENNEY, OSWALD E. A photographic study of leprosy.
- LANTIN, PEDRO T. A comparative study of different methods of treatment of typhoid fever.
- MERRILL, E. D., and WADE, H. W. The validity of the name *Discomyces* for the genus of fungi variously called *Actinomyces*, *Streptothrix*, and *Nocardia*.
- BANKS, CHARLES S. *Iontha ida*, a new Philippine noctuid.
- COCKERELL, T. D. A. The social bees of the Philippine Islands.
- COCKERELL, T. D. A. The Philippine bees of the family *Nomadidæ*.
- SHUFELDT, R. W. The osteology of the giant gallinule of the Philippines, *Porphyrio pulverulentus* Temminck: With notes on the osteology of *Tachybaptus philippensis* (Bonnaterre) and *Hydrophasianus chirurgus* (Scopoli).
- TAYLOR, EDWARD H. New or rare Philippine reptiles.
- TAYLOR, EDWARD H. Ipon fisheries of Abra River.
- REINKING, OTTO A. *Phytophthora faberi* Maubl.: The cause of coconut-bud rot in the Philippines.
- REVIEWS.
- Proceedings of the Manila Medical Society.

*No. 2, February, 1919*

- BANKS, CHARLES S. *Phlebotomus nicnic*, a new species, the first Philippine record for this genus.
- BANKS, CHARLES S. The bloodsucking insects of the Philippines.
- COCKERELL, T. D. A. The *Prosopidæ*, or obtuse-tongued bees, of the Philippine Islands.
- COCKERELL, T. D. A. The Philippine bees of the families *Anthophoridæ* and *Melectidæ*.
- CARREON, MARCIANO. The absence of both hind legs below the femur in a full-term pig.
- HAUGHWOUT, FRANK G., and DE LEON, WALFRIDO. On the ingestion of erythrocytes by *Pentatrachomonas* sp., found in a case of dysentery.
- WITT, J. C. The effect of calcium sulphate on cement: Second paper.
- PANĀGANIBAN, C. S., and SCHÖBL, O. Experience with methylene blue-eosin lactose agar in searching for *Bacillus dysenteriae* in stools.
- MERRILL, E. D. Notes on the flora of Sumatra.
- REVIEWS.

*No. 3, March, 1919*

- ACOSTA-SISON, HONORIA, and CALDERON, FERNANDO. Pelvimetry and cephalometry among Filipino women and newborn babies: Made on one thousand two hundred thirty-seven cases.
- AGUILAR, R. H. The lumbang-oil industry in the Philippine Islands.
- FELT, E. P. New Philippine gall midges.
- BECCARI, O. The palms of the Philippine Islands.
- REVIEWS.

*No. 4, April, 1919*

MERRILL, E. D. New or noteworthy Philippine plants, XV.

*No. 5, May, 1919*

JOHNSTON, JOHN A. Some bacteriologic phases of the cholera-carrier problem.

DAR JUAN, T., and ELICAÑO, V. Philippine raw materials for glass making.

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The following special publications were issued during the year:

Seventeenth Annual Report of the Director of the Bureau of Science.  
 Vegetation of Philippine Mountains: The relation between the environment and physical types at different altitudes. By W. H. Brown.

Several other special publications are in course of preparation. Of these, Index to the Genera of Birds, by R. C. McGregor, is now in page proof.

The following press bulletins were issued during 1919:

- No. 92. Milk. (March 10, 1919.)  
 No. 93. Notes on the culture of coconuts in Mindanao. (April 25, 1919.)  
 No. 94. The manufacture of high-grade lime. (October 8, 1919.)

Publication of the Mineral Resources of the Philippine Islands has been resumed and copy for the 1917-1918 issue is now

in the hands of the printer. This number contains the following papers:

Staff, division of mines of the Bureau of Science.

Introduction, by Elmer D. Merrill.

Review of Philippine mining activities, by Victoriano Elicaño.

Mineral production of the Philippine Islands in 1917 and 1918, by Leopoldo A. Faustino.

Statistics of mineral production in the Philippine Islands in 1917 and 1918, by Leopoldo A. Faustino.

Philippine gold mining, by Victoriano Elicaño.

Iron and other metallic minerals, by Victoriano Elicaño.

Coal mining in the Philippines, by Leopoldo A. Faustino.

Nonmetallic minerals, by Leopoldo A. Faustino.

The Philippine asbestos industry, by W. H. Overbeck.

Philippine materials suited to the manufacture of glass, by T. Dar Juan and V. Elicaño.

Mining legislation in the Philippines, by Victoriano Elicaño.

Directory of mine owners, mine lessees, dredging companies, and coal operators in the Philippine Islands, by Leopoldo A. Faustino.

Coal leasing Act No. 2719 and its rules and regulations.

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

|                          | 1918  | 1919  |
|--------------------------|-------|-------|
| Paid subscriptions ..... | 426   | 553   |
| Exchanges .....          | 505   | 476   |
| Reviews .....            | 60    | 32    |
| Free .....               | 49    | 67    |
| Total .....              | 1,040 | 1,128 |

These figures show that the number of paid subscriptions has increased by more than 25 per cent. This is most satisfactory as indicating the growing popularity of the Philippine Journal of Science and a wider appreciation of its value.

The decrease in number of exchanges is due to the fact that the late war interfered with the publication of many of the European journals with which the Philippine Journal of Science enjoyed exchange relations.

#### POWER PLANT

The personnel directly connected with the power plant has remained practically unchanged during the past year. Mr. Felix V. Valencia, who was employed as a testing engineer and whose work was thus intimately connected with the power plant, resigned from the Government service on October 15, 1919, to accept a more lucrative position in commercial life.

Minor repairs have been made on boilers Nos. 1 and 2, while

more extensive repairs have been made on boiler No. 3. The arch in the latter was removed and a new one constructed with fire bricks manufactured at the Bureau of Science from Los Baños clay. These bricks were manufactured and installed for experimental purposes. They have proved to be exceedingly economical and are rendering very satisfactory service. It has been necessary to make rather extensive alterations and repairs on the gas producer. The original electric motor, which was burned out due to constant use and heavy load, has not been returned from the Bureau of Public Works, where it was sent for repairs in November, 1918, and a 15-horsepower motor belonging to the large centrifuge of the serum laboratory has been utilized as a substitute. In the latter part of the year it became necessary to overhaul the gas-producer engine. This engine has been run constantly since 1911, except on Sundays. The necessary repairs included the manufacture of a new piston, a new set of piston rings, turning the crank shaft, rebabbiting the borings, and boring the cylinders.

The electric current generated and delivered at the switch-board was 19,382 kilowatt hours at an average cost per kilowatt hour of ₱0.1557, as compared with ₱0.1093 for 1918 and ₱0.0803 for 1917. The total amount of steam generated in the boilers was 5,311,738 kilograms at an average cost per kilogram of ₱0.0084674, as compared with ₱0.005210 in 1918 and ₱0.003811 in 1917. It will be noted that the cost per kilowatt hour of electric current and the cost of steam per kilogram show a distinct increase over that for 1918 and an even greater increase over that for 1917. This is due to the radical increase in the price of coal, both for imported Japanese coal used in the ordinary furnaces and for the local Batan coal used in the producer. When the use of Batan coal was commenced its price per ton was ₱17.28, but in October this was increased to ₱29 per ton. With Batan coal at ₱29 per ton, in contrast with Japanese coal at ₱42 per ton, probably the use of the local coal results in little or no economy in our gas-producer plant, as the coal from Batan is of a lower grade than that from Japan, 1½ tons being practically equivalent to 1 ton of Japanese coal. Under equal circumstances, the use of Japanese coal is more advantageous in efficiency and economy, although it has the disadvantage of producing larger quantities of tar than does Batan coal, thus rendering necessary more frequent cleaning of the gas producer.

Another item that has contributed to the increased cost is the increase in wages for laborers. It has been absolutely necessary for us to promote the labor force in the power plant in

order to retain the services of experienced individuals. We have practically been obliged to pay the same wages for firemen and other laborers as are paid by manufacturing industries for the same type of labor in Manila. This has involved an increase of approximately 15 per cent in the labor pay roll.

The total amount of gas generated for use in the laboratories of the Bureau of Science was 920,378 cubic feet, the average cost of production being ₱2.58 per 1,000 cubic feet, as compared with ₱2.68 per 1,000 cubic feet for the preceding year, showing a slight decrease in cost. The dilution of the Mansfield gas-generating plant gas with producer gas has been continued throughout the year and has been exceedingly satisfactory.

In order to provide sufficient power to the Philippine General Hospital when the new buildings now under construction for that institution shall have been completed, it becomes necessary for the Bureau of Science to take steps toward the establishment of a new power unit. It has been recommended that provision be made for the purchase of a crude-oil engine of the Diesel or semi-Diesel type, as it is believed that the operation of this type of engine will be distinctly more economical than any source of power other than perhaps the gas producer. It is hoped that this new power unit can be secured and installed before the buildings for the Philippine General Hospital shall have been completed.

#### CLERICAL DIVISION

As usual, a certain amount of readjustment within the Bureau in the clerical force has been made, several new clerks and junior stenographers having been appointed to fill positions left vacant by registrations or transfers, while promotions have been granted to various members of the clerical staff as they have become eligible for promotion. The most serious loss in the clerical force was the resignation of the property clerk, Mr. Enrique Martinez, who retired from the Government service on September 1, 1919, to enter commercial life. Mr. Martinez, from his long connection with the Bureau of Science in the property division, was intimately acquainted with the requirements of this position and his services were always eminently satisfactory. No appointment has been made to this position as yet because, on account of the technical qualifications necessary, it is highly desirable that several candidates be tried out in order to determine their fitness for the very specialized work required in this position in the Bureau of Science. On the whole, the clerical work has been efficient and satisfactory during the year.

