

QUARTERLY
BUREAU
OF
SCIENCE
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SEVENTH ANNUAL REPORT
OF THE DIRECTOR OF
THE BUREAU OF SCIENCE

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY
PAUL C. FREER
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING AUGUST 1, 1908



MANILA
BUREAU OF PRINTING
1909

SEVENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE.

DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, August 15, 1908.

SIR: The following report gives an account of the work performed in the Bureau of Science for the period from August 1, 1907, to August 1, 1908, together with such recommendations regarding future improvements as seem to me to be necessary.

The past year has been one of rapid development in a number of branches of the work of the Bureau of Science, and, as in 1907, the one which perhaps calls for greatest attention and the adoption of a permanent, carefully considered policy is that involving the relations between this Bureau and the Philippine Medical School. It is for this reason that a brief statement, somewhat more ample than the one in the previous annual report, regarding the growth of the latter institution and its clinics, is here given.

THE PHILIPPINE MEDICAL SCHOOL.

The first academic year of this institution closed on February 17, 1908. By this time the organization of the faculty and the clerical force had been completed so far as was practicable and the Director of the Bureau of Science could calculate fully the calls which would be made upon his staff in the development of the lectures and clinics and upon his stock of apparatus and supplies in furnishing other material absolutely needed to carry on the work before the equipment of the school would arrive.

The following members of the Bureau of Science are more or less actively engaged in the task of instruction: The Director, Doctors Musgrave, Marshall, Garrison, Ruediger, and Messrs. Vivencio del Rosario and Clegg; Dr. Strong was absent on leave during the greater part of the year, but assumed his duties as professor of tropical medicine upon his return. Doctors Gilman and Bean, in pathology and anatomy respectively, came from the United States as members of the faculty of the Medical School and are on the pay rolls of that institution. It soon became apparent that, unless instruction were to be merely perfunctory and if proper attention were to be given to lectures, laboratory

courses and clinics, the strain would be very great not only upon the members of the staff of the Bureau who are members of the faculty, but also upon the others who are not connected with the school but who are compelled to take the extra work brought upon them by the partial absence of so many of their colleagues. Despite this handicap, the work of the Bureau of Science was properly cared for and the laboratory courses in chemistry, anatomy, pathology and bacteriology, medical zoölogy and the clinical microscopy in the Medical School were soon organized and running smoothly, although some difficulty was at first experienced in procuring sufficient material for dissection and autopsy.

The clinical branches were somewhat more difficult to adjust. These required the organization of the dispensary, for which space had been obtained on the ground floor of St. Paul's Hospital, the adoption of a system of records and prescriptions for the patients coming to this clinic, the establishment of a pharmacy, the devising of a method of dividing the patients among the teaching staff and the externs and the preparation of regulations concerning the admission of patients to the free beds, paid for by the Government and controlled by the faculty of the school.

ARRANGEMENT OF THE CLINICS.

Funds for fifty beds for the clinical use of the school were furnished by Act No. 1679, and fifty more, supported by the city of Manila, were also available. This made one hundred beds to be divided between the chairs of surgery (including gynæcology and genito-urinary diseases), clinical medicine, tropical medicine, obstetrics, pediatrics and ophthalmology, otology and rhinology. It can readily be seen that this left but few available beds for each department of the work and made a careful adjustment of the needs of each chair imperative. It also rendered necessary the adoption of uniform hospital rules, case histories and records. The faculty, to meet these requirements, authorized the Dean to appoint a clinical committee, which consists of all the members engaged in clinical teaching, and a chief of clinics, who is chairman of the committee and who has charge of the general unification of the work, the admission of patients and the monthly certification to the chairman of the board of control of the number of beds occupied. Dr. Musgrave was appointed chief of clinics and as at that time, owing to the absence of Dr. Strong, he was also acting chief of the biological laboratory of the Bureau of Science, it is evident that his time was more than fully occupied, yet despite this fact he carried on research work successfully and prepared two papers for publication, one of which concerned a *Streptothrix* isolated from a case of Madura foot.

The organization of the clinics proceeded successfully and by the end of the year all causes of friction had been adjusted, although the

great need of good interns to be continually in the hospital was seriously felt. This lack throws additional work upon the staff, especially upon those who also have their duties at the Bureau of Science, as it necessitates repeated visits to the hospital after the official hours of the day are completed. The number of patients visiting the dispensary has increased from month to month almost without a break.

PHILIPPINE MEDICAL SCHOOL FREE DISPENSARY.

Statement of the number of patients visiting the clinic, by months.

Month.	Medical.	Surg- ical.	Chil- dren.	Obstet- rical.	Eye, ear, nose and throat.	Total.
1907.						
September.....	492	236	73	2	19	822
October.....	575	254	43	1	101	974
November.....	587	281	56	1	155	1,080
December.....	508	286	70	1	160	1,025
1908.						
January.....	573	324	45	0	221	1,163
February.....	577	331	37	0	223	1,168
March.....	605	361	43	0	265	1,274
April.....	494	326	43	0	251	1,114
May.....	413	301	44	0	179	937
June.....	620	388	83	0	221	1,312
Total.....	5,444	3,088	537	5	1,795	10,869

After the first few weeks the beds in the hospital were continually filled and now it is always impossible to accommodate all of the patients who apply. One fundamental need not only of the school, but also of the Bureaus which are engaged in the study of diseases as they exist in the Tropics, is for more hospital beds, but this can not be met in any measure until the new hospital, the plans of which are just finished, is completed, although possibly fifty more might be provided for by the next appropriation bill. When, for example, the chairs of clinical and tropical medicine are limited to from fifteen to twenty beds each, it is obvious that a great variety of diseases can not be studied, the instructors having to confine themselves to a few typical cases of the particular subjects they wish to discuss, to the exclusions of others. This is neither good for the general conduct of the hospital nor for the class work and it is certainly very detrimental to investigation.

Nineteen hundred and seventy-nine patients came under consideration as clinical material for the purpose of instruction, although classification of all the cases is not complete, as such a compilation of accurate and well-considered data will take much time, but the principal diseases among protozoal infections have been in part reviewed and were as follows: Amœbiasis occurred in more than 25 per cent of the patients and furthermore, lesions due to the action of this parasite were present in approximately 50 per cent of the autopsies of patients dying in the wards; hepatic abscesses were observed approximately eleven times

during the year; splenomegaly of various types has been a very common cause of admission but, although more than fifty splenic punctures have been made, the Leishmann-Donovan bodies have not been found. The tertiary lesions of syphilis and neurologic manifestations of the infection such as locomotor ataxia, paresis and others have been quite common. Malaria, with æstivo-autumnal fever predominant, has been the cause of admission in about 15 per cent of the cases; opisthorchiasis has furnished fifteen to twenty cases, paragonimiasis three, schistosomiasis a few; infection with *Tænia* were not very frequent, about twenty cases being observed, but unciniariasis was of course present in a large number of instances. Three exceedingly severe infections with *Strongyloides* have been seen, and in one instance these organisms were apparently the sole cause of death. *Ascaris*, especially *Ascaris lumbricoides*, is exceedingly common, particularly in children; *Oxyuris vermicularis* has also been met with a number of times.

This very brief summary, which is by no means complete, gives some idea of the variety of protozoal infection which the students have an opportunity to see. Bacterial infections, such as tuberculosis in its various forms, typhoid fever, pneumonia and others of course formed a large proportion of the causes of admission. The classification of the latter is not sufficiently far advanced to give an outline. However, it is apparent that ample material for instruction is at hand, that if more beds were available they would promptly be filled and that the clinics of the Medical School, besides the purpose for which they were arranged, in reality constitute a great charity.

The school has been compelled to buy a certain amount of surgical and other equipment for its clinics and has placed a number of microscopes at St. Paul's Hospital for the use of its students. All of this apparatus is properly marked and available in the new General Hospital.

CASE RECORDS.

The clinical work in the new General Hospital will constitute a continuation of that at present being carried on at St. Paul's, and it would be most unfortunate if the case records at present being compiled at the latter institution could not be transferred to the new one upon its completion. These records constitute a beginning of the great work of properly classifying and studying diseases in the Philippines and therefore the clinical committee has deemed it necessary to adopt a permanent form, adapted from the best practice in the hospitals of the world and modified to meet local conditions; the records kept on these blanks can be transferred when the time comes.

ASSISTANTS.

It became evident soon after the organization of the school that it would be impossible for the salaries offered to secure from outside the institution, the necessary assistants with proper training for the minor positions, and therefore with the beginning of the second academic year, the old places of demonstrators and instructors at salaries from 1,000 to 2,400 pesos per annum were abandoned and in their stead

three grades of student assistants were substituted: namely, student demonstrators at 480 pesos; first-class student assistants at 240 pesos and second-class student assistants at 120 pesos per annum. This system will need to be continued until we have graduates of our own who can take the higher positions of graduate instructors and demonstrators and who will have the proper training to advance upward in the ranks of the faculty.

RESEARCH IN THE MEDICAL SCHOOL.

Research work, apart from that more properly belonging in the Bureau of Science, has been going on in spite of the handicap brought upon the members of the faculty by the work of organization. Dr. Gilman, at first in conjunction with Dr. Marshall, afterwards alone, has already studied and published in the Philippine Journal of Science the results of one hundred autopsies and is well along on his second hundred, this series being the beginning of the compilation of data of great importance for a proper comprehension of the conditions which surround us. The chair of pathology and bacteriology has also undertaken the formation of a museum of pathology for the school. Material of much interest has already been gathered; it will be carefully studied and the results published as opportunity offers. Dr. Bean has finished his paper embodying the results of the measurements of more than 1,000 students (923 boys, 116 girls) at the University of Michigan and, as his time has permitted, has been actively engaged in completing the anthropometric records of 775 school children in the Philippines, 100 brain weights with measurements of the bodies and heads of Filipinos and 145 measurements of Igorots. Other studies which will throw light upon the race histories of the peoples of these Islands have also been undertaken. The Medical School is fortunate in having secured the services of an anatomist who also is familiar with anthropometric work, as a thorough study of the Filipino peoples conducted by a trained investigator will do much to assist us in our educational problems.

NUMBER OF STUDENTS AND REQUIREMENTS FOR ADMISSION.

The number of students enrolled in the Philippine Medical School is as follows: First year, 22; second year, 16; third year, 7; fourth year, 10; fifth year, 12; total, 67.