Owing to the high cost of living, it became necessary to revise

the labor pay roll and grant promotions to all laborers in the Bureau. Without such promotions it would have been practically impossible for the Bureau to retain many of its experienced laborers in competition with commercial interests.

An important function of the clerical division, in addition to the general routine devolving on its personnel, is to maintain a supply of animals for the serum and biological laboratories. The breeding of rabbits has been continued as in previous years, although with somewhat less success in 1919 than during the preceding year. Two hundred seventy-five rabbits were born during the year, compared with 542 for 1918. Of these, 217 were used in the serum and biological laboratories and 99 died during the year. In order to meet the needs of the Bureau it became necessary to purchase 55 rabbits, as compared with 40 purchased during 1918. At the end of the year there were on hand 111 rabbits. The breeding of guinea pigs has also been continued, but the supply has not been equal to the demand, and it became necessary to secure a considerable number from the Bureau of Agriculture, and a few were purchased from outside sources. When the serum laboratory shall have been transferred to Alabang, it is planned to expand the breeding of guinea pigs and rabbits; and it is believed that under the more favorable conditions existing at Alabang no difficulties will be met in breeding sufficient of these animals for the needs of both laboratories. As in past years, a considerable number of monkeys have been used in the laboratory work, these being secured through correspondents in the provinces. In addition to those required for the Bureau of Science, 200 monkeys were secured at the request of the United States military authorities and shipped to the United States. A sufficient supply of monkeys was available at the end of the year for the current needs of the laboratories. Sixty-two condemned horses were obtained free of charge from the United States military authorities, while 9 were secured from the city of Manila. These animals were utilized for the production of serum.

The necessary supervision and inspection of the Bureau of Science premises were made from time to time, and such minor repairs as were found necessary have been requested. The most extensive repairs during the year were made in connection with a portion of the north wall opposite the main staircase, necessitating the replacement of certain timbers. Toward the latter part of the year the Bureau of Public Works commenced replacing the roof on the main building, which has been in rather bad condition for a number of years past, provision for its re-

pair having been included in the Bureau of Public Works budget for the year 1919. This work was not finished at the end of the year but will be completed in the early part of 1920.

#### PHOTOGRAPHY

The photographic work carried on by the Bureau has been of the same nature as that prosecuted in previous years. Photographs have been made not only for the Bureau of Science itself but for many other Government units. The negatives now on file at the Bureau of Science number 22,998. A record of the photographic work performed during the past year is as follows:

|   |        |
|---|--------|
| Negative plates:                          |        |
| 5 by 7.....                               | 722    |
| 8 by 10.....                              | 11     |
| Prints:                                   |        |
| 5 by 7 (including 722 for the album)..... | 10,236 |
| 8 by 10 (including 11 for the album)..... | 791    |
| Miscellaneous sizes.....                  | 935    |
| Direct enlargements.....                  | 92     |
| Developing:                               |        |
| Plates, 4 by 5.....                       | 84     |
| Plates, 5 by 7.....                       | 144    |
| Plates, 8 by 10.....                      | 2      |
| Films, rolls (exposures).....             | 14     |
| Cinematograph film:                       |        |
| Negatives developed, feet.....            | 600    |
| Lantern slides:                           |        |
| Colored .....                             | 482    |
| Uncolored .....                           | 387    |
| Transparency, colored, 8 by 10.....       | 1      |

#### AQUARIUM

The administration of the aquarium has continued as during past years. During the year only a sufficient number of trips were made to secure the necessary new specimens to keep the collections in an attractive condition. The aquarium has continued to receive a large patronage from visitors to the Islands and from residents. The arrangement for admitting students and teachers from public and private schools through the means of special passes has been continued. The earnings of the aquarium were about ₱500 less than for the preceding year, to be accounted for by the fact that no carnival was held in 1919, as the average monthly receipts, except for February, the month in which the carnival is held, were in excess of those for 1918. In addition to the paid admissions, about 1,500 free ad-



missions were granted students and teachers of Government and private schools, wounded Czecho-Slovak soldiers, and visiting representatives of foreign governments.

The expenses in connection with the upkeep of the aquarium were ₱1,293.89 in excess of those for 1918, caused by increased salaries, the bonus adopted for Civil Service employees, and the increase in the cost of materials.

With no technical personnel in the fisheries division the aquarium cannot be utilized to its greatest extent, and until a new technical staff shall have been secured we can do no more than maintain the aquarium as a place for public recreation and education.

#### RECOMMENDATIONS

Recommendations with reference to the special needs of the individual units of the Bureau of Science have been included in the body of this report under the several heads. Certain general features, however, remain to be discussed.

The necessity for maintaining the technical personnel of the Bureau of Science has been ably discussed in the annual reports of the former Director of the Bureau of Science, and it is believed that no further argument is necessary at this time with reference to this particular phase of the question. Conditions have changed radically in the past two years, and all over the world the salaries of technical men have been greatly increased. With the salaries at present provided by law in the Bureau of Science, it is absolutely impossible to attract properly qualified and experienced technical men or to retain the services of the men who have acquired experience in many lines of work. We can, of course, secure employees at the salaries offered; but we cannot command the services of technical men of the higher type, able to initiate and to prosecute successfully work on problems that involve original research. While the provisions for granting special contracts to technical employees affords some relief, this method of securing new employees is not particularly satisfactory. Within the past year the Bureau of Science has lost the services of a considerable number of technical men, both Americans and Filipinos. Two of our highest-paid technical Filipinos resigned to accept appointments in commercial life at salaries approximating twice what they received in the Government service. Certain members of the junior technical personnel have been attracted from the Government service to commercial life for similar reasons.

Under the present salary schedule the Government service

fails to attract the brighter recent graduates of the University because of inadequate remuneration; and, as the Bureau of Science to a large degree is dependent for its success on the efficiency of its technical personnel and as, logically, its technical personnel should be developed so far as possible from its employees, every effort should be made to attract to the service the better-equipped individuals. A man of ordinary ability can be trained to do routine work satisfactorily, but most such individuals are never successful in handling research problems; and, as a general rule, to accomplish tangible results in research, whether it be in chemistry, in bacteriology, or in any other of the sciences, an individual must possess not only exceptional ability but also technical training in his particular specialty. The undersigned is of the opinion that the greatest single need of the Bureau of Science at the present time is a thorough revision of the salary schedule for all grades, but especially as it affects technical men.

Although the original draft of the bill providing for sending students to the United States for advanced training was prepared by the former Director of the Bureau of Science, at the time the selection of students was made the Bureau of Science unfortunately secured the allotment of but five positions. The need at the present time for additional technically trained men in the sciences is infinitely greater than it was one or two years ago. Educational facilities in the Philippines at the present time do not permit of a sufficient amount of specialized training in many of the sciences, and the products of our local educational institutions are usually, at most, fitted to do routine work only.

The Bureau of Science at the present time is very badly in need of technically trained men in bacteriology, serology, organic and inorganic chemistry, geology and mining, fisheries, entomology, and botany. Men properly equipped to undertake advanced technical work in these sciences are not available in the Philippines. The present technical force of the Bureau of Science is so badly depleted that the junior personnel can scarcely be given the necessary supervision and instruction in technical details. With no candidates available to fill the more advanced positions in these sciences, it becomes necessary to seek for the services of technical men in other countries. In the world as a whole the demand for technically trained men is now so great that unusually high salaries have to be offered to attract foreigners to the Philippine service. The Bureau of Science at the present time should have in training in the United States from

one to two or three men in all of the sciences mentioned above, in order that they may be properly equipped to carry on and develop the technical work in the Philippines on behalf of the local Government. Unless promising individuals be selected among the Filipino graduates of our local institutions to receive advanced training in foreign countries, the Bureau of Science will constantly be faced with the necessity of securing the services of technically trained men of other races.

At the present time a number of most important technical positions in the Bureau of Science are occupied by Filipinos who received their technical training in the United States; their services are eminently satisfactory. It is only logical to believe that other individuals, given the same opportunities for advanced work, will be able to accomplish as much as they have. By judiciously selecting students for advanced work, it is believed that the future technical work of the Bureau of Science can be kept at a relatively high standard, if we can secure the services of a proper number of technically trained Filipinos who have had the advantages of advanced study in their chosen professions in foreign countries. Even if we can secure the services of urgently needed, technically trained men in the United States now, it is highly improbable that chemists brought to the Philippines on a special-contract basis will remain in the service for longer than two or three years; so that, unless in the meantime selected Filipino students are being trained in advanced work in the United States or in other foreign countries, it will be necessary at the end of two or three years, as the case may be, to attempt to secure the services of still other chemists to carry on the work required of the Bureau of Science.

The same statement applies to all other departments of the Bureau of Science in which technical work is done. An additional number of technical fellowships for the Bureau of Science is, therefore, urgently necessary.

An infinite amount of work remains to be done in relation to the commercial development of Philippine resources. The work of the division of mines should be rehabilitated, but to do this it will be necessary to secure the services of additional men, trained and experienced in geology and mining.