Some criticism has been expressed regarding the supposed leniency of the school in its interpretation of the entrance requirements at the present time. The attitude of the majority of the faculty on this subject is that the present hygienic conditions of the Archipelago imperatively demand at as early a date as possible as many reasonably well-trained native physicians as can be secured. It believes that the propaganda for advancing the mode of life of the provincial population, for the understanding of the *meaning* of the precautions to be taken by each

individual to prevent the spread of infectious and epidemic diseases and for the eradication of pernicious superstitions can only successfully be disseminated by natives educated in modern laboratory methods, who will explain the more recent ideas on the propagation of disease with the *conviction* that they are correct and not with the inward feeling that they are merely a mass of theories, more or less unreliable in emergencies, to be superseded at will by the older views and beliefs. It is true that possibly by waiting long enough we could procure for admission a sufficient number of entrants who would have all the preliminary training that could be asked of the candidates, but nevertheless, among those who at present gain admission with what may be called a liberal interpretation of the requirements, there will be a large percentage who can successfully complete the course, the others will fall by the wayside and in this way we will have gained a number of years. We have already waited too long in undertaking many of the permanent projects in the Islands. I do not wish to be misunderstood as saying that we have admitted students who in the face of the examination returns were obviously unfit to go on with the work. I mean to say that we have been sufficiently liberal to admit enough students to form a fair-sized class all of whom have *prospects* of being able to carry the work, without regard to the question of whether or not they have actually gained a graduation certificate from a high school or normal school. The standard will steadily be raised as the schools become able to supply *graduate* material, and at the same time the standard of the older, non-Government institutions in the Archipelago will be advanced to a point where they also can send us well-equipped students.

The conditions are not as they are in the United States or Europe. In those countries there are many excellent colleges or gymnasia which supply more than enough aspirants to the medical profession; even the smallest village has its doctor. It is different in the Philippines. The Government schools have slowly been working up to the point where they have prospects of graduating throughout the Islands in one year a sufficient number of students whose preparation may be considered as equivalent to that which we could expect at home. The private and ecclesiastical schools are laudably also endeavoring to increase their standard, and, while the plan of studies and mental training of their pupils may be different, still, if these pupils were to acquire a thorough knowledge of English and if methods of laboratory training could be advanced considerably, I can see no reason why they should not do as well in medicine as the others. Meanwhile, according to statistics available, there is but one physician to every 430 square miles of territory in the Philippines and many towns even of some importance not only do not have a resident doctor, but a physician may be lacking within a radius of many miles, in districts where transportation is often

difficult or impossible. It is the general opinion of the faculty that, so far, we have every reason to be satisfied with the intelligence, industry and progress of our students. Some, of course, have been dropped, but the majority will continue throughout the five years and ultimately obtain their degrees.

THE RELATION BETWEEN THE CLINICAL TEACHING AND THE LABORATORY WORK IN THE BUREAU OF SCIENCE.

I have entered thus fully into a discussion of the Medical School in a report of the Director of the Bureau of Science because the relations between the Bureau and the School are so inseparable that one can scarcely be considered without the other and because, in order successfully to advance both hospital and laboratory work and to accomplish what we should in regard to a study of diseases in the provinces, a comprehensive readjustment of the present plan, involving some additional expense will be necessary.

The work naturally divides itself into two branches, the one more strictly pertaining to the biological laboratory of the Bureau of Science, involving work in serum therapy and immunity, in helminthology, bacteriology, and pathology both in Manila *and in the provinces*, in the working out in the laboratory of problems first encountered in the clinics, in doing the diagnostic work for the hospitals and prisons, and in assisting the health authorities in every way to give a scientific and comprehensive basis to their measures of practical hygiene. This field, including the necessary laboratory teaching in the Medical School, is sufficiently great to occupy all of the time of the chief of the laboratory and his staff. On the other hand, we have the active work in the wards, the study of the clinical manifestations of the diseases which occur in this Archipelago and the frequent encountering of infections which have heretofore been unknown in the Philippines, or which may even be due to hitherto unknown pathogenic organisms. This work, as experience has shown, frequently involves extended laboratory study.

The conclusion is obvious. We should have a laboratory staff whose duty should primarily be to the biological laboratory, which should be able to devote all of its time to this work or to the teaching immediately connected with it and which should be sufficiently large to maintain some members in the provinces at all times, for experience has taught us that many conditions and diseases are encountered in the provinces which are unknown in Manila. However, this staff as a necessary condition to successful work, should have the privilege of entry to the clinical wards of the hospital to follow up and study any diseases which their laboratory studies prove to be worthy of extended investigation. The salaries and costs belonging to this portion of the work should obviously be borne by the Bureau of Science.

We must also have a clinical staff whose duties pertain closely to the needs of the patients in the hospital, to clinical instruction and to the investigation of diseases as they occur in the Philippines. The clinics would be fed not only by the incoming patients, but also by material sent in from the provinces by the laboratory workers. However, the clinical staff, to obtain full advantage of the conditions, should have space and apparatus always available in the laboratory, so that its members also could complete the studies of their cases and could fully understand new conditions. The students would have the dual advantage of hospital and laboratory, could early in their studies be taught the necessity of following out all the details of the investigation of their cases, and would thus gain the independent method of thought which will be so necessary for them when they are isolated in provincial towns.

The conditions at present are as follows: We have on the faculty of the Medical School members who are devoting their time exclusively to instruction and to research connected with their specialties, and whose salaries are met by the Medical School; we have others who are practicing their professions and who, also by appointment, hold clinical positions on the faculty, devoting a portion of their time to clinical teaching. The salaries of this class are also paid by the Medical School. We have a third class, the representatives of which belong to the staff of the Bureau of Science, who give a part of their time to the duties of the Medical School and a part to the work of the laboratory. Their salaries come from the Bureau of Science, but among the latter are some who are engaged, not in instruction in laboratory branches, but in *clinical teaching*, and who practice their profession as well. The result is not of the best advantage either to the Medical School or to the laboratory. The chief of the biological laboratory not only is engaged in teaching every Monday, Wednesday and Friday from 7.30 to 9 or 9.30 a. m., and every Tuesday, Thursday and Saturday from 10.30 to 12 m., but outside of these hours he must give some attention to the task of providing his clinics with suitable material and besides, with a number of hospital patients under his care, he must frequently return to the hospital later in the day. When, beyond this we allow some time for recreation and some for such outside government patients as he is compelled to attend, it is obvious that the biological laboratory and its investigations, among the most important undertakings in the Philippines, can have at best but a certain fraction of his time.

The second to the chief of the biological laboratory is not only professor of clinical medicine, but is also chief of clinics in the Medical School. He too, has long hours of clinical instruction, from 8.30 to about 10 a. m. Mondays, Wednesdays and Fridays, from 7.30 to 10.30 on Tuesdays and Thursdays, and from 9.30 to 10.30 on Saturdays; he must give considerable extra time to his clinical patients and after the official hours he also attends to his private practice. The result is that

he can give but few hours a day to his laboratory researches and the biological laboratory suffers in consequence. Even if both these scientific workers were to abandon all attention to outside patients, which at present out of regard to the community at large and with due consideration of the number of available practitioners in Manila, would be impossible, this sacrifice would not give the laboratory any more *actual service within the building*, it would only result in their being able to give more time to outside study and recreation and more thought to the work of the laboratory.

The biological laboratory is thus in the condition of having its two head men away for a good share of each day engaged in work which, while of course it is intimately connected with the laboratory, is not laboratory work *per se*. The younger men in the laboratory whose time is not so taken with other duties, need to be encouraged by word and example, they require advice in their work where advice is necessary, and correction where it is needed, and, above all, they should constantly be spurred on by the spirit of *work* and enthusiasm which alone builds up a scientific institution. The absence of their colleagues in the higher positions and the knowledge that it is not expected of them rigidly to devote their energies solely to the advancement of laboratory study does not tend in this direction. Above all, they need the object lesson of some extensive and fundamental piece of research being pushed forward by their superiors, whose wide experience and comprehensive viewpoint shows them how they too can develop great things.

It is unfortunate that the conditions of necessity are such that there seems no remedy for the present. The work of the school, once begun, must go on and we must use our best men in teaching and clinical work, but nevertheless it is distinctly my opinion that if we wish to obtain the results we imperatively need from the biological laboratory, a division with close union must be made. The clinical staff, with the privilege of private practice and also the right to laboratory space, apparatus and facilities should pertain primarily to the Medical School and hospital; the laboratory staff, without the privilege of private practice, belonging in the first instance to the laboratory, with the right to the clinical facilities of the hospital when these are needed to follow out their work. The entire body, clinical and laboratory, should form a united scientific unit, each member assisting the others to advance our knowledge of disease and prophylaxis in the Islands.

The additional cost to the Government would be the salaries paid to the clinical professors in the Medical School; the gain would be a biological laboratory which, without severing its clinical connections, would be able to devote all of its time to the problems which surround us and which can only be settled by laboratory investigation. These problems could be advanced at a rapid pace and as their understanding is fundamental in the hygienic regeneration of the Islands, the result

would be a saving of money. It may not be out of place to state that all biological laboratories, similar to ours, in Europe have hospitals connected with them and that *vice versa* all large hospitals conducted on modern lines throughout the world, have laboratories for the purpose of more extended clinical study. The latter condition has always been met by the Government, the former, so far as possible, but the founding of the Medical School has brought about conditions necessitating a much more absolute and intimate interrelationship.

THE ORGANIZATION OF A MORGUE AT THE PHILIPPINE MEDICAL SCHOOL.

The formation of the department of pathology and bacteriology in the Philippine Medical School rendered it necessary to transfer all of the general autopsy work to that institution. The school has a well-equipped morgue, screened against flies and insects, and with the members of the staff constantly accessible. Autopsies can be performed promptly and without the loss of time which formerly was a necessary incident to going to San Lazaro. I can absolutely see no objection to transferring the bodies of those dead of diseases dangerous to the community at large and communicable to this new morgue. It certainly, under Dr. Gilman's direction, is in better condition and better cared for than is the old one at the other end of the city. The spread of infectious diseases from a morgue depends upon the manner of construction of the building, the degree of discipline of the staff and the care and precautions taken. All of these conditions are met in the best way possible in the Medical School.

THE SECURING OF TRAINED MEN FOR THE BUREAU OF SCIENCE.

We have continued the policy of securing young men with proper fundamental training who have shown the ability to do good work, relying upon the ability of the more experienced specialists here to round out the knowledge and advance the technique of the later arrivals to the point where the latter also produce results in conformity with the traditions of the institution. However, we are in many instances confronted with the fact that in two years or more they find more attractive places elsewhere, just as they are accomplishing important work in the study of the conditions which we have to meet, or in the bacteriology or pathology of the diseases which it is necessary more thoroughly to understand to obtain the best results in prophylaxis. The investigations are therefore once more interrupted, to be again taken up by new men who must spend at least a year in becoming thoroughly familiar with the problems. A concrete example occurred this year in our losing Dr. Marshall who was called to the chair of pathology in the University of Virginia. Dr. Marshall has been in the Bureau two years and was in the midst of a most important investigation on the

morphology of a large number of strains of the cholera spirillum obtained from various sources and under different conditions, the research including the changes in the virulence, the variation in form and the relations between the individual cultures, all in connection with the occurrence of the disease in these Islands. A large part of the work is practically completed, Dr. Marshall having taken all but a synopsis of his results with him for the purpose of placing them in form for publication, but many questions in regard to this investigation remain to be answered and the work must be carried forward by new men who have not had the varied experience acquired by Dr. Marshall with these particular strains, nor his intimate contact with the conditions of the past two years; who have not heard the extended discussion of the problem which has been going on between the members of the Bureau of Science and Health and who have not had access to the large amount of necroscopy material which came under Dr. Marshall's hands.