The work of the division of fisheries should be made much more extensive than has been the case in the past. In this division provision has never been made for more than one technical employee. In view of the very primitive condition of the Philippine fishery industry and the practically unlimited field

for its expansion, the Government should undertake an investigation of the whole fishing field, more especially in reference to the economic aspects of the problem, the location and utilization of fishing banks, improved methods of catching fish, and methods of preserving fish and fish products for food. Further, work should be done on the life histories of migratory species, especially those that enter fresh water for breeding purposes, such investigations to be made with a view to recommending suitable legislation for the proper protection of migratory species.

The entomological work has already been rehabilitated by the retransfer of the entomological collections to the Bureau of Science and the reappointment of Mr. Banks as entomologist. Provision should be made for additional assistants in this division, as it is illogical to expect one man to cover the whole field of systematic and economic entomology.

In chemistry and the allied sciences there is an infinite number of problems in reference to industrial resources of the Philippines awaiting solution, and the proper solution of many of these problems depends on careful and critical chemical investigations. It is hardly necessary to enumerate the various lines of investigation that should be carried on with especial reference to chemistry, as this subject has already been thoroughly discussed in the annual reports of the former Director. The field, however, covers such questions as the better utilization of low-grade Philippine coal for fuel; the utilization of powdered coal, briquets, etc.; the extension of the work of the Iloilo sugar laboratory; further investigations of the nipa palm as a possible commercial source of sugar; the investigation of local medicinal and poisonous plants; a study of Philippine soils, which perhaps might be carried on in coöperation with the Bureau of Agriculture; a field survey of Philippine water supplies; and the amplification of the facilities of the Bureau for the manufacture of tikitiki extract.

As soon as the proper technical personnel in chemistry is available, it is recommended that the Bureau of Science be authorized to arrange for coöperation with various local commercial units in the sugar, copra, coconut oil, and tobacco industries for investigation of various problems in connection with these industries on a basis similar to that in operation at the Mellon Institute for Industrial Research, at Pittsburgh. There are a number of problems in connection with the above industries demanding solution which can best be handled by coöperation between the various commercial units involved and

such an institution as the Bureau of Science, where the necessary laboratory facilities, library, and equipment are already available.

In reference to the work of the biological laboratory, while during the past year the work has been almost entirely of a routine nature, and while it is realized that proper provision must be made for the prosecution of the required amount of routine work, the fact should not be forgotten that in biological problems affecting human health, routine and investigation work are closely associated. The staff of the biological laboratory should be of sufficient size, not only to accomplish all necessary routine work, but also to carry on investigations in certain fields, such as the question of carriers in relation to cholera, typhoid, bacillary dysentery, etc.; the intensive study of parasites both in the field of protozoölogy and of helminthology, and the relationships of these parasites to disease; and the investigation of the causes of certain tropical diseases that are as yet obscurely or imperfectly known. Provision should be made for the establishment of a certain number of branches of the biological laboratory to be located at strategic points in the provinces, in a limited number of provincial capitals so selected that the laboratories will serve the largest possible number of people. It is believed that six or eight such laboratories should be established first and, if the idea underlying their establishment proves to be practicable, the number can then be increased as conditions warrant and as properly trained technical personnel becomes available. It is confidently believed that small biological laboratories situated in a certain number of provincial capitals remote from Manila will be of infinite value to the residents of the Philippines in connection with matters appertaining to the public health. Such laboratories, if established under the direction of the Bureau of Science, would, while serving the interests of the Philippine Health Service, at the same time be independent of that service and would thus be strategically in better position to serve the needs of private practitioners and the public as a whole. Should these laboratories be established, the incumbents in charge must receive a careful course of training in the laboratories of the Bureau of Science before being assigned to provincial stations, as they must be competent to carry on all ordinary routine microscopical examinations for the detection of pathogenic bacteria and other organisms and, at the same time, should be trained to administer the Wassermann test, the Widal reaction, the Pasteur treatment, etc. It is recommended that

provision be made for the establishment of eight of these laboratories during the coming year.

No provision for additional laboratory space has been made for the Bureau of Science since the east wing was completed in 1912. In the intervening seven years the work of the Bureau has expanded, and its permanent collections of books, equipment, and illustrative material have been greatly increased. The library is now practically expanded to the full capacity of its present quarters and provision must soon be made for additional space. The quarters now occupied by the botanical and zoölogical collections must be assigned to the library, and new quarters provided for botany and ornithology. Entomology is now assigned to the vacant space in the ichthyological quarters, but the entomological collections must be removed as soon as the work on fisheries is rehabilitated, which will be in the course of a few months. The transfer of the serum laboratory to Alabang will make a certain amount of space available, but this is already largely assigned to the chemical and testing laboratories. Entomology can be provided for temporarily in one of the laboratories now utilized in the serum work, but the move will be, at most, one of a temporary nature. It is respectfully recommended that provision be made for the construction of the west wing to the Bureau of Science building to duplicate the present east wing, but with proper arrangement of space to accommodate botany, entomology, and general zoölogy on the second floor, and certain units of the chemical laboratory, now badly cramped for room, on the first floor.

The old wooden stable used for serum horses should be removed when the serum laboratory is transferred to Alabang, the new cement stable and the bleeding house transformed into testing laboratories, and the present cement laboratory raised and extended for the proper accommodation of the assay work.

It is recommended that the material to be made available by the removal of the old wooden stable be utilized to construct a few small houses at the rear of the Bureau of Science grounds for the accommodation of the firemen employed in the power plant. This is highly desirable on account of the present critical condition of the housing problem in Manila, and further because of our very great difficulty in retaining the services of experienced firemen in competition with commercial firms who offer more favorable terms to laborers of this class than does the Bureau of Science. The construction of these quarters will distinctly add to the economy and efficiency of our power department.

Tables showing the routine work performed and supplies manufactured and disposed of during the year 1919, and a financial statement showing the available appropriation for the year and its disposition are attached hereto.

Respectfully submitted,

ELMER D. MERRILL,  
*Director, Bureau of Science.*

To the Honorable  
The SECRETARY OF AGRICULTURE  
AND NATURAL RESOURCES.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1919, as compared with the fiscal year 1918, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

| Subdivisions of the Bureau of Science.  | Samples or units. |       | Cash work.        |       |           |           |
|---|-------------------|-------|-------------------|-------|-----------|-----------|
|   |                   |       | Samples or units. |       | Pesos.    |           |
|   | 1918              | 1919  | 1918              | 1919  | 1918      | 1919      |
| General, inorganic, and physical chemistry:   |                   |       |                   |       |           |           |
| Metals and alloys.....  | 51                | 16    | 45                | 14    | 1,009.95  | 153.00    |
| Rocks, minerals, natural pigments, and similar substances.....  | 9                 | 40    | 8                 | 38    | 86.00     | 256.00    |
| Clays, shales, limestones, limes, wall plasters, cement, and slags.....                                 | 12                | 9     | 11                | 8     | 74.00     | 116.00    |
| Fertilizers.....  | 10                | 26    | 9                 | 24    | 80.00     | 216.00    |
| Soils and similar substances.....   | 22                | 19    | 11                | 9     | 375.00    | 220.00    |
| Coal analyses.....  | 33                | 25    | 33                | 25    | 1,000.00  | 311.00    |
| Calorimetric tests of fuels.....  | 33                | 23    | 33                | 23    | 660.00    | 440.00    |
| Paints and varnishes.....   | 2                 | 15    | 2                 | 15    | 20.00     | 392.50    |
| Waters.....   | 158               | 187   | 12                | 20    | 391.00    | 233.00    |
| Crude chemical and miscellaneous analyses.....  | 119               | 20    | 110               | 14    | 271.70    | 99.00     |
| Standard solutions (in liters).....   | 214               | 225   | 62                | 35    | 225.77    | 142.00    |
| Physical tests of wire, twine, fibers, textiles, paper, and similar articles.....                       | 139               | 29    | 138               | 29    | 114.00    | 69.00     |
| Cements.....  | 4,999             | 6,888 | 4,999             | 6,888 | 5,211.60  | 8,725.45  |
| Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc..... | 68                | 111   | 68                | 111   | 215.65    | 337.60    |
| Standardization of road materials.....  | 3                 | 6     | 3                 | 6     | 12.00     | 40.00     |
| Standardization and correction of units of measure.....   | 2,681             | 1,111 | 2,681             | 1,111 | 349.40    | 582.50    |
| Miscellaneous inorganic analyses.....   | 48                | 115   | 43                | 108   | 231.83    | 1,389.00  |
| Total.....  | 8,601             | 8,865 | 8,268             | 8,478 | 10,327.90 | 13,722.05 |



TABLE 1.—Comparative table of routine work performed, etc.—Continued.

| Subdivisions of the Bureau<br>of Science.                        | Samples or units. |                | Cash work.        |                |                 |                 |
|--|-------------------|----------------|-------------------|----------------|-----------------|-----------------|
|  |                   |                | Samples or units. |                | Pesos.          |                 |
|  | 1918              | 1919           | 1918              | 1919           | 1918            | 1919            |
| <b>Organic chemistry:</b>  |                   |                |                   |                |                 |                 |
| Urines, clinical and<br>toxicological an-<br>alyses .....        | 390               | 361            | 259               | 229            | 819.84          | 803.06          |
| Essential oils and es-<br>sences .....                           | 9                 | 14             | 9                 | 14             | 58.50           | 104.00          |
| Petroleum and prod-<br>ucts, copra, and<br>similar materials ... | 460               | 508            | 453               | 504            | 2,011.50        | 2,766.00        |
| Linseed and castor<br>oils .....                                 | 16                | 21             | 11                | 19             | 133.00          | 183.00          |
| Gums, resins, and<br>similar materials ...                       | 1                 |                | 1                 |                | 10.00           |                 |
| Paper and similar<br>materials .....                             | 3                 | 5              |                   |                |                 |                 |
| Gastric juice, clinical<br>examinations .....                    | 1                 | 2              |                   |                |                 |                 |
| Foods, alcohols, and<br>beverages .....                          | 813               | 1,631          | 171               | 128            | 786.35          | 867.67          |
| Food preservatives<br>and coloring mat-<br>ter .....             | 171               | 69             | 15                | 10             | 80.00           | 99.00           |
| Medicines and simi-<br>lar articles .....                        | 66                | 120            | 28                | 17             | 283.00          | 266.00          |
| Miscellaneous organ-<br>ic analyses and ex-<br>aminations .....  | 81                | 433            | 42                | 426            | 377.40          | 964.70          |
| <b>Total .....</b>   | <b>2,011</b>      | <b>3,164</b>   | <b>989</b>        | <b>1,347</b>   | <b>4,559.59</b> | <b>6,053.43</b> |
| <b>Mines:</b>  |                   |                |                   |                |                 |                 |
| Assays .....   | 253               | 400            | 253               | 346            | 1,353.67        | 1,120.41        |
| Smelting and refining<br>of gold .....                           |                   | 320,798        |                   | 320,798        |                 | 6,565.15        |
| <b>Total .....</b>   | <b>253</b>        | <b>321,198</b> | <b>253</b>        | <b>321,144</b> | <b>1,353.67</b> | <b>7,685.56</b> |
| <b>Biological laboratory:</b>                                    |                   |                |                   |                |                 |                 |
| Fæces .....  | 149,890           | 136,563        | 417               | 246            | 1,472.30        | 952.32          |
| Sputum .....   | 887               | 635            | 72                | 57             | 204.38          | 162.00          |
| Blood .....  | 67                | 64             | 54                | 35             | 291.34          | 154.67          |
| Cultures .....   | 9                 | 2              | 9                 | 2              | 41.67           | 10.00           |
| Widal tests .....  | 1,550             | 1,475          | 4                 | 34             | 12.00           | 101.00          |
| Wassermann tests ...   | 497               | 326            | 360               | 210            | 3,208.00        | 2,100.00        |
| Leprosy .....  | 338               | 56             | 8                 | 6              | 23.00           | 16.00           |
| Urines .....   | 37                | 11             | 32                | 11             | 117.00          | 31.00           |

TABLE 1.—Comparative table of routine work performed, etc.—Continued.

| Subdivisions of the Bureau of Science.                      | Samples or units. |            | Cash work.        |            |            |            |
|---|-------------------|------------|-------------------|------------|------------|------------|
|   |                   |            | Samples or units. |            | Pesos.     |            |
|   | 1918              | 1919       | 1918              | 1919       | 1918       | 1919       |
| Biological laboratory—<br>Continued.                        |                   |            |                   |            |            |            |
| Gonococci .....   | 13,888            | 93         | 51                | 32         | 139.00     | 106.00     |
| Waters .....  | 3,156             | 4,054      | 8                 | 9          | 152.00     | 278.00     |
| Histological examinations .....                             | 11                | 6          | 7                 | 2          | 70.00      | 20.00      |
| Rabies .....  | 3                 | 4          |                   | 2          |            | 10.00      |
| Rats for plague .....                                       | 90,008            | 97,477     |                   |            |            |            |
| Miscellaneous biological examinations .....                 | 1,938             | 3,379      | 24                | 10         | 154.50     | 134.66     |
| Total .....   | 262,279           | 244,145    | 1,046             | 656        | 5,885.19   | 4,075.65   |
| Serum section of the biological laboratory:                 |                   |            |                   |            |            |            |
| Vaccine virus (doses) .....                                 | 4,589,358         | 9,416,254  | 4,589,358         | 9,416,254  | 47,934.72  | 95,322.16  |
| Mallein (doses) .....                                       | 188               |            | 188               |            | 188.00     |            |
| Miscellaneous sérums and vaccines (ampules and units) ..... | 3,309,706         | 4,902,964  | 3,309,706         | 4,902,964  | 13,621.17  | 16,389.90  |
| Total .....   | 7,899,252         | 14,319,218 | 7,899,252         | 14,319,218 | 61,743.89  | 111,712.06 |
| Miscellaneous:  |                   |            |                   |            |            |            |
| Photographic work .....                                     | 13,033            | 13,583     | 10,954            | 9,989      | 3,710.82   | 3,614.52   |
| Natural-history specimens .....                             | 32                | 41         | 31                | 41         | 276.40     | 647.80     |
| Shop work .....   | 174               | 187        | 23                | 8          | 372.18     | 122.25     |
| Drafting .....  |                   | 85         |                   | 11         |            | 7.75       |
| Miscellaneous work .....                                    |                   | 6          |                   | 6          | 6,602.20   | 5,523.04   |
| Supplies .....  | 4,918             | 3,751      | 4,869             | 3,751      | 8,666.00   | 5,998.19   |
| Tikitiki extract .....                                      |                   | 799        |                   | 799        |            | 489.42     |
| Sales of publications .....                                 |                   |            |                   |            | 5,194.48   | 5,399.27   |
| Refunded, work not done, etc. (deducted) .....              |                   |            |                   |            | (280.00)   | (405.00)   |
| Power, gas, etc. ....                                       |                   |            |                   |            | 28,163.24  | 40,923.05  |
| Total .....   | 18,157            | 18,452     | 15,877            | 14,605     | 52,705.32  | 62,320.29  |
| Grand total .....   | 8,190,553         | 14,915,042 | 7,925,685         | 14,665,448 | 136,575.56 | 205,569.04 |

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1919, as compared with the fiscal year 1918, by number or quantity and by value, arranged with reference to Government and other patronage.