An adequate system of pensions for service and the certainty of the permanency of the service and of future rewards for good work would be a financial gain in the end. Another relief it is hoped will gradually come about in the measure as we can obtain young Filipino graduates from the United States and from the Philippine Medical School, who shall step by step replace the present incumbents of the lower positions as vacancies occur. It must be clearly understood that this policy necessitates a somewhat *greater* expense in salaries paid by the Bureau while the substitutions are being brought about, as the young men will be just fresh from college, with no graduate experience and at the beginning without ability to work independently and to carry on investigations. For a year at least after their entrance to the Bureau they would be under the tutelage of the present incumbents and at smaller salaries, which would have to be met by appropriations; then, gradually they would work upward as they gained experience and as their talents warranted. The ultimate result will be that only a few, well-paid specialists with world-wide reputations shall remain at the head of the work of investigation, these to be associated in the routine and research by the rising younger generation of scientifically trained Filipinos. This seems to me to be the only means of continuing the progress of the laboratories in the future and of bringing them to a still higher plane of efficiency. We must always have a certain number of men who are recognized authorities in their specialities, who have the comprehensive and original point of view necessary for carrying on original investigations of great scope and who can be relied upon to obtain such accurate and far-reaching results that they will be of permanent benefit to the country and the world at large.

This Bureau is not like others, where one position leads naturally to the next above, through regular gradation to the highest. Each man on the scientific staff must be specially prepared and trained, in most instances he can not cross over to the other lines of work and must depend

upon advancement in his own particular branch. *Places are always available in other parts of the world for good, scientific men, and to retain our own we must make conditions which are favorable to them.* If a fund could be provided which could be used at discretion in advancing the salaries of specially valuable men, or which could be utilized in obtaining, even for a certain time, the services of certain well-known specialists from other institutions in order to carry on particular investigations which are deemed of great importance, the situation would be much relieved. We should certainly be in a position, when necessary or advisable, to call to the Islands some of the most prominent men of Europe or America.

It is unfortunate that this Bureau at least two years ago had no exact knowledge of the qualifications of the young Filipinos studying in America, nor any information as to how many were fitting themselves for our work, or how their laboratory courses were planned. This is especially so, as these young men are bound under contract to serve the Government for as many more years as they were supported by it in the United States. An early knowledge of the students who are preparing themselves for a scientific career in the United States would enable us, in conjunction with the Bureau of Education, to guide their work so that they would have training in those lines which we need. It is also true that no exact provision in the appropriation bills has been made for these returning graduates so that, when they reach the Islands, civil-service positions are not open to them, but they must be put on temporary employment depending upon the money available. It would seem to be necessary to provide each Bureau at an early date with exact lists of the young men preparing themselves in America, such lists to include all data as to the courses pursued, the grade of the work, the university in which it is being done and the time of the expected return of the Government students. By this means places could be provided in advance in each appropriation bill. This Bureau will next year, need to submit a number of such places for permanent adjustment.

It is hoped that the permanent committee of the Philippine Legislature will carefully consider the present needs and the future policy of the laboratory in such a way that a permanent plan for the future may be adopted and adhered to.

THE NEED OF BACTERIOLOGISTS FOR THE PROMPT EXAMINATION OF ARTESIAN WELL WATER.

The year showed a great increase in the demand for routine bacteriological examinations of waters from artesian wells. It seems evident that while the waters from this source are not free from organisms, yet they are so much better than the well, spring or river waters usually used for drinking purposes by the people, that the sinking of these wells marks an advance from a hygienic standpoint. The greatest difficulty still experienced is in the prompt transportation of samples of water to the

laboratory, the result being that the reports generally show a worse condition than really exists in the fresh water. A remedy for this difficulty would be found in the providing of salaries for one or two bacteriologists who should be engaged for the sole purpose of making cultures and such examinations as might be possible on the spot where the well is being sunk and who could then bring the cultures to the laboratory for study. The cost of this work could be spread over the charges for all artesian well work done during the year, and would therefore be met by the municipalities who had contracted for the wells. By this system the actual increased cost of any one well would not be great.

THE STUDY OF DISEASE IN THE PROVINCES.

Although the results in the biological laboratory for the past year have been gratifying, it nevertheless seems evident to me that we must endeavor so to arrange and increase our staff as to enable us to keep one or more field parties in appropriate places in the provinces, to study the broader and more fundamental problem of the geographical distribution of infections in the Islands. One source of material should be found in the diseased individuals periodically gathered together for the purpose of segregating the lepers to be sent to the Culion leper colony. The Director of the Bureau recently accompanied the Director of Health on one of his trips and as a result was able to bring to Manila two interesting cases of enlarged feet, one of them, who was not on superficial examination considered to be such, ultimately proved to be a leper. These trips are always conducted with the greatest celerity, so as to avoid the payment of more than is absolutely necessary for the charter of the vessel, but so fruitful is this means of studying diseases as they exist in the provinces, and so grave are the consequences of error in diagnosis, that it is hoped that arrangements can be made to give the pathologist detailed for this work from the Bureau of Science a greater opportunity to study the cases and also the means of bringing to the hospitals of Manila such individuals as urgently need attention and who would furnish material for further study. I am convinced that it is only a question of time when this course would produce the most valuable results, whereas the additional expense would not be very great and it would be far outweighed by the certainty of diagnosis and the knowledge which would be acquired.

THE RESULTS OF THE TRANSFER OF THE RINDERPEST-SERUM HERD TO THE BUREAU OF AGRICULTURE.

The plan which went into effect on January 1, 1907, of transferring to the Bureau of Agriculture the care and immunizing of the cattle used in the preparation of anti-rinderpest serum, whereas the centrifugating, filtering, bottling and testing of the serum are performed at the Bureau of Science, has proved itself to be an excellent one. Formerly, the bacteriologist in charge of the serum work needed to devote practically all

of his time to the routine connected with the herd of cattle and as a consequence could do but little in advancing the technique involved in the production, or in working out new methods of increasing the potency of the serum. The cost of the preparation of rinderpest serum is in the aggregate so great that it is distinctly a matter of economy to furnish ample means for investigation, as each improvement brings with it a resulting reduction in the charges. The increase in the potency of the serum by even one-fourth, would reduce the number of cattle necessary for turning out the same amount by just that much and would more than pay the salaries involved in the research.

One result in the past year has been that peritoneal washings are now employed in the immunizing of the serum animals, this procedure greatly reducing the cost of production and perhaps increasing the potency of the serum.

THE PHILIPPINE ISLANDS MEDICAL ASSOCIATION AND THE FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE.

The meeting of the Philippine Islands Medical Association for 1908 was attended by twelve delegates from foreign governments and the time was deemed to be ripe to form an association of medicine which should embrace all of the countries of the Far East. After the question had been thoroughly discussed, a constitution and by-laws were adopted which provided for biennial meetings in each of the component countries which would issue invitations, all the members of the regular medical societies within the zone of the organization, as well as representatives of the army, navy and civil medical corps of the government represented in the society, being eligible to membership. The first meeting of the association will be held in Manila in 1910, and a large attendance may be expected. The formation of this association marks a step forward in the consolidation of the scientific interests of the Far East.

THE NECESSITY OF PROVIDING FACILITIES FOR EXPERIMENTS ON THE HYBRIDIZATION OF SILK-WORMS AT THE LABORATORY.

The Singalong experiment station where the silk breeding house has been established, is to be abandoned by the Bureau of Agriculture within something more than a year and provision must now be made for providing sufficient mulberries at the new station to feed a considerable number of worms. However, when the future move is complete, it will be impossible for us to carry on hybridization experiments at such a distance from the laboratories as the location of the new station will be and as this work is of great importance, provision will not only need to be made on our own premises for a sufficient number of mulberry trees, but also for a silk house in which we can carry on experiments with several thousand worms. Indeed, the difficulty already experienced with the work owing to the lack of food is such that we can not keep enough

hybrid material on hand to enable us to make a sufficient selection for breeding purposes. The cost of a permanent silk house would be from 1,000 to 1,500 pesos and the Bureau will place a request for such a structure on the next appropriation bill.

One fact is evident. Without mulberry trees there can be no silk industry and it would be highly advisable if the Bureau of Education, through its division superintendents, would begin to encourage the planting of mulberry trees throughout the school districts as soon as the slips can be obtained. In a short time there would be many places in the Archipelago where silk culture should be possible and, as the outlay for buildings and equipment is not great, this should certainly be an industry which could be developed to large dimensions in the Philippines. Careful and systematic instruction in the care and feeding of the worms must be given, for if all precautions are not taken the latter soon deteriorate in size and even become diseased.

The entomological work in the Philippine Islands is at present carried on by only two men and when we consider how much more is spent on this important economic branch by other governments, we can only be surprised at the amount which has been accomplished in the Islands.

A BOTANIC GARDEN.

Many, if not all, of the countries of the Far East have established botanic gardens either directly in their principal cities, or at least within easy reach of them. The importance of such botanic gardens to the economic development of the countries in question can not be doubted and it is recommended that measures be taken at an early stage to establish a similar institution here. It would also be advisable, in coöperation with the municipal authorities, carefully to select the trees, shrubs and plants to be set out for ornamental purposes in the new parks now being laid out around the walls of the city. A very good botanic garden for purposes of instruction could be established without additional cost by this measure and it would also be useful to a certain extent for experimental purposes. An arrangement looking to this end could easily be made between the Insular and municipal governments before the work has progressed too far to render a botanical selection of the ornamental plants possible. The botanists of this Bureau would give their heartiest support to such a plan.

THE INCREASING USE OF CHEMICAL LABORATORY BY THE PUBLIC.

The public has made greater use of this division during the past year than ever before, the statistics showing 5,574 individual determinations for 1908 as against 3,064 for 1907. However, the mere comparison of numbers does not give an exact knowledge of the real significance of the development, the greatest gain lies in the increasing frequency with which persons interested in Philippine commodities come

to us for consultation in regard to the values and uses of the products of the Islands and in the growing confidence felt in the accuracy and justness of our analyses. It is always the custom, the world over, if a chemical result is not just what is expected, or if substances are found in a material which others maintain are not present, at once without thought to blame the analyst and maintain the unreliability of his results. Chemists are human, and consequently they err at times, but it must be remembered that it takes years of training to develop a thorough chemist, that the men in the laboratory are specialists who have been selected just because they have the necessary education successfully to carry on the work and that it may be safely assumed that when they make a statement this is very nearly certain to be a fact. That this is so is being realized in an increasing degree by the public, as their experience with laboratories grows and as they understand that a chemical analysis consists not merely in smelling of, or in looking at, a sample. The chemist is not gifted with second sight and can not state offhand of what a substance submitted to him really consists; the demonstration of its composition involves painstaking and often lengthy work.