| Customer.   | Samples or units. |        | Cash work.        |        |        |        |
|---|-------------------|--------|-------------------|--------|--------|--------|
|   |                   |        | Samples or units. |        | Pesos. |        |
|   | 1918              | 1919   | 1918              | 1919   | 1918   | 1919   |
| <b>Bureau of Agriculture:</b>                         |                   |        |                   |        |        |        |
| Soils and similar substances                          |                   | 2      |                   |        |        |        |
| Crude chemical and miscellaneous analyses             | 9                 | 3      |                   |        |        |        |
| Foods, alcohols, and beverages                        | 63                | 18     |                   |        |        |        |
| Miscellaneous organic analyses and examinations       | 4                 |        |                   |        |        |        |
| Miscellaneous inorganic analyses                      |                   | 1      |                   |        |        |        |
| Miscellaneous serums and vaccines (ampules and units) |                   | 48,000 |                   | 48,000 |        | 48.00  |
| Photographic work                                     |                   | 8      |                   | 8      |        | 3.20   |
| Total   | 76                | 48,032 |                   | 48,008 |        | 51.20  |
| <b>Bureau of Coast and Geodetic Survey:</b>           |                   |        |                   |        |        |        |
| Vaccine virus   | 100               | 100    | 100               | 100    | 1.00   | 1.00   |
| <b>Bureau of Commerce and Industry:</b>               |                   |        |                   |        |        |        |
| Fertilizers   |                   | 2      |                   |        |        |        |
| Miscellaneous organic analyses and examinations       |                   | 1      |                   |        |        |        |
| Fæces   | 2                 |        |                   |        |        |        |
| Sputum  | 1                 | 2      |                   | 2      |        | 2.00   |
| Blood   |                   | 1      |                   | 1      |        | 2.00   |
| Leprosy   |                   | 1      |                   |        |        |        |
| Waters, biological                                    |                   | 2      |                   |        |        |        |
| Photographic work                                     | 180               | 1,879  | 180               | 1,879  | 29.23  | 444.49 |
| Natural-history specimens                             |                   | 2      |                   | 2      |        | 30.00  |
| Total   | 183               | 1,890  | 180               | 1,884  | 29.23  | 478.49 |
| <b>Bureau of Customs:</b>                             |                   |        |                   |        |        |        |
| Metals and alloys                                     | 1                 |        |                   |        |        |        |
| Foods, alcohols, and beverages                        | 1                 | 1      |                   |        |        |        |
| Waters, biological                                    | 1                 |        |                   |        |        |        |
| Petroleum and products, copra, and similar materials  | 2                 | 1      |                   |        |        |        |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.  | Samples or units. |       | Cash work.        |       |        |        |
|--|-------------------|-------|-------------------|-------|--------|--------|
|  |                   |       | Samples or units. |       | Pesos. |        |
|  | 1918              | 1919  | 1918              | 1919  | 1918   | 1919   |
| Bureau of Customs—Ctd.                                     |                   |       |                   |       |        |        |
| Miscellaneous inorganic analyses.....                      | 2                 | 1     |                   |       |        |        |
| Linseed and castor oils.....                               | 1                 |       |                   |       |        |        |
| Medicines and similar articles.....                        | 3                 | 10    |                   |       |        |        |
| Miscellaneous organic analyses and examinations.....       |                   | 3     |                   |       |        |        |
| Photographic work.....                                     | 30                |       | 30                |       | 6.00   |        |
| Total.....   | 41                | 16    | 30                |       | 6.00   |        |
| Council of National Defense:                               |                   |       |                   |       |        |        |
| Photographic work.....                                     | 2,852             | 1,493 | 2,852             | 1,493 | 970.00 | 536.29 |
| Bureau of Education:                                       |                   |       |                   |       |        |        |
| Soils and similar substances.....                          |                   | 5     |                   |       |        |        |
| Miscellaneous inorganic analyses.....                      | 3                 | 4     |                   |       |        |        |
| Photographic work.....                                     | 28                | 365   | 28                | 365   | 7.00   | 238.23 |
| Total.....   | 31                | 374   | 28                | 365   | 7.00   | 238.23 |
| Executive Bureau:  |                   |       |                   |       |        |        |
| Photographic work.....                                     | 11                | 1     | 11                | 1     | 14.60  | 5.00   |
| Supplies.....  | 2                 |       | 2                 |       | 4.80   |        |
| Total.....   | 13                | 1     | 13                | 1     | 19.40  | 5.00   |
| Department of Finance:                                     |                   |       |                   |       |        |        |
| Metals and alloys.....                                     | 1                 |       |                   |       |        |        |
| Department of Mindanao and Sulu:                           |                   |       |                   |       |        |        |
| Photographic work.....                                     |                   | 83    |                   | 83    |        | 27.70  |
| Bureau of Dependent Children:                              |                   |       |                   |       |        |        |
| Miscellaneous serums and vaccines (ampules and units)..... |                   | 6,000 |                   | 6,000 |        | 9.00   |
| Bureau of Forestry:  |                   |       |                   |       |        |        |
| Fertilizers.....   | 1                 |       |                   |       |        |        |
| Photographic work.....                                     | 71                | 260   | 71                | 260   | 20.80  | 136.00 |
| Supplies.....  | 118               |       | 118               |       | 33.16  |        |
| Total.....   | 190               | 260   | 189               | 260   | 53.96  | 136.00 |
| Philippine Census:   |                   |       |                   |       |        |        |
| Photographic work.....                                     |                   | 9     |                   | 9     |        | 10.32  |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.   | Samples or units. |                   | Cash work.        |                   |                  |                  |
|---|-------------------|-------------------|-------------------|-------------------|------------------|------------------|
|   |                   |                   | Samples or units. |                   | Pesos.           |                  |
|   | 1918              | 1919              | 1918              | 1919              | 1918             | 1919             |
| Philippine Health Service:                                |                   |                   |                   |                   |                  |                  |
| Waters, chemical.....                                     | 10                | 5                 |                   |                   |                  |                  |
| Waters, biological.....                                   |                   | 3,099             | 3,202             |                   |                  |                  |
| Crude chemical and miscellaneous analyses.....            | 88                | 2                 | 88                |                   | 35.20            |                  |
| Urines, clinical and toxicological analyses.....          | 104               | 111               |                   |                   |                  |                  |
| Petroleum and products, copra, and similar materials..... | 4                 | 1                 |                   |                   |                  |                  |
| Linseed and castor oils.....                              | 3                 | 2                 |                   |                   |                  |                  |
| Gastric juice, clinical examinations.....                 | 1                 | 2                 |                   |                   |                  |                  |
| Foods, alcohols, and beverages.....                       | 557               | 1,451             |                   |                   |                  |                  |
| Food preservatives and coloring matter.....               | 156               | 59                |                   |                   |                  |                  |
| Medicines and similar articles.....                       | 11                | 9                 |                   |                   |                  |                  |
| Miscellaneous organic analyses and examinations.....      | 11                | 51                | 11                | 48                | 28.40            | 19.20            |
| Fæces.....  | 53,591            | 42,843            |                   |                   |                  |                  |
| Sputum.....   | 808               | 577               |                   |                   |                  |                  |
| Blood.....  | 11                | 29                |                   |                   |                  |                  |
| Widal tests.....  | 1,492             | 1,433             |                   |                   |                  |                  |
| Wassermann tests.....                                     | 16                | 84                |                   |                   |                  |                  |
| Leprosy.....  | 323               | 49                |                   |                   |                  |                  |
| Urines.....   | 5                 |                   |                   |                   |                  |                  |
| Gonococci.....  | 13,837            | 61                |                   |                   |                  |                  |
| Histological examinations.....                            | 2                 | 2                 |                   |                   |                  |                  |
| Rabies.....   | 3                 | 2                 |                   |                   |                  |                  |
| Rats for plague.....                                      | 90,008            | 97,469            |                   |                   |                  |                  |
| Miscellaneous biological work and examinations.....       | 1,897             | 3,364             |                   |                   |                  |                  |
| Vaccine virus.....  | 4,412,152         | 9,360,000         | 4,412,152         | 9,360,000         | 44,126.20        | 93,600.00        |
| Miscellaneous serums and vaccines.....                    | 1,748,506         | 1,858,510         | 1,748,506         | 1,858,510         | 4,619.67         | 3,039.70         |
| Photographic work.....                                    | 290               | 318               | 290               | 318               | 115.10           | 128.70           |
| Shop work.....  | 2                 |                   | 2                 |                   | 75.70            |                  |
| Supplies.....   | 1,697             | 2,362             | 1,697             | 2,362             | 89.60            | 194.80           |
| <b>Total.....</b>   | <b>6,328,684</b>  | <b>11,371,998</b> | <b>6,162,746</b>  | <b>11,221,238</b> | <b>49,089.87</b> | <b>96,982.40</b> |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.  | Samples or units. |         | Cash work.        |         |        |          |
|--|-------------------|---------|-------------------|---------|--------|----------|
|  |                   |         | Samples or units. |         | Pesos. |          |
|  | 1918              | 1919    | 1918              | 1919    | 1918   | 1919     |
| Philippine General Hospital:                                 |                   |         |                   |         |        |          |
| Vaccine virus .....  |                   | 40      |                   | 40      |        | 4.00     |
| Miscellaneous serums and vaccines .....                      |                   | 397,876 |                   | 397,876 |        | 2,262.10 |
| Photographic work .....                                      |                   | 103     |                   | 103     |        | 110.20   |
| Shop work .....  |                   | 1       |                   | 1       |        | 7.50     |
| Total .....  |                   | 398,020 |                   | 398,020 |        | 2,383.80 |
| House of Representatives:                                    |                   |         |                   |         |        |          |
| Photographic work .....                                      |                   | 80      |                   | 80      |        | 102.50   |
| Bureau of Internal Revenue:                                  |                   |         |                   |         |        |          |
| Standardization and correction of weights and measures ..... | 40                |         | 40                |         | 4.00   |          |
| Foods, alcohols, and beverages .....                         |                   | 2       |                   |         |        |          |
| Medicines and similar articles .....                         | 1                 |         |                   |         |        |          |
| Photographic work .....                                      |                   | 312     |                   | 312     |        | 108.12   |
| Total .....  | 41                | 314     | 40                | 312     | 4.00   | 108.12   |
| Independence Mission:  |                   |         |                   |         |        |          |
| Photographic work .....                                      |                   | 1,148   |                   | 1,148   |        | 441.60   |
| Bureau of Justice:   |                   |         |                   |         |        |          |
| Photographic work .....                                      | 1                 |         | 1                 |         | .20    |          |
| Urinés, clinical and toxicological analyses .....            |                   | 1       |                   | 1       |        | 75.00    |
| Medicines and similar articles .....                         | 19                | 9       | 19                | 9       | 185.00 | 90.00    |
| Blood .....  |                   | 3       |                   | 3       |        | 15.00    |
| Total .....  | 20                | 13      | 20                | 13      | 185.20 | 180.00   |
| Office of the Governor-General:                              |                   |         |                   |         |        |          |
| Supplies .....   |                   | 1       |                   | 1       |        | 2.40     |
| Board of Pharmaceutical Examiners and Inspectors:            |                   |         |                   |         |        |          |
| Medicines and similar articles .....                         | 21                | 87      |                   | 3       |        | 60.00    |
| Philippine Library and Museum:                               |                   |         |                   |         |        |          |
| Supplies .....   | 2                 |         | 2                 |         | 24.00  |          |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.   | Samples or units. |              | Cash work.        |              |               |               |
|---|-------------------|--------------|-------------------|--------------|---------------|---------------|
|   |                   |              | Samples or units. |              | Pesos.        |               |
|   | 1918              | 1919         | 1918              | 1919         | 1918          | 1919          |
| <b>Philippine National Guard:</b>                     |                   |              |                   |              |               |               |
| Foods, alcohol, and beverages .....                   | 1                 |              |                   |              |               |               |
| Fæces .....   | 1                 |              | 1                 |              | 5.33          |               |
| Wassermann tests .....                                | 54                |              | 54                |              | 148.00        |               |
| Vaccine virus .....                                   | 700               |              | 700               |              | 7.00          |               |
| Miscellaneous serums and preparations .....           | 102               |              | 102               |              | 14.95         |               |
| Shop work .....                                       | 2                 |              | 2                 |              | 133.56        |               |
| <b>Total .....</b>                                    | <b>860</b>        |              | <b>859</b>        |              | <b>313.84</b> |               |
| <b>Bureau of Non-Christian Tribes:</b>                |                   |              |                   |              |               |               |
| Blood .....   |                   | 4            |                   | 4            |               | 12.00         |
| <b>Philippine Constabulary:</b>                       |                   |              |                   |              |               |               |
| Urines, clinical and toxicological analyses .....     | 1                 |              |                   |              |               |               |
| Miscellaneous biological work and examinations .....  | 13                |              |                   |              |               |               |
| Miscellaneous organic analyses and examinations ..... | 6                 | 1            | 6                 | 1            | 24.00         | 49.00         |
| Miscellaneous inorganic analyses .....                | 3                 | 1            | 3                 | 1            | 15.00         | 10.00         |
| Photographic work .....                               | 900               |              | 900               |              | 250.00        |               |
| Vaccine virus .....                                   | 6,950             | 4,000        | 6,950             | 4,000        | 69.50         | 40.00         |
| Miscellaneous serums and vaccines:                    | 4,875             | 234          | 4,875             | 234          | 120.55        | 98.40         |
| Supplies .....  |                   | 60           |                   | 60           |               | 1.20          |
| <b>Total .....</b>                                    | <b>12,748</b>     | <b>4,296</b> | <b>12,734</b>     | <b>4,296</b> | <b>479.05</b> | <b>198.60</b> |
| <b>Bureau of Posts:</b>                               |                   |              |                   |              |               |               |
| Photographic work .....                               | 1                 | 4            | 1                 | 4            | 8.00          | 19.20         |
| <b>Bureau of Printing:</b>                            |                   |              |                   |              |               |               |
| Paper and similar materials .....                     | 3                 | 5            |                   |              |               |               |
| <b>Bureau of Prisons:</b>                             |                   |              |                   |              |               |               |
| Soils and similar substances .....                    |                   | 3            |                   |              |               |               |
| Fæces .....   | 92,219            | 89,498       |                   |              |               |               |
| Sputum .....  | 1                 |              |                   |              |               |               |
| Widal tests .....                                     | 54                | 8            |                   |              |               |               |
| Wassermann tests .....                                | 121               | 32           |                   |              |               |               |
| Leprosy .....   | 7                 |              |                   |              |               |               |
| Rats for plague .....                                 | 4                 | 1            |                   |              |               |               |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.   | Samples or units. |        | Cash work.        |       |        |        |
|---|-------------------|--------|-------------------|-------|--------|--------|
|   |                   |        | Samples or units. |       | Pesos. |        |
|   | 1918              | 1919   | 1918              | 1919  | 1918   | 1919   |
| <b>Bureau of Prisons—Ctd.</b>   |                   |        |                   |       |        |        |
| Histological examinations.....  | 2                 | 2      |                   |       |        |        |
| Water, biological.....  | 42                | 12     |                   |       |        |        |
| Miscellaneous biological work and examinations.....   |                   | 1      |                   |       |        |        |
| Vaccine virus.....  |                   | 300    |                   | 300   |        | 3.00   |
| Miscellaneous serums and vaccines.....  |                   | 12     |                   | 12    |        | 8.40   |
| Supplies.....   | 36                |        | 36                |       | 1.50   |        |
| Total.....  | 92,486            | 89,869 | 36                | 312   | 1.50   | 11.40  |
| <b>Bureau of Public Works:</b>  |                   |        |                   |       |        |        |
| Standard solutions (liters).....  | 8                 |        | 8                 |       | 11.00  |        |
| Cements.....  | 111               | 6      | 111               | 6     | 211.50 | 44.50  |
| Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc..... | 9                 | 9      | 9                 | 9     | 63.00  | 32.00  |
| Standardization of road materials.....  | 3                 | 2      | 3                 | 2     | 12.00  | 10.00  |
| Paints and varnishes.....   | 1                 | 1      | 1                 | 1     | 15.00  | 22.50  |
| Waters, chemical.....   | 133               | 161    |                   |       |        |        |
| Waters, biological.....   | 4                 | 9      |                   |       |        |        |
| Photographic work.....  |                   | 11     |                   | 11    |        | 4.30   |
| Total.....  | 269               | 199    | 132               | 29    | 312.50 | 113.30 |
| <b>Bureau of Quarantine Service:</b>  |                   |        |                   |       |        |        |
| Urines, clinical and toxicological analyses.....  | 6                 | 6      |                   |       |        |        |
| Fæces.....  | 3,104             | 3,564  |                   |       |        |        |
| Sputum.....   | 1                 |        |                   |       |        |        |
| Gonococci.....  |                   | 1      |                   | 1     |        | 3.00   |
| Rats for plague.....  |                   | 7      |                   |       |        |        |
| Vaccine virus.....  | 15,100            | 7,500  | 15,100            | 7,500 | 151.00 | 75.00  |
| Total.....  | 18,211            | 11,078 | 15,100            | 7,501 | 151.00 | 78.00  |
| <b>Bureau of Science:</b>   |                   |        |                   |       |        |        |
| Metals and alloys.....  | 2                 | 1      |                   |       |        |        |
| Rocks, minerals, natural pigments, and similar substances.....  | 1                 | 2      |                   |       |        |        |



TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.   | Samples or units. |              | Cash work.        |          |              |             |
|---|-------------------|--------------|-------------------|----------|--------------|-------------|
|   |                   |              | Samples or units. |          | Pesos.       |             |
|   | 1918              | 1919         | 1918              | 1919     | 1918         | 1919        |
| <b>Bureau of Science—Ctd.</b>   |                   |              |                   |          |              |             |
| Clays, shales, limestones, limes, wall plasters, cements, and slags ..... | 1                 | 1            |                   |          |              |             |
| Soils and similar substances .....  | 11                |              |                   |          |              |             |
| Crude chemical and miscellaneous analyses .....                           |                   | 1            |                   |          |              |             |
| Standard solutions (in liters) .....                                      | 152               | 190          |                   |          |              |             |
| Foods, alcohols, and beverages .....                                      |                   | 6            |                   |          |              |             |
| Fæces .....   | 23                | 12           |                   |          |              |             |
| Petroleum and products, copra, and similar materials .....                | 1                 |              |                   |          |              |             |
| Sputum .....  | 4                 | 1            |                   |          |              |             |
| Urines, clinical and toxicological analyses .....                         | 20                | 15           |                   |          |              |             |
| Blood .....   | 2                 |              |                   |          |              |             |
| Miscellaneous chemical analyses and examinations .....                    | 33                |              |                   |          |              |             |
| Waters, chemical .....  |                   | 1            |                   |          |              |             |
| Waters, biological .....  |                   | 1            |                   |          |              |             |
| Photographic work .....   | 2,079             | 3,594        |                   |          |              |             |
| Natural-history specimens .....   | 1                 |              |                   |          |              |             |
| Shop work .....   | 151               | 179          |                   |          |              |             |
| Drafting .....  |                   | 74           |                   |          |              |             |
| Supplies .....  | 49                |              |                   |          |              |             |
| <b>Total .....</b>  | <b>2,530</b>      | <b>4,078</b> |                   |          |              |             |
| <b>Bureau of Secret Service:</b>  |                   |              |                   |          |              |             |
| Medicines and similar articles .....                                      |                   | 1            |                   | 1        |              | 3.00        |
| Urines, clinical and toxicological analyses .....                         | 2                 | 1            | 2                 | 1        | 28.50        | 3.00        |
| <b>Total .....</b>  | <b>2</b>          | <b>2</b>     | <b>2</b>          | <b>2</b> | <b>28.50</b> | <b>6.00</b> |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.  | Samples or units. |               | Cash work.        |               |                 |                 |
|--|-------------------|---------------|-------------------|---------------|-----------------|-----------------|
|  |                   |               | Samples or units. |               | Pesos.          |                 |
|  | 1918              | 1919          | 1918              | 1919          | 1918            | 1919            |
| <b>Bureau of Supply:</b>   |                   |               |                   |               |                 |                 |
| Metals and alloys.....   | 2                 | 1             |                   |               |                 |                 |
| Physical tests of wire, twine, fibers, textiles, paper, and similar materials..... | 1                 | 22            |                   | 22            |                 | 44.00           |
| Cements.....   | 4,858             | 6,700         | 4,858             | 6,700         | 4,832.10        | 7,877.45        |
| Paints and varnishes.....  |                   | 6             |                   | 6             |                 | 75.00           |
| Standardization and correction of units of measure.....                            | 2,590             | 808           | 2,590             | 808           | 241.70          | 426.40          |
| Miscellaneous inorganic analyses.....  |                   | 2             |                   | 1             |                 | 6.00            |
| Petroleum and products, copra, and similar materials.....                          |                   | 2             |                   |               |                 |                 |
| Linseed and castor oils.....   | 1                 |               |                   |               |                 |                 |
| Foods, alcohols, and beverages.....  | 20                | 25            |                   |               |                 |                 |
| Medicines and similar articles.....  | 2                 |               |                   |               |                 |                 |
| Miscellaneous chemical analyses and examinations.....                              | 2                 |               |                   |               |                 |                 |
| Waters, chemical.....  | 3                 |               |                   |               |                 |                 |
| Miscellaneous biological work and examinations.....                                |                   | 4             |                   |               |                 |                 |
| Vaccine virus.....   | 40,100            |               | 40,100            |               | 401.00          |                 |
| Miscellaneous serums and vaccines.....   | 12,358            | 25,251        | 12,358            | 25,251        | 91.90           | 125.25          |
| Supplies.....  | 1,667             | 207           | 1,667             | 207           | 722.30          | 207.30          |
| Tikitiki extract.....  |                   | 314           |                   | 314           |                 | 147.80          |
| <b>Total.....</b>  | <b>61,604</b>     | <b>33,342</b> | <b>61,573</b>     | <b>33,309</b> | <b>6,289.00</b> | <b>8,909.20</b> |
| <b>University of the Philippines:</b>  |                   |               |                   |               |                 |                 |
| Vaccine virus.....   | 370               | 12            | 370               | 12            | 37.00           | 1.20            |
| Fæces.....   | 534               | 400           |                   |               |                 |                 |
| Miscellaneous serums and vaccines.....   | 7,506             | 32,139        | 7,506             | 32,139        | 17.70           | 103.05          |
| Photographic work.....   | 1,273             | 989           | 1,273             | 989           | 311.92          | 187.17          |
| Natural-history specimens.....   |                   | 9             |                   | 9             |                 | 21.00           |
| Shop work.....   | 1                 | 2             | 1                 | 2             | 4.00            | 10.65           |
| Supplies.....  | 13                | 3             | 13                | 3             | 12.40           | 15.00           |
| <b>Total.....</b>  | <b>9,697</b>      | <b>33,554</b> | <b>9,163</b>      | <b>33,154</b> | <b>383.02</b>   | <b>338.07</b>   |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.  | Samples or units. |         | Cash work.        |         |        |        |
|--|-------------------|---------|-------------------|---------|--------|--------|
|  |                   |         | Samples or units. |         | Pesos. |        |
|  | 1918              | 1919    | 1918              | 1919    | 1918   | 1919   |
| <b>City of Manila:</b>   |                   |         |                   |         |        |        |
| Standard solutions<br>(in liters).....   | 51                | 24      | 51                | 24      | 199.27 | 92.00  |
| Miscellaneous organic<br>analyses and<br>examinations.....   | 3                 | 30      | 3                 | 30      | 10.00  | 116.40 |
| Miscellaneous biological<br>works and<br>examinations.....   | 2                 |         | 2                 |         | 5.50   |        |
| Blood.....   |                   | 3       |                   | 3       |        | 9.00   |
| Waters, biological.....  |                   | 819     |                   |         |        |        |
| Vaccine virus.....   | 300               |         | 300               |         | 3.00   |        |
| Miscellaneous serums<br>and vaccines.....  | 100,000           | 173,000 | 100,000           | 173,000 | 100.00 | 173.00 |
| Total.....   | 100,356           | 173,876 | 100,356           | 173,057 | 317.77 | 390.40 |
| <b>Provinces and municipalities:</b>   |                   |         |                   |         |        |        |
| Cements.....   | 11                | 1       | 11                | 1       | 51.00  | 13.75  |
| Standardization of<br>units of weight.....   | 6                 |         | 6                 |         | 9.00   |        |
| Clays, shales, lime-<br>stones, limes, wall<br>plasters, cements,<br>and slags.....  | 1                 |         | 1                 |         | 10.00  |        |
| Compression, ten-<br>sile, or transverse<br>strength of con-<br>crete, stone, mor-<br>tar, rope, iron and<br>steel, etc..... | 37                | 20      | 37                | 20      | 79.65  | 57.30  |
| Standardization of<br>road materials.....  |                   | 4       |                   | 4       |        | 30.00  |
| Medicines and simi-<br>lar articles.....   | 5                 |         | 5                 |         | 50.00  |        |
| Waters, chemical.....  | 3                 | 7       | 3                 | 7       | 130.00 | 105.00 |
| Waters biological.....   | 2                 | 2       | 2                 | 2       |        | 80.00  |
| Total.....   | 65                | 34      | 63                | 34      | 329.65 | 286.05 |
| <b>United States Army and Navy:</b>  |                   |         |                   |         |        |        |
| Metals and alloys.....   | 12                | 3       | 12                | 3       | 72.00  | 26.00  |
| Physical tests of<br>wire, twine, fibers,<br>textiles, paper, and<br>similar articles.....                                   | 7                 | 1       | 7                 | 1       | 14.00  | 4.00   |
| Cements.....   | 2                 | 11      | 2                 | 11      | 7.50   | 51.25  |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.  | Samples or units. |                | Cash work.        |                |                 |                 |
|--|-------------------|----------------|-------------------|----------------|-----------------|-----------------|
|  |                   |                | Samples or units. |                | Pesos.          |                 |
|  | 1918              | 1919           | 1918              | 1919           | 1918            | 1919            |
| <b>United States Army and Navy—Continued.</b>  |                   |                |                   |                |                 |                 |
| Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc ..... | 17                | 38             | 17                | 38             | 29.00           | 151.30          |
| Crude chemical and miscellaneous analyses .....  | 7                 |                | 7                 |                | 108.50          |                 |
| Standardization of units of weight .....   | 1                 |                | 1                 |                | 20.00           |                 |
| Petroleum and products, copra, and similar materials ...   | 9                 | 11             | 9                 | 11             | 122.00          | 51.00           |
| Linseed and castor oils  | 5                 | 3              | 5                 | 3              | 75.00           | 18.00           |
| Foods, alcohols, and beverages .....   | 10                | 10             | 10                | 10             | 84.00           | 62.00           |
| Waters, biological ...   | 2                 |                | 2                 |                | 40.00           |                 |
| Vaccine virus .....  | 83,201            | 31,272         | 83,201            | 31,272         | 1,815.10        | 985.20          |
| Mallein .....  | 188               |                | 188               |                | 188.00          |                 |
| Miscellaneous serums and vaccines .....  | 515,175           | 681,268        | 515,175           | 681,268        | 1,690.33        | 1,650.15        |
| Supplies .....   | 24                | 20             | 24                | 20             | 60.00           | 60.00           |
| <b>Total.....</b>  | <b>598,660</b>    | <b>712,637</b> | <b>598,660</b>    | <b>712,637</b> | <b>4,325.43</b> | <b>3,058.90</b> |
| <b>Miscellaneous:</b>  |                   |                |                   |                |                 |                 |
| Metals and alloys.....   | 33                | 11             | 33                | 11             | 937.95          | 127.00          |
| Clays, shales, limestones, limes, wall plasters, cements, and slags .....                                | 10                | 8              | 10                | 8              | 64.00           | 116.00          |
| Rocks, minerals, natural pigments, and similar substances .....  | 8                 | 38             | 8                 | 38             | 86.00           | 256.00          |
| Fertilizers .....  | 9                 | 24             | 9                 | 24             | 80.00           | 216.00          |
| Soils and similar substances .....   | 11                | 9              | 11                | 9              | 375.00          | 220.00          |
| Coal analyses .....  | 33                | 25             | 33                | 25             | 1,000.00        | 311.00          |
| Calorimetric tests of fuels .....  | 33                | 23             | 33                | 23             | 660.00          | 440.00          |
| Crude chemical and miscellaneous analyses .....  | 15                | 14             | 15                | 14             | 128.00          | 99.00           |
| Paints and varnishes   | 1                 | 8              | 1                 | 8              | 5.00            | 295.00          |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.  | Samples or units. |         | Cash work.        |         |          |          |
|--|-------------------|---------|-------------------|---------|----------|----------|
|  |                   |         | Samples or units. |         | Pesos.   |          |
|  | 1918              | 1919    | 1918              | 1919    | 1918     | 1919     |
| <b>Miscellaneous—Ctd.</b>  |                   |         |                   |         |          |          |
| Physical tests of wire, twine, fibers, textiles, paper, and similar articles.....                        | 131               | 6       | 131               | 6       | 100.00   | 21.00    |
| Standard solutions (in liters) .....   | 3                 | 11      | 3                 | 11      | 15.50    | 50.00    |
| Cements .....  | 17                | 170     | 17                | 170     | 109.50   | 738.50   |
| Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc. .... | 5                 | 44      | 5                 | 44      | 44.00    | 97.00    |
| Standardization and correction of units of measure .....   | 44                | 303     | 44                | 303     | 74.70    | 156.10   |
| Miscellaneous inorganic analyses.....  | 40                | 106     | 40                | 106     | 216.83   | 1,373.00 |
| Urines, clinical and toxicological analyses .....  | 257               | 227     | 257               | 227     | 791.34   | 725.06   |
| Essential oils and essences .....  | 9                 | 14      | 9                 | 14      | 58.50    | 104.00   |
| Petroleum and products, copra, and similar materials .....   | 444               | 493     | 444               | 493     | 1,889.50 | 2,715.00 |
| Linseed and castor oils .....  | 6                 | 16      | 6                 | 16      | 58.00    | 165.00   |
| Gums, resins, and similar materials.....   | 1                 |         | 1                 |         | 10.00    |          |
| Foods, alcohols, and beverages .....   | 161               | 118     | 161               | 118     | 702.35   | 805.67   |
| Foods, preservatives, and coloring matter.....   | 15                | 10      | 15                | 10      | 80.00    | 99.00    |
| Medicines and similar articles .....   | 4                 | 4       | 4                 | 4       | 48.00    | 113.00   |
| Miscellaneous organic analyses and examinations .....  | 22                | 347     | 22                | 347     | 315.00   | 780.10   |
| Assays .....   | 253               | 400     | 253               | 346     | 1,353.67 | 1,120.41 |
| Smelting and refining of gold .....  |                   | 320,798 |                   | 320,798 |          | 6,565.15 |
| Waters, chemical .....   | 9                 | 13      | 9                 | 13      | 161.00   | 128.00   |