A CENTRAL CEMENT TESTING LABORATORY.

In my past annual report I called attention to the desirability of uniting all cement-testing work in one laboratory, both for the purpose of securing greater uniformity of results and in the interests of economy. This change is gradually coming about without action on our part. The city of Manila is now sending to us all of their work and has turned over their apparatus to us, and the Bureau of Public Works is also doing the same. In the previous fiscal year we tested only about 24 samples, but in 1908 we have received over 1,200 in the past seven months. Only the Purchasing Agent, the port works in Manila and the Army and Navy at present do not send their cement work to the laboratory.

It has been proposed, and it is now feasible under the law, to make a charge for cement to all Bureaus, Departments and Offices, so proportioned that the total cost of operation would be divided by the number of samples tested and after thus fixing the price per unit, to bill to the various Bureaus their proportional amount according to the number of samples submitted. Under the conditions existing in the fiscal year 1908 we were not at liberty to charge Bureaus of the Insular Government, but only had authority to collect from the municipalities, the Army and Navy, with the result that, as the growing work necessitated the engaging of additional men, the greater proportion of the burden fell outside the Insular Government. If all were to unite in one laboratory, the cost per test would be as follows: 211 to 325 samples per month, 3.50 pesos each; 326 to 500 samples per month, 2 pesos each. The price per sample would increase rapidly with less

work, as the highest paid employees would need to be retained, a reduction in the pay roll being possible only by dropping part of the laborers.

Certainly, the average cost per sample, if enough were sent to the central laboratory for testing, would be sufficiently small to warrant more extensive and thorough tests of all cements purchased by the Government, and besides, although we would of course charge a certain profit to private persons, nevertheless contractors, importers and merchants could afford to take extensive advantage of the laboratory. It is hoped that we can make a positive advance in this direction during the present year and in order to prepare for the work, the Bureau has constructed a new cement-testing laboratory, using the building occupied by the former calf stable of the biological laboratory. This structure is admirably adapted for the purpose and we now have a cement-testing laboratory which is fully equipped for a large volume of work and equal to any demand which can be made upon it.

GENERAL TESTING MACHINERY.

It is intended gradually to enlarge the scope of this laboratory so as to include other facilities for testing. With this end in view we have already installed a machine for the testing of cloth, twine, wire, rubber and other lighter materials. The end of the building should be enlarged to accommodate a steel testing machine with a capacity of 100,000 kilos, which would cost approximately 10,000 pesos with all accessories. Rope and chain testing machinery could subsequently be added if necessary.

THE UTILIZATION OF PHILIPPINE FIBERS SUITABLE FOR PAPER-MAKING AND THE DESIRABILITY OF AN EXPERIMENTAL PLANT.

Mr. Richmond has finally finished his work on Philippine fibers and fibrous substances in relation to their suitability for paper-making, so far as our facilities will allow. However, all of our past work has been conducted on a very small scale. There seems to be no doubt, to judge from the numerous inquiries, that ultimately a great paper industry will be established in the Islands. The large supplies of the different classes of bamboos, grasses and other fiber producing materials and the diminution of the available supply in other parts of the world will render this necessary.

As a result of our investigations here and of those of the British in Burmah, it is certain that we have a number of raw materials which are entirely suitable for paper-pulp manufacturing. We have agitated the question of paper production in the Islands and have called attention to the possibilities of the industry here as fully as the means at our command will permit. The reason why no immediate development along the lines laid down by us has resulted, is that capitalists desire particulars of actual commercial practice, and not because the world's markets feel that the existing available supply is a permanent one.

Recent legislative attempts to regulate the wood-pulp tariff in the United States have been undertaken because of the decreasing supply of raw material and the increased cost of manufacturing wood pulp. The attention of paper-trade journals and of pulp manufacturers during the past year has been very largely drawn to the question of new and cheaper substitutes for wood. If it were feasible, the time would therefore be ripe for us to take steps in the direction of the commercial utilization of our fibers. Mr. Richmond has come to this conclusion because of his knowledge of the existing conditions in the paper world, because of information derived from his studies here and because the results already obtained, while they have attracted much attention, have not yet resulted in great industrial development. It is believed that the remedy would be found in our being able to make paper pulp on a larger scale.

The installing of a small plant of sufficient capacity to turn out 4 or 5 tons a week would not only provide us with an opportunity of making practical investigations of the pulping qualities of various materials, but it would also furnish sufficient pulp to supply paper-makers with enough material for the determination in their own factories of the commercial value of each variety. Different raw materials could be converted into pulp with the same plant and by the same process. The working qualities of many fibers can only be ascertained to the satisfaction of paper-makers by such practical trials. With proper facilities we could decide all questions asked by persons intending to put capital into the industry, before they venture upon it, and although the cost of production would be relatively high as compared with that of a factory with a large output, still a close calculation of manufacturing costs would be feasible. An expert, practical pulp maker and six unskilled laborers could carry on all of the ordinary operations. The plant would be as follows:

1 circular-saw outfit; 1 chaff cutter; 1 digester (2 meters in diameter, 2 meters high) suitable for digesting 1 ton of grass or bamboo; 1 breaking engine, for breaking and washing boiled pulp; 1 stuff tank (2 meters in diameter, 1.3 meters deep), for storage of washed pulp; 1 strainer for straining the pulp and removal of impurities; 1 wet-press machine for converting pulp into sheets; 1 baling press for packing sheets into bales for shipment; necessary shafting and gearing; 1 water tank and pump; galvanized-iron tanks, scales, sundries. If steam power is not available from a source already existing, there would be required in addition to the above; 1 vertical boiler, 100 horsepower; 1 steam engine, 100 horsepower. The estimated cost of the plant would be approximately 20,000 pesos; the labor, per year, about 6,500 pesos.

THE PRODUCER-GAS PLANT.

The question of installing a producer-gas plant is still an open one and the discussion of this subject is given in detail under the section of weights, measures and mineral analysis of the chemical laboratory. Our appropriation of 10,000 pesos was made for this purpose more than a

year ago, and Mr. Gilkerson, engineer of the Bureau, was detailed to the Bureau of Public Works to perfect working plans and prepare specifications for the construction of a plant at the Bureau by contract let in the islands. However, unfortunately, Mr. Gilkerson became ill and was compelled to stop work for about four months. In the meantime, so much new work accumulated in the Bureau of Public Works that undivided attention could not be given to this matter even after Mr. Gilkerson's return to duty. However, as the installation of producer plants is rapidly progressing in the United States, we attempted to get all the information possible from other sources. It must be confessed that this information has been somewhat meager. One firm has submitted an estimate on the entire plant, which is practically prohibitive at present; one producer for water gas and another for producer gas, together with the necessary gas holders being estimated at 28,000 pesos. This figure seems absurdly high, in view of the estimated cost of what we can build a similar plant for here.

One fact seems to be evident. It will not be economical to burn producer gas under our present boilers to produce steam. This we always knew to be the case, but we supposed it could be done with Philippine coal at no greater expense than if we burned Australian coal directly, but in view of careful study in the light of recent work it seems doubtful if we could keep steam up with producer gas. Producer gas operating a gas engine directly is the only economical means and the only way of fairly demonstrating the method and as we will inevitably need a spare engine when the new hospital and medical school are operated from one plant, it is only reasonable to add the cost of a gas engine to that of the producer and to operate under the best conditions for Philippine coal. The question of the type of gas engine to be employed would therefore also come under consideration. A gas engine certainly needs less attention and smaller outlay than one operated by steam.

We are still endeavoring to obtain data from various manufacturers in the United States, as we wish to make no mistakes when we actually begin constructing the plant and in the meantime, as opportunity permits, we will try to push our own plans to completion. One thing is certain—when the new hospital and Medical School are completed, we shall need an additional supply of good illuminating gas for laboratory purposes and it is not economical further to enlarge our present system. One producer would therefore be operated for making water gas, while the other would be used for producer gas and as water gas would not be rich enough for laboratory purposes, it can be improved most economically by mixing it with a certain amount of gas from our present system. This would solve the problem of an ample and cheap gas supply for laboratory purposes. We have thought of installing regular gas retorts and of making gas from coal directly, but it seems

evident that the care and repair of a battery of gas retorts would be so great in a small plant as to render the plan not feasible.

The importance of utilizing Philippine coals in the most economical way, the object lesson which a good producer plant would supply and the undoubted fact that, once one were to be in successful operation, others would follow, warrant the expense even though we would ultimately find that we would need more money than the sum allowed and although we certainly will need a gas engine directly coupled to a new electric unit as well. The question is even of sufficient importance to warrant some one visiting the United States to obtain the necessary exact data which can not be learned at this distance.

THE IMPORTANCE OF INVESTIGATING THE PRODUCTION OF PHILIPPINE SUGAR IN THE FIELD.

The importance of the sugar question to the Archipelago is so great that it would be advisable to provide funds for at least two years to place a regular laboratory staff of at least three chemists with a man who has made sugar chemistry a life study at the head, in the field. Such a man could be obtained for a limited period, although work of this kind is in great demand in other sugar producing countries.

THE DEVELOPMENT OF THE WORK OF FOOD AND DRUG INSPECTION.

Mr. H. D. Gibbs, formerly chief chemist of the San Francisco board of health, was engaged to take charge of the laboratory work in connection with the food and drugs investigations in August, 1907, and the Bureau has profited greatly by his extended experience. It soon became evident that if the samples which were sent to the laboratory were to have even reasonably prompt and careful attention, more assistants would be needed. As a consequence, Mr. Francisco Ageaoli, a graduate of Cornell University, recently returned from the United States, was given an appointment and placed in the food laboratory. It was also the policy of this Bureau when the work was first organized, to assist in every way by assigning certain of the samples to others whenever they had time to spare, but this did not result successfully, first, because the fragmentary character of such work necessarily greatly decreased its efficiency and what is more important, increased the chances of error, and second, because the additional detailed work made necessary by this system occupied so much of the time of the chief of the chemical division that he was unable to carry on any experimental investigations himself or to give proper attention to the many other important problems with which he was concerned. Another factor also soon presented itself. Careful work in the examination of foods and drugs demonstrated that many of the present analytic methods adopted by official chemists were either imperfect or else needed revision in the Philippines, for nearly all products of this nature which

reach the Islands have been subjected to long voyages in the holds of vessels where they are not only exposed to high temperatures, but also to continuous agitation. However, any such revision of methods to be of value to ourselves requires not only much painstaking work but it also necessitates a research knowledge of the principles of organic and inorganic chemistry such as is not usually possessed by men trained for analytic work. Foods and food products are complex substances and even individual chemical bodies contained in them are subject to decomposition and also to synthetic changes.

A concrete example is to be found in certain imported articles in which oil of wintergreen is used as a flavor. Such articles reach the Philippines with a considerable content of free salicylic acid, although we are confident in many cases that no such preservative has been added by the manufacturer. The reason for its presence is to be found in hydrolysis under the conditions surrounding the product. The determination of the rate of hydrolysis of methyl salicylate and kindred substances both in acid solution and in the presence of alkalies (including carbonates and bicarbonates) becomes necessary before the fact as to whether salicylic acid has been *added* to the product as a preservative, can be ascertained. Another case is to be found in the separation of morphine and codeine, for the reactions and consequently the quantitative estimation of the former alkaloid are obscured in the presence of codeine. Therefore, the correction of the methods now in use becomes imperative and such corrections necessarily involve extended investigations.

The cases here cited are only instances of many more which have arisen within the past year and would in themselves keep the time of one investigator fully occupied without giving any consideration to the problems of native food products and imported Chinese and Japanese medicines, the labels on the containers of which latter are in a foreign language, their composition at present being entirely obscure.

These experiences have shown us that we can accomplish but little that is permanent and absolutely reliable in this important branch of the laboratory work unless the policy is pursued as rapidly as possible of greatly strengthening and enlarging its scope. With this end in view, it should be made a division of the Bureau, the chief of which must be a thoroughly experienced man with a broad scientific training, who should devote his time exclusively to the investigation of the problems which arise daily and to the overseeing and checking of the work of his subordinates on whom the routine work of investigations and analysis would fall. The chief of this division should receive a salary sufficiently large to insure his remaining a number of years, as the value of his services greatly depend upon his specific knowledge of the conditions which surround this work in the Philippines and such knowledge can only be gained by experience. With such an organization the *quality* of the work will be of the best and the *quantity* will only depend upon the number of assistants the government is willing to authorize. The commercial interests involved, the value of the imports which are held

awaiting decision and the losses which result from the rejection of any shipment are sufficiently great to warrant the expense of the best type of organization.

The expansion of this work, apart from the limits imposed on it by the amount available for salaries, is also greatly hindered by lack of space. We are practically now at the limit of our available room for chemical work in the laboratories, as so much of the space designed for this purpose has necessarily been turned over to other divisions of work and so the development in the division of foods and drugs must be accompanied by corresponding enlargement of the building. The wing which has so urgently been advocated in the past therefore becomes doubly necessary. Until this addition is constructed, a very great increase in the number of chemists engaged in the analysis of foods, food stuffs and drugs will not be feasible, although the organization proposed above can be perfected and so no time be lost when future expansion is possible.

THE PHILIPPINE MUSEUM.

The Bureau of Public Works, in April of this year, finally removed all of their stores from the ground floor of the building which we have obtained for museum purposes, and as soon as this was done, the plan at once suggested itself of enlarging the scope of the museum and of utilizing a part of this space for an exhibition of woods and other collections relating to forest products and also of the natural and agricultural resources of the Islands. This space needs extensive repairs as it always has been used as a warehouse, and is dark and unsightly, but the sum of approximately 12,000 pesos will not only place it in proper condition but will also provide about ten large museum cases of the best pattern. Bids have already been advertised for this work. This plan has the hearty coöperation of the Bureau of Forestry and the latter will assist both with funds and exhibits.

It should be realized that we have in this museum the nucleus of a great national undertaking, and it should be fostered accordingly. The present exhibit is already a very good one and the possibilities of development, when we consider the great diversity of peoples and the variety of products in the Philippines, are without limit. As soon as cases are available all divisions of the Bureau of Science whose work makes it possible, will assist in preparing good specimens and such funds as can be spared by the Bureau for the purchase of museum material will be utilized. However, although the building we now have is a fairly large one, it being of two stories and about 150 feet long by 50 feet wide, it is evident that in a very short time all available space will be taken if we wish to have a representative museum of the greatest value to the people. Moreover, the location is far from desirable. It is in the business portion of the city where visitors from abroad seldom come, it is not a structure which *per se* would attract the stranger and

it is at a great distance from the other buildings of the Bureau of Science. Another fact should be emphasized. Such development as the museum can expect must at present be due solely to the meager funds available on the regular appropriation of the Bureau of Science, and to gifts and exchanges.

The undertaking is of sufficient importance to have an appropriation set aside for its own specific uses, to acquire materials, to engage especially qualified persons to gather special exhibits and above all to render feasible the proper organization of the commercial section, mention of which was included in my last annual report. A proper commercial exhibit, with which should be combined a far-reaching center of exact commercial information, would be of the greatest value in the development of the Islands.

One plan I believe should be inaugurated as soon as possible in connection with the museum, and that is a survey from a standpoint of material development of each province of the Archipelago. To take a concrete example, the photographer of the Bureau recently made an extended trip to La Laguna Province, where he obtained excellent views of all of the industries carried on in that portion of the Islands. This set includes coconut plantations, oil production, furniture and hat making, roads, people and methods of transportation. Properly to utilize such a collection, a study of Laguna Province should be made, such a study to include the area under cultivation and the available uncultivated land, the value of such land for agricultural purposes, the value of the chief products grown in the province, the means of improving the present methods of production, the quality, quantity and price of labor, the forest products, mineral waters, water power, transportation, scenery, public health, cattle and beasts of burden—in short everything of interest in the material development of this district. When all these data are properly brought together they should be published with the series of views above referred to. Gradually, step by step, we could thus go over the various provinces of the Archipelago and by this means give accurate and complete descriptions which would be used as a basis for the plans of all who are interested in this portion of the world. The existing provincial officials, the school teachers, the Constabulary and other members of the Insular Government could lend their assistance to this work, but the first, fundamental prerequisite is to have some one man make a preliminary survey in each province, organize the work, provide for the shipping to the laboratories of materials for investigation and for the collecting and sifting of the various reports which are received. Obviously also, the museum, if this plan were carried out, would receive rapid accessions from all parts of the Archipelago.

It would seem advisable now to consider the construction of a permanent building for museum purposes. Probably the cost could in

part be met by a sale of the present structure on Calle Anloague, which is admirably adapted for business purposes. It is hoped that the permanent committee of the legislature will study the present museum and consider not only plans for its healthy growth and the increase of the staff devoted to this work, but also plans for its permanent future. It seems unfortunate that in the past so many collections which are difficult to duplicate have left the Islands.

A FLOATING LABORATORY FOR THE WORK ON FISH AND FISHERIES.

The importance of thoroughly studying our marine resources and industries has been brought forward in the past annual reports and need not be repeated. The work this year has demonstrated that we have been much handicapped by lack of proper facilities in the field. A consultation with some of the staff of the United States ship *Albatross*, detailed for fishery investigations in Philippine waters, has only confirmed me in my belief that the most economical and at the same time adequate means of marine exploration consists in constructing properly equipped scows which should contain living quarters, a small laboratory, aquaria, pumps, a diving outfit, sail boats, a naphtha or petroleum launch and all necessary accessories. Such a scow or scows could be anchored in favorable, sheltered locations and the work could be systematically prosecuted from them. When a district is thoroughly surveyed the floating laboratory can be towed to some other place and so, step by step, the exploration of the field completed. The central laboratory and collections at Manila would form a basis in which to work up materials as they came in. The results already obtained certainly show that the work in fish and fisheries should be fostered, that this branch should be made a division of the laboratory and that a larger staff and adequate facilities should be provided. An aquarium in Manila would greatly aid in the work and add to public interest, and it seems reasonable to recommend that the proposed new wing mentioned in my last annual report be so extended as to include not only an aquarium for the public but also laboratories for marine biological investigation. At present the plans for the structure contemplate only a rather large museum room with limited space for laboratory work in connection therewith.

THE DEVELOPMENT OF THE LIBRARY.

The library is the point around which the work of the divisions of the Bureau centers, but it is gratifying to note that during the past year, especially because of the establishment of the Philippine Medical School, a growing tendency has been manifested by others, not connected with the Bureau of Science, to make use of its facilities. It has been the endeavor from the beginning to give to the Government of the Philippine Islands a well-rounded, *working*, scientific library, and the present condition of this division of the Bureau demonstrates that

this mission is being fulfilled. Certainly, as we add new sections of work, we find weaknesses which must be corrected, this has naturally been the case this year in the branches of ichthyology and marine biology, in anthropology, paleontology and geology, and the additions which we needed to purchase even reasonably to meet the wants of these specialties, have increased our book orders considerably. However, the library as it now stands represents an enormous amount of labor, both in obtaining complete sets by purchase and in arranging for gifts and exchanges. Its value is correspondingly large and so great has been our success in completing series of books, that it is safe to say that the collection could not be duplicated within a period of time many years longer than that which has elapsed since the beginning of the Bureau. It must also be remembered that this library must inevitably form the nucleus of the scientific library which will need to be established in connection with the new University.

Shelf room will be approximately fully occupied by about 1910 or 1911 and the necessity of enlarged quarters will arise. This necessity can either be met by providing room in the proposed new wing for the photographer and the Director of the Bureau, thus giving us two more rooms for library purposes, or by putting the library itself in the new wing, reserving the present space for collections. The latter plan would be preferable, as we could thus furnish fireproof quarters, directly accessible from outside to the public, which now has to come through the laboratory building and up stairs before it can have access to the books. The Government should earnestly and seriously consider the great value of this library and its necessary function and should form some definite plans as to its future expansion.

THE PHILIPPINE JOURNAL OF SCIENCE.

The plan of issuing the Philippine Journal of Science in three sections has been most successful, and has encouraged subscriptions and exchanges. Each section has six numbers to the year and we had an ample amount of good material to fill the Journal. A system of editorials on topics which were not ordinarily printed from the laboratory and other institutions has been begun with Volume III, and will be continued. The editing of the Journal in three sections has necessarily thrown much work on the Director, although he has been cordially assisted by the members of the staff, as an effort must constantly be made to keep up the standard and to supply good editorials, and with the growing work of the Bureau it is becoming more and more difficult for him to give the necessary time. We have secured the services of a thoroughly trained stenographer and typewriter, who is familiar with the foreign languages, to take over the copying and make up of the Journal, and this move has given considerable relief, but nevertheless the editorial work will always be a great task where attention must be given to so many outside details. A number of monographs have been submitted

on ethnological subjects which are of too comprehensive or too specifically technical a nature to be placed in the Journal and these have been published as a continuation of the series of the Ethnological Survey. One of these, Dr. Saleeby's History of Sulu, will be of especial interest to the public and its sale will show how successfully we can enter upon publications of that class. There seems no doubt but that we can regularly edit and publish volumes of general interest to the Philippines and it would be in the interests of economy to organize a regular division of work to take charge of the proof reading, advertising, mailing and the work in general of bringing before the public our Journal, and the other publications which are issued. The success of any such enterprise consists largely in judicious advertising and with our present force, as we have no one regularly to assign to the work, this is far from satisfactory, nor do we obtain the results that we should.

The number of subscribers to the Journal is 234; and the number of exchanges 357.

THE PROPOSED NEW WING OF THE LABORATORY BUILDING.

The urgent necessity for an addition to the present Bureau of Science building has been pointed out in previous annual reports. As each year passes and the work of the Bureau continues to expand, the need of such space becomes more and more evident. The library will soon have all of its shelf space filled. The herbarium has now completely occupied one room and some cases have been placed in another; the entomological collection is practically at its limit; the collection of fishes takes a large part of the room devoted to pathologic exhibits, and when identified specimens return from the United States there will be no place to put them; the division of mines has not been able properly to extend its work because of lack of floor space and when Dr. W. D. Smith, now on leave in Europe, returns with his collection of identified paleontologic material we will be hard put properly to accommodate it. Further expansion of the chemical laboratory is also practically impossible without vacating some of the laboratory rooms used for other purposes. These collections are now so valuable and of such fundamental importance for scientific work in the Islands and also for the development of the Philippine University that I hope the appropriation for the construction of a suitable wing will not be delayed beyond the next session of the Legislature. It would be well, at the same time, to consider the advisability of building the structures necessary for the Philippine Museum in connection with this wing.

THE BIOLOGICAL LABORATORY.

THE STAFF.

A few changes have occurred in the staff during the year. Dr. Edwards resigned March 12, 1908, and Dr. Teague was appointed to fill his place on June 27. Dr. Vernon L. Andrews was also appointed

an assistant in the laboratory to fill a long existing vacancy and sailed from the United States for Manila on June 23.

It seems necessary again to point out the difficulty and the long delays experienced in securing well-trained and capable men to accept positions in the biological laboratory for the salaries at present offered. Several of the large research laboratories in the United States are able to offer higher salaries to competent men than those appropriated for the laboratories here; hence the difficulty arises of securing capable men to accept positions in a tropical country where the risks to life and to health are greater and the financial remuneration not much more or even less than in the United States.

Dr. R. P. Strong, chief of the biological laboratory, was absent from Manila for the greater part of the year, and during that time the laboratory was under the direction of Dr. W. E. Musgrave. Almost the entire time of Dr. Strong's vacation was spent in connection with the study and development of laboratory work and of tropical medicine. The most important scientific institutions in Milan, Berne, Paris, Munich, Leipzig, Vienna, Dresden, Berlin, Hamburg, London, Liverpool, Oxford, Cambridge, New York, Boston, Baltimore and Philadelphia were visited and their work examined into. Particular attention was paid to the several foreign schools of tropical medicine and studies in connection with this subject were performed, particularly in Hamburg and in northern Africa and India. In all of these scientific institutions, much courtesy was shown to Dr. Strong and much valuable information and material obtained. It is hoped that this Bureau will in the future have an opportunity in return to receive visitors from the same institutions and to render in turn all possible assistance during their stay in the Philippines. Many valuable pathologic specimens, etc., were secured which will be of great value in connection with the work of the Medical School.

Dr. Strong attended the Fourteenth International Congress of Hygiene in Berlin in September, and reported upon the subject of protective inoculation against plague. In addition, in accordance with instructions from the Governor-General and the Philippine Commission, he acted as delegate for the Government of the Philippine Islands at this congress. The annual Natur-Forscher Versammlung in Dresden was also attended. Much valuable information was obtained from these meetings. The hygienic exhibition was particularly instructive and furnished an excellent opportunity for the observance of progress in scientific work and particularly of all new forms of laboratory apparatus.

ROUTINE WORK.

The most important change in the routine of the laboratory has been the transfer of the general autopsy work to the Philippine Medical School, and now the bodies of all individuals for autopsy, except those who have died of acute infectious diseases, are removed to the Medical

School morgue for examination. However, this laboratory still undertakes the diagnosis and autopsy of all acute infectious diseases. As during the previous year, considerable time has been spent in work in connection with the suppression of the cholera epidemic and the methods employed in the bacteriologic diagnosis of the disease, the preparation and furnishing of cholera immune sera for diagnosis and the prophylactic inoculations have been fully described by the chief of the laboratory in the Philippine Journal of Science for October, 1907, page 413.

During the cholera epidemic, a systematic analysis of the waters of sewers and esteros was made with a view of determining whether the spirillum of Asiatic cholera was present in the water of any of them and hence whether these waters were an important factor in continuing the epidemic. Forty analyses of the waters of esteros were made during the month of January, and the cholera organism was demonstrated three times. Since then these infected sewers and esteros have been investigated repeatedly with negative results. From time to time there was isolated from the esteros a number of spirilla which morphologically resembled *Spirillum cholerae asiaticæ*. Some of these were not pathogenic for guinea pigs and did not liquefy gelatine. Some of the other spirilla isolated, which resembled the cholera organism in many of their cultural properties, possessed multiple flagella and did not show characteristic reactions with cholera immune sera. They were not regarded as being cholera vibrios. The reaction of the organism upon ordinary cholera media was found to be one of the least satisfactory methods of differentiating the different strains of cholera spirilla. The serum reactions are considered to be the most reliable means we at present possess for the diagnosis of the true cholera organism.

Nine excursions through various provinces of the Islands have been made in company with a representative of the Bureau of Health for the bacteriologic diagnosis of leprosy cases. In all, 1,875 individuals were examined and in 1,571 a positive bacteriologic diagnosis of leprosy was established.

A number of valuable additions have been made to the pathologic museum during the year. Among these may be mentioned excellent specimens of gangosa, mycetoma and Kala azar and many of the animal parasites. The museum has been completely catalogued and indexed, and constitutes a valuable adjunct in the study of tropical pathology.

Many bacteriologic examinations of water from various Bureaus of the Government and from different sources have been made during the past year; for example, for the Bureau of Public Works, which sent in a large number from artesian wells; for the Bureau of Health, including those from sewers and esteros, and bottled mineral waters, lemonades, etc. Several examinations of water from artesian wells for the United States Army were also performed. Complete bacteriologic examinations were

made of several waters from sanitary resorts in the Islands; among these were those of the water of Sibul Springs. While no protozoa were found present in the latter, it was established that it possessed no substances which retarded bacterial growth in any manner. If the water is to be bottled for sale for drinking purposes, thorough sterilization before bottling will be necessary.

Owing to the lack of transportation facilities the samples of water sent from the provinces for examination were frequently delayed and often several days elapsed before they reached the laboratory. Perhaps largely on this account very few provincial waters, from a bacteriologic point of view, were potable. However, in a few cases, notably an artesian well in the Province of Bulacan and one sunk by the United States Army at Fort McKinley, the water proved to be excellent for drinking purposes, both from a chemical and bacteriologic standpoint. In regard to the waters in general from the artesian wells it may be stated that while many of them could not be considered potable from a bacteriologic standpoint, it seems probable that the high bacteria counts in the majority of them were dependent chiefly upon the method of collecting the samples and in the delay in their reaching the laboratory. The waters sent for examination from the artesian wells were far superior from a bacteriologic standpoint to any others received from other drinking sources.

PUBLICATIONS AND INVESTIGATIONS.

Owing to the fact that seven of the staff of the laboratory have been engaged in teaching at the Philippine Medical School during the year, less time has been available for research work. However, the hospital of the Medical School has furnished much valuable material for scientific investigation to several of the laboratory staff.

The following researches have been completed by the laboratory during the year and have been published:

Studies in Plague Immunity, by Richard P. Strong; The Recent Trend of Immunity Research, by Harry T. Marshall; Infant Feeding and its Influence upon Infant Mortality in the Philippine Islands, by W. E. Musgrave and George F. Richmond; Gangosa in the Philippine Islands, by W. E. Musgrave and Harry T. Marshall; The Investigations carried on by the Biological Laboratory in Relation to the Suppression of the Recent Cholera Outbreak in Manila, by Richard P. Strong; Yaws: A Histologic Study, by Harry T. Marshall; The Etiology of Mycetoma, by W. E. Musgrave and M. T. Clegg; A Series of Cases of Tropical Infantile Dysentery with a Hitherto Undescribed Bacillus as the Causative Factor, by Fred B. Bowman; An Investigation of the Quantitative Relationships Between Agglutinin, Agglutinoid, and Agglutinable Substance, by Y. K. Ohno; Peculiar Cases of Traumatism of Internal Organs, Some Due to Tropical Conditions and Practices, by Maximilian Herzog; The Influence of Symbiosis Upon the Pathogenicity of Microorganisms, by W. E. Musgrave; Studies of Cholera, by Harry T. Marshall; A Biologic Study of the Water Supply of the Philippine Islands, with a Description of a New Pathogenic Organism, by Ralph T. Edwards; Filtration Experiments with the Virus of Cattle Plague, by E. H. Ruediger.

SERUM SECTION.

The work in connection with the care and immunizing of the cattle used in the preparation of anti-rinderpest serum, which was transferred to the Bureau of Agriculture January 1, 1907, has been continued by that Bureau throughout this year. The Bureau of Agriculture sends to the Bureau of Science, in sterile bottles of five liters capacity each, all serum after it has been separated from the clot. This serum is centrifugated, filtered, bottled and tested for sterility at the Bureau of Science. At intervals of about three months, the potency of the serum is determined at the laboratory on non-immune bullocks. Nearly all the time of one assistant is occupied in centrifugating, filtering and bottling the anti-rinderpest serum. However, it is hoped that many of the difficulties in this work will soon be overcome by the arrival of a large centrifugal machine carrying ten liters of fluid and by the arrival of another large filtering apparatus which will more than quadruple the facilities of the laboratory for carrying on this work. It is the intention of the Bureau to attempt the centrifugation of fresh, citrated anti-rinderpest blood and it is hoped that by this process the volume of serum obtained from each animal will be greatly increased.

VACCINE VIRUS.

The preparation of vaccine virus has been continued steadily throughout the year and no difficulty has been encountered in supplying the demand. During a slight epidemic of variola in Manila, variola material was transformed into variola vaccine or vaccine virus, in April, 1908. After having been passed through five calves, twenty-two persons were vaccinated with the material. Twelve were secondary vaccinations and ten were primary. All but one gave positive results, and aside from a slight generalized eruption resembling varioloid in one case, no bad effects followed. Since the month of May the strain has been regularly used in the preparation of vaccine virus with good results, the material from the fifth calf is still being used as stock virus.

BACTERIAL VACCINES AND PROPHYLACTIC SERUMS AND MISCELLANEOUS PRODUCTS OF THE LABORATORY.

Cholera prophylactic, plague prophylactic, gonococcus vaccine, *Staphylococcus aureus* vaccine, *Staphylococcus albus* vaccine and *Staphylococcus citreus* vaccine were prepared in moderate quantities. Anti-diphtheritic serum, anti-tetanic serum, anti-cholera serum, anti-typhoid serum, anti-plague serum, and anti-dysenteric serum, were made in amounts sufficient to supply the demand. Anthrax vaccine, tuberculin, both human and bovine and mallein were also prepared. Typhoid reagent, paratyphoid reagent and cholera reagent (killed cultures) for agglutination, were continually kept on hand. Agglutinating and bacteriolytic serums in

liquid and dried form for the purpose of the diagnosis of infectious diseases, normal horse serum, normal ox serum, and normal carabao serum, have also been added to the list of preparations of the laboratory.

INVESTIGATIONS OF THE SERUM SECTION.

The study of the etiology of rinderpest was carried on by Dr. Ruediger, but so far its causative factor remains unknown. It was found that the infectious material present in the blood of the sick animal does not pass through any of the ordinary Berkefeld filters, while that from the peritoneal washings obtained with 0.25 per cent potassium citrate solution passes through all the Berkefeld but does not pass through the Chamberland filters.

Having found the peritoneal washings of sick animals to be highly virulent, these washings were employed in immunizing serum animals, which has greatly reduced the cost of production of anti-rinderpest serum, since a larger amount of virulent material for immunization may be obtained from a single animal. The cost of this serum has been further reduced since it has been shown that the time of immunization of the serum animals may be shortened without decreasing the value of the serum.

ENTOMOLOGICAL SECTION.

Mr. Banks was occupied during the entire year mostly with systematic and economic work on *Culicidae* or mosquitoes. The importance of mosquitoes in the transmission of fevers among mankind has made it more than ever necessary to work out, first, the systematic classification and second, the life histories of *Culicidae*. Several new species of the former family were discovered. The results of the investigations with reference to malaria-mosquitoes were published in the Philippine Journal of Science, Volume II, No. 6, page 513, under the title "Experiments in Malarial Transmission by Means of *Myzomyia ludlowii* Theob."

Reports of an outbreak of malaria in Lepanto-Bontoc came to the knowledge of this Bureau at the beginning of the year 1908. Mr. Banks was sent to this province for the purpose of determining if possible, the species of mosquitoes transmitting the disease. The result obtained was to the effect that a supposedly purely salt-water mosquito (*Myzomyia ludlowii* Theob.) was found breeding in river water and was the cause of the malarial transmission at this place.

Mr. Banks left Manila on May 15. Arrangements have been made for him to visit the British Museum during his vacation and several other foreign institutions on the mainland of Europe for the proper identification of several thousand specimens belonging to the laboratory collection.

Numerous questions relating to field crops destroyed or attacked by insects were investigated during the year. One of the entomologists

was sent to study the damage in each instance, to learn its nature and to provide means to correct and prevent the pestilence.

For a long time efforts were made to secure from the United States bumblebees for the purposes of fertilizing the red clover which had been introduced into the mountain districts of Benguet Province. It was found that although this variety of clover thrives very well in this region, it never produced any seeds for the reason that it is fertilized by a special kind of bumblebee; hence it was thought necessary to introduce this insect from the United States. The experiment proved an extremely difficult one in view of the fact that the bees had to be shipped in cold storage. In December, 1907, an excursion was undertaken to Benguet Province in connection with this work. As yet no report can be made as to whether the bees have thrived in their new habitat.

Several years ago efforts were made to introduce silkworms into the Philippine Islands with a view of establishing a new industry. There were many difficulties to overcome, the main drawback being the scarcity of mulberry trees (*Morus alba* Linn.), the leaves of which constitute the natural food of the silkworm. A few old specimens of trees were found in Manila and from these the Bureau of Science, in cooperation with the Bureau of Agriculture and the department of sanitation and transportation of the city of Manila, made cuttings and finally succeeded in obtaining a sufficient number of plants to carry on silkworm experiments to a moderate degree. Every effort was made during the year to advance the experiment. The first silkworms were introduced from Ceylon in February, 1907, several previous efforts having failed. In Ceylon the form of *Bombyx mori* Linn. produces seven generations in a year, but Mr. Schultze has succeeded in raising eight and a half generations in Manila and by careful selection has been able to keep them alive to the fifteenth generation without the introduction of new blood. As the Ceylon silk of this multi-voltine species is inferior in grade to the silk of the Japanese mono-voltine variety, it was thought worth while to attempt to improve the grade of the silk, but at the same time not to reduce the number of generations to any considerable extent. With this end in view, Mr. Schultze has carried on extensive experiments in hybridization and has succeeded in securing much better cocoons with reference to general shape, color and quality of silk, the only drawback being that the mono-voltine character of the Japanese variety seems to be dominant. For this reason only one-tenth of the hybrid eggs will hatch at the regular time of the multi-voltine Ceylon species. This difficulty could more easily be overcome if selection could be made from more hybrid material.

Therefore, if the establishment of a silkworm industry in these Islands is to be considered, it will be advisable to carry on experiments in hybridization on a much larger scale. One thousand cocoons of the Ceylon variety give about 50 grams of good silk, the same number of hybrid

cocoons will give about 80 grams of silk. The price of silk per pound of this quality ranges from 5 to 8 pesos, Philippine currency, in the foreign market according to the quotations from large silk firms of the United States obtained through the Bureau of Insular Affairs.¹

The services of a Japanese woman were secured in October, 1907, to teach a Filipina girl the reeling of silk; subsequently the Bureau engaged a Filipina girl, who will be able to give instruction outside.

In December, 1907, a disease among silkworms in Nasugbu was reported to the Bureau, but on investigation it was found not to be serious, but was due to neglect on the part of the caretaker.

A large amount of routine work, such as recording, mounting insects, drawing, rearranging the collections, etc., has been performed by the section of entomology. Information relating to insects injurious to sugar and other economic plants was furnished to the Bureau of Agriculture and in relation to the destruction of locusts, to officials of several provinces.

During the entire year systematic collecting has been very much neglected; in fact, the laboratory depended solely on private collectors, members of the Bureau of Forestry and others. The only opportunities for collecting by the laboratory staff were during the few days spent in the field on other investigations and on Sundays and holidays. In October, 1907, the Bureau of Science secured a student from the Manila High School to help on the routine work.

At the present time the quarters of the section are extremely crowded and as unidentified specimens do not take so much space as identified and classified material, the laboratory has become more and more cramped as time goes on. With the return of the material taken away by Mr. Banks, it will be necessary to increase the number of insect boxes at least 50 per cent.

The following investigations have been completed during the year:

Experiments in Malarial Transmission by Means of *Myzomyia ludlowii* Theob., by Charles S. Banks; New and Little Known Lepidoptera of the Philippine Islands, by W. Schultze; Life Histories of Certain *Coleoptera*, by W. Schultze; A Mosquito which Breeds in Salt and Fresh Water, by Charles S. Banks; Biology of Philippine *Culicidae*, by Charles S. Banks; Life Histories of Some Philippine *Cassididae*, by W. Schultze.

THE BOTANICAL SECTION OF THE BIOLOGICAL LABORATORY.

Mr. Elmer D. Merrill was absent from the Philippines on leave for the greater part of the past fiscal year, having left Manila on May 23, 1907, returning March 15, 1908. During his absence he spent two

¹ It may not be out of place here in conjunction with the results obtained in our silkworm experiments, to quote the first sentence of Toyama summarizing the results of his experiments: "Of the various characters of the silkworm, some strictly follow Mendel's law of heredity while others are governed by other laws. The color of the cocoon and the egg and the various larval markings belong to the former category and the shape of the cocoon and the *brood-characters* such as *uni*, *di* and *multi-voltine* etc., to the latter."

months in Washington, working over the Philippine material in the United States National Herbarium and about one week at the New York Botanical Garden, going over matters pertaining to Philippine botany. Later he studied a few Philippine types at the Gray Herbarium, Cambridge, Massachusetts. He received authority from the Philippine Commission before leaving Manila to return via Europe, and accordingly he left New York on October 22, arriving in London a week later, and remaining in that city until January 7th, examining the types of Philippine species in the Kew Herbarium and at the British Museum. From London he proceeded to Berlin, with a single day's stop at Leyden to examine some of Blume's types. Mr. Merrill then stopped in Berlin and worked at the Botanical Museum for two weeks; thence he went to Geneva, staying one week in the latter place studying various types in the DeCandolle Herbarium, the Boissier Herbarium and the Herbarium Delessert. He visited Florence after visiting Geneva, doing some botanical work there and sailed for Hongkong from Genoa.

All of the work of the botanical laboratory and herbarium devolved on Dr. Foxworthy during Mr. Merrill's absence, the former having been in charge of the botanical work for nearly ten months. Dr. Foxworthy, having no assistance, necessarily spent much of his time in routine work, but nevertheless he succeeded in finishing and publishing a valuable paper on the histology of the most important Philippine timbers, and made considerable progress on the taxonomy of Philippine Gymnosperms and *Casuarinaceæ*.

Mr. Merrill, while in Washington, received directions from Manila to search for an assistant in the botanical work, and after a thorough consideration of the situation, the place was offered to Dr. C. B. Robinson, of the New York Botanical Garden, who accepted the position as economic botanist, and arrived in Manila March 4, 1908. Dr. Robinson is thoroughly fitted for the position, having devoted much of his time for the past two years to the extensive Philippine collections made by R. S. Williams for the New York Botanical Garden, and accordingly has a large knowledge of Philippine plants, so that he need lose no time in acquainting himself with the local flora. Owing to Mr. Merrill's absence, a great amount of work had accumulated upon Dr. Robinson's arrival, and so in the beginning he has largely been engaged in systematic studies, but he will take up economic work as soon as conditions warrant that course of action.

Dr. Foxworthy left for Singapore and Borneo shortly after Mr. Merrill's return, he being authorized to make extensive investigations on the vegetable resources of Borneo, with the special object of correlating as far as possible Philippine and Borneo timbers. He will also devote some time to the questions of the production of the various resins, of rubber and to the tanbark industry.

ECONOMIC WORK.

Although systematic work has predominated during the past year, as in previous ones, one of the ultimate objects of the botanic work, the economic side, has not been lost sight of. More attention can be given to this branch, but economic investigations without a thorough knowledge of the names and relationships of the plants considered would not be of lasting value. Material, including tanbarks, rubber-producing vines, perfume-producing plants, gums, resins and medicinal plants, has been collected in bulk, as in preceding years. The chemists of the Bureau have begun investigations with much of the material so secured, and some important papers have been published by them. Dr. Robinson has studied and reported upon a disease of sugar cane which has appeared in Laguna Province and which is caused by the smut *Ustilago sacchari*, and has recommended measures to hold it in check. These measures have been applied with excellent results in the regions where the smut is known to occur.

Dr. Copeland has continued his work on the bud-rot of the coconut, which has assumed serious proportions in the Provinces of Laguna and Tayabas, this work having been done under the Bureau of Education, but in connection with the Bureau of Science. Dr. Foxworthy has devoted as much time as possible to the histology and classification of Philippine commercial timber.

SYSTEMATIC WORK.

The systematic work accomplished during the past year has been very extensive and many papers have appeared in the botanical section of the Philippine Journal of Science, others of a systematic nature are either in press or in course of preparation. One piece of work on the Philippine plants gathered during the Wilkes expedition, was written by Mr. Merrill while he was in the United States, and during his visit to London, together with Mr. R. A. Rolfe of the Kew Herbarium, Mr. Merrill prepared a joint paper on the results secured after examining the Philippine material in the Kew Herbarium.

THE HERBARIUM.

The Herbarium has been augmented as rapidly as in past years. The total number of accessions for the fiscal year ending June 30, 1908, was 15,132, this being slightly less than the amount recorded for the preceding year. The accessions are as follows:

Collection of the employees of the Bureau of Science.....	1,791
Collections of the employees of the Bureau of Forestry.....	4,012
Miscellaneous Philippine collections	3,397
Foreign material, received in exchange.....	5,932
Total	15,132

The employees of the Bureau of Science made comparatively small collections. This was largely because of Mr. Merrill's absence which left only Dr. Foxworthy in Manila. The miscellaneous Philippine accessions include Philippine plants received in exchange, as gifts, and for identification, and include 650 specimens collected by Mr. Elmer, 1,430 from the Williams Philippine collection, received from the New York Botanical Garden, 187 of Lohrer's Philippine plants from the United States National Herbarium, 104 of Cuming's Philippine plants, from Kew, and Mrs. Clemen's Mindanao collection, about 875 specimens.

The foreign exchanges sent to us during the past year have been most valuable. Besides the exceedingly important material mentioned above under miscellaneous Philippine accessions, valuable Formosan specimens have been received from the Botanical Institute of the Imperial University, Tokyo; Australian material from the Botanic Garden, Sydney, and especially large collections from the Royal Botanic Gardens of Berlin and the Museum of Natural History, Paris. A large number of miscellaneous specimens from the Indo-Malayan region, many of them from old collections, as well as about 300 numbers of Volken's more recent Caroline Island collection, were included in the material from Berlin, and that from the Paris Museum contained a large series of plants collected in southern and Indo-China by Gaudichaud and Gallery, Indian specimens collected by Jacquemont, as well as a number of Wallich's numbered Indian plants. A considerable amount of Hooker and Thompson's Indian material was also included.

The total number of mounted specimens in the Herbarium is 61,045, of which 39,163 are Philippine and 21,882 are extra-Philippine.

EXCHANGES.

No general distribution of duplicates has been made in the past year, although some material has been sent to specialists for study or for purposes of identification. This is as follows:

Murrill, W. A., New York Botanical Garden, fungi.....	625
Brotherus, V., Helsingfors Finland, mosses.....	123
Stephani, F., Leipzig, Germany, <i>Hepaticae</i>	53
Radlkofer, L., Munich, Germany, <i>Sapindaceae</i>	31
Engler, A., Berlin, Germany, <i>Araceae</i>	40
Hieronymus, G., Berlin, Germany, <i>Selaginella</i>	30
Diels, L., Berlin, Germany, <i>Menispermaceae</i>	20
Ames, O., North Easton, Massachusetts, <i>Orchidaceae</i>	306
Total	1,228

All of our mounted material of *Eria* and *Dendrobium* has been sent to Dr. Fr. Kränzlin of Berlin to assist him in his monograph of the two genera, all of our *Zingiberaceae* have been forwarded to H. N. Ridley, Director of the Botanic Garden, Singapore, for study, while about 50 specimens of palms have been packed for shipment to Dr.

Beccari, Florence, Italy. Our *Piperaceae* are ready to be sent to C. DeCandolle, Geneva, Switzerland, who plans to prepare a monograph of the Philippine representatives of this difficult family.

COÖPERATIVE WORK.

Cordial coöperation still holds with employees of the Forestry Bureau, the Bureau of Agriculture and the Bureau of Education. Numerous identifications have been made for the Forestry Bureau, while various employees of the Bureau of Agriculture have come to recognize the necessity of the collection and accurate identification of plants of economic importance. Dr. Copeland, of the Bureau of Education, has continued his active work on fern flora of the Philippines.

This laboratory is in close relationship with various botanical institutions in America, Europe, India, China, Japan and Australia, the exchanges previously arranged have been completed and new ones provided for, with the most beneficial effect upon the growth and value of our herbarium, which has become one of the largest in the Far East. While Mr. Merrill was in Europe he made the personal acquaintance of many of the leading systematists, not only of those who previously had made identifications for us, but also of others who have agreed to undertake work on the Philippine flora as soon as material can be supplied to them. Because of the work which is being accomplished here, and with the coöperation of many of the leading specialists of the world, rapid progress is being made in classifying the flora of the Philippines, so that even at this date the Philippine flora in many respects is better known than that of any other part of the Malayan region.

Manila more than ever has become the center of work on Philippine botany. When Dr. Robinson was appointed to the position of economic botanist in this Bureau, the Director of the New York Botanical Garden informed Mr. Merrill that his institution would do very little more on the Philippine flora, and consequently he has sent for determination to the Bureau of Science through Dr. Robinson, all the unidentified material represented by duplicates in the Williams Philippine collection.

RECOMMENDATIONS.

The present crowded condition of the herbarium room is too well known to the authorities to require much mention, but additional space should be provided as soon as possible. With financial support equal to that of the past year, the botanical work can be prosecuted with rapidity, but, if possible, provision should be made for the employment of an artist to make drawings of new or especially interesting Philippine plants, which should be issued with descriptive matter in the form of *Icones*, similar to *Icones Bogoriensis*, or Hooker's *Icones Plantarum*.

SECTION OF THE BIOLOGICAL LABORATORY FOR THE COLLECTION OF
NATURAL HISTORY SPECIMENS.

Since his return from Camiguin Island in July, 1907, Mr. Richard C. McGregor has been engaged on work in Manila. The greater part of his time has been devoted to the preparation of manuscript for a manual of Philippine birds, the first part of which is completed and the second and final section is under way. Nine papers on Philippine ornithology were published by him in the Philippine Journal of Science and four others have been written, but have not yet appeared in print. A start has been made on material for a bibliography of Philippine ornithology. A revised price and exchange list of bird skins has been printed.

Mr. Andres Celestino, the only assistant in this division, has made collections in northern Mindanao, in Siquijor, and in Bulacan Province, Luzon, securing 402 specimens of birds and a few insects, mollusks and mammals.

Valuable additions to the bird collection have been made by exchange with the British Museum and the Menage Collection, and by gifts from the Secretary of the Interior, Mr. Alvin Seale, Chaplain Joseph Clemens, and Mr. William Edmonds. The number of bird specimens added during the year is 843 and the total number of birds in the collection is now 7,946.

More than during any previous year this section has been able to afford assistance to students who are not connected with the Bureau of Science. Large collections made by Chaplain Joseph Clemens in northern Mindanao were received on deposit and partly identified; they were finally removed by their owner. Dr. Edgar A. Mearns spent considerable time in the Bureau identifying his collections from various parts of the Archipelago and was afforded every possible facility in the use of specimens and literature, as well as storage room for his collections, until he removed them on his return to the United States. While in Manila, Dr. Mearns prepared two papers on birds which were published in the Philippine Journal of Science. Two papers contributed to the Journal by the Secretary of the Interior were based in part upon material in the collection of this division. Dr. R. W. Shufeldt was furnished with osteologic material for his paper on *Sarcops calvus*, which was printed in the Journal. Several small lots of skins were identified for Major John R. White of Palawan.

THE CHEMICAL LABORATORY.

PUBLICATIONS AND INVESTIGATIONS.

It has been the endeavor to keep several members of the chemical staff continuously engaged on problems of economic importance to the Philippine Islands, and a more systematic division of the routine work of the division and increased facilities both in equipment and the number of

workers, has allowed us to do this. The past year has shown a decidedly greater advance in the important field of economic investigation than the previous ones.

Mr. Richmond, upon his return from leave on November 1, began a systematic study of the so-called Manila copal or *almaciga*. Comparatively little is known of the Manila copal of commerce, except that it is undoubtedly of vegetable origin and is collected in Malayan regions. Much confusion exists in the literature and in the trade regarding this important product. At the present time varnish manufacturers, who are the great consumers of this commodity, have to depend largely upon the different systems of grading practiced by oriental shippers and they in turn must contend with the indiscriminate mixing of good, bad and indifferent varieties as practiced by native collectors.

Two natural orders of resin-producing trees, namely, the dipterocarps and conifers, are found widely distributed in Philippine forests. The product of the former is collected as a fresh exudation from the tree, while the resin from the latter is obtained in a semi-fossil state from beneath the surface of the ground and constitutes the class of resin known and exported from the Philippines as Manila copal or *almaciga*. However, the greater portion of the Manila copal of commerce is finally shipped from Singapore and is said to be derived from both dipterocarps and coniferous trees, while the resin known commercially as dammar is believed to have a similar origin.

It is hoped that the work undertaken in this laboratory will aid in clearing up the confusion which at present exists in regard to the identity of these gums and in establishing a better system of commercial grading, thus promoting the exportation and intelligent utilization of these intrinsically valuable products.

The work on Philippine oils and their sources, undertaken by Messrs. Richmond and Mariano Vivencio del Rosario, has continued throughout the year as time and material were available. The preliminary paper on this subject appeared in the Philippine Journal of Science for December, 1907. In this connection and in conjunction with the Bureau of Agriculture, the feeding value of certain oil cakes and seeds as ingredients in compounding native stock feeds is being studied, and large amounts of analytical data on extracted copra cake, kapok-seed meal, and some hemp-seed meal have thus become available to the Bureau of Agriculture.

Dr. Bacon has continued his studies on several of the native resins and two collecting trips were made during the year. "Brea," the soft resin of *Canarium luzonicum* A. Gray, is known on the world's market as Manila "*elemi*." It contains 15 to 20 per cent of terpenes, which formed the basis of Dr. Clover's investigation mentioned in the last annual report and which was published in the Philippine Journal of Science for 1907. These terpenes can be used for many of the same purposes to which ordinary turpentine is applied, but they are also of such a character as

to offer great possibilities in the manufacture of more valuable products, such as perfumes and drugs. Their application in this direction is being studied by Dr. Bacon and his initial paper on the subject appeared in the Philippine Journal of Science for April, 1908. The residue, after distilling the terpenes, is a brilliant, light-colored resin which should prove valuable in the manufacture of varnishes. The quantity of "brea" available in the Philippines is such that if valuable uses can be found for it, it will be one of the principal secondary products from the forests.

Rather extended studies have been made of ylang-ylang oil by Dr. Bacon and a method of analysis has been developed, so that the quality of an oil may now be determined from the safe basis of chemical and physical analysis rather than from the more uncertain judgment of smell. For the first time, the methods of manufacture of this oil have been published and better methods of distillation and of handling the flowers have been indicated.

Several other essential-oil bearing plants have been examined. The common grass root called in Tagalog "moras" (*Andropogon squarrosus* L. f.) has been distilled and a 1 per cent yield of vetiver oil obtained. Another *Andropogon* species which has been studied is the common lemon grass (*Andropogon citratus* DC.) The plant grows well in most parts of the Islands and between 0.2 and 0.3 per cent of a good grade of oil has been distilled from Philippine material. Plots