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

| Customer.   | Samples or units. |            | Cash work.        |            |            |            |
|---|-------------------|------------|-------------------|------------|------------|------------|
|   |                   |            | Samples or units. |            | Pesos.     |            |
|   | 1918              | 1919       | 1918              | 1919       | 1918       | 1919       |
| Miscellaneous—Ctd.  |                   |            |                   |            |            |            |
| Waters, biological.....   | 6                 | 7          | 6                 | 7          | 112.00     | 198.00     |
| Fæces.....  | 416               | 246        | 416               | 246        | 1,466.97   | 952.32     |
| Sputum.....   | 72                | 55         | 72                | 55         | 204.38     | 160.00     |
| Blood.....  | 54                | 24         | 54                | 24         | 291.34     | 116.67     |
| Cultures.....   | 9                 | 2          | 9                 | 2          | 41.67      | 10.00      |
| Widal tests.....  | 4                 | 34         | 4                 | 34         | 12.00      | 101.00     |
| Wassermann tests.....   | 306               | 210        | 306               | 210        | 3,060.00   | 2,100.00   |
| Leprosy.....  | 8                 | 6          | 8                 | 6          | 23.00      | 16.00      |
| Urines, biological.....   | 32                | 11         | 32                | 11         | 117.00     | 31.00      |
| Gonococci.....  | 51                | 31         | 51                | 31         | 139.00     | 103.00     |
| Histological exami-<br>nations.....   | 7                 | 2          | 7                 | 2          | 70.00      | 20.00      |
| Rabies.....   |                   | 2          |                   | 2          |            | 10.00      |
| Miscellaneous biolog-<br>ical work and ex-<br>aminations.....                   | 22                | 10         | 22                | 10         | 149.00     | 134.66     |
| Vaccine virus.....  | 30,385            | 13,030     | 30,385            | 13,030     | 1,323.92   | 612.76     |
| Miscellaneous serums<br>and vaccines.....                                       | 921,184           | 1,680,674  | 921,184           | 1,680,674  | 6,966.07   | 8,872.85   |
| Photographic work.....  | 5,317             | 2,926      | 5,317             | 2,926      | 1,977.97   | 1,111.50   |
| Natural history spec-<br>imens.....   | 31                | 30         | 31                | 30         | 276.40     | 596.80     |
| Shop work.....  | 18                | 5          | 18                | 5          | 153.92     | 104.10     |
| Drafting.....   |                   | 11         |                   | 11         |            | 7.75       |
| Miscellaneous work.....   |                   | 6          |                   | 6          | 6,602.20   | 5,523.04   |
| Supplies.....   | 1,310             | 1,098      | 1,310             | 1,098      | 7,718.24   | 5,517.49   |
| Tikitiki extract.....   |                   | 485        |                   | 485        |            | 341.62     |
| Sales of publications.<br>Refunded, work not<br>done, etc. (deduct-<br>ed)..... |                   |            |                   |            | 5,194.48   | 5,399.27   |
| Power, gas, etc.....  |                   |            |                   |            | 28,163.24  | 40,923.05  |
| Total.....  | 960,806           | 2,022,145  | 960,806           | 2,022,091  | 73,246.64  | 90,393.87  |
| Grand Total.....  | 8,190,553         | 14,915,042 | 7,925,685         | 14,665,448 | 136,575.56 | 205,569.04 |

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1919 (January 1 to December 31, 1919) as compared with the fiscal years 1917 and 1918.

## EXPENDITURES.

| Items.  | Fiscal year.  |               |               |
|---|---------------|---------------|---------------|
|   | 1917          | 1918          | 1919          |
| Salaries and wages, etc.:   | <i>Pesos.</i> | <i>Pesos.</i> | <i>Pesos.</i> |
| Salaries and wages, including accrued leave .....                         | 218,161.41    | 213,396.23    | 229,600.39    |
| Bonuses .....   |               |               | 30,186.48     |
| Travel expenses of personnel .....  | 10,772.71     | 8,991.08      | 8,998.20      |
| Total .....   | 228,934.12    | 222,387.31    | 268,785.07    |
| Apparatus, supplies etc.:   |               |               |               |
| Consumption of supplies and materials, including sub-<br>scriptions ..... | 88,028.54     | 94,452.90     | 111,172.13    |
| Apparatus and equipment, including books .....                            | 13,449.10     | 19,761.31     | 20,134.81     |
| Total .....   | 101,477.64    | 114,214.21    | 131,306.94    |
| Miscellaneous:  |               |               |               |
| Rental of buildings .....   | 360.00        |               | 16.10         |
| Postal, telegraph, telephone, and cable service .....                     | 3,944.89      | 4,000.00      | 4,500.00      |
| Freight, express, and delivery service .....                              | 1,157.99      | 1,278.38      | 1,191.01      |
| Printing and binding reports, documents, and publica-<br>tions .....      | 25,000.00     | 34,725.00     | 27,000.00     |
| Illumination and power service .....                                      | 1,683.66      | 1,800.00      | 1,749.35      |
| Miscellaneous service .....   | 1,305.07      | 4,736.69      | 4,717.87      |
| Maintenance and repair of furniture and equipment .....                   | 4,200.00      | 1,752.27      | 2,092.24      |
| Total .....   | 37,601.61     | 48,292.34     | 41,266.57     |
| Grand total .....   | 368,018.37    | 384,898.86    | 441,358.58    |
| INCOME.   |               |               |               |
| Receipts from operation .....   | 81,456.29     | 130,054.47    | 198,258.97    |
| Sales of supplies .....   |               | 26.35         | 600.00        |
| Sales of fixed assets .....   | 1,524.42      | 6,244.67      | 5,028.96      |
| Other .....   | 1,688.74      | 250.07        | 1,681.11      |
| Total .....   | 84,669.45     | 136,575.56    | 205,569.04    |
| Appropriation account:  |               |               |               |
| Appropriated .....  | 381,810.00    | 433,120.00    | 525,930.00    |
| Allotted by the Emergency Board .....                                     | 28,000.00     |               | 2,500.00      |
| Appropriated by Deficiency Act No. 2783 .....                             |               | 20,725.00     |               |
| Brought forward for equipment .....                                       | 13,609.87     | 10,160.77     | 10,399.46     |
| Total .....   | 423,419.87    | 464,005.77    | 538,829.46    |

TABLE 3.—Comparative statement showing expenditures, etc.—Continued.

## MISCELLANEOUS ACCOUNTS (1919).

| Items.  | Available.    | Expended.     | Balance.              |
|---|---------------|---------------|-----------------------|
|   | <i>Pesos.</i> | <i>Pesos.</i> | <i>Pesos.</i>         |
| Tikitiki distribution, Acts Nos. 2376, 2714, and 2744 .....                                       | 11,345.14     | 6,404.21      | <sup>a</sup> 4,940.93 |
| Improvement of the Aquarium, Act No. 2494 .....   | 77.15         | -----         | 77.15                 |
| Replacement fund (Iloilo fire) .....  | 1,013.90      | -----         | 1,013.90              |
| Construction of Serum Laboratory, Act No. 2786 .....  | 200,000.00    | 3,841.45      | 196,158.55            |
| Publicity service for the Philippine Food Commission (al-<br>lotted by the Emergency Board) ..... | 1,738.80      | -----         | 1,738.80              |
| Preparation and free distribution of antityphoid vaccine,<br>Act No. 2743 .....                   | 3,922.95      | 1,954.29      | <sup>a</sup> 1,968.66 |
| Total .....   | 218,097.94    | 12,199.95     | 205,897.99            |

<sup>a</sup> Reverted to the general funds of the Government.



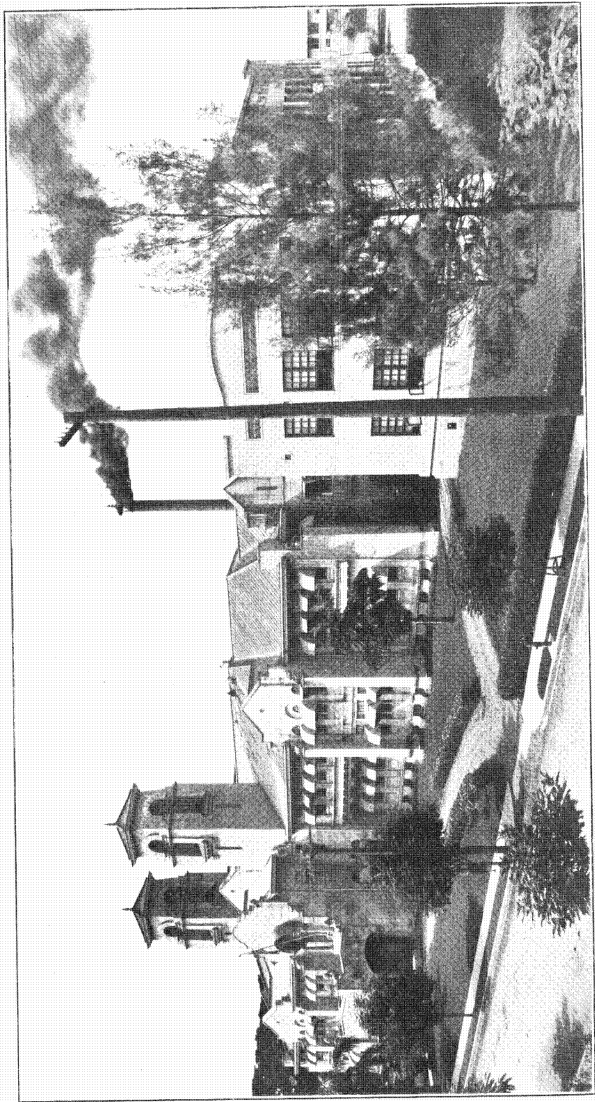
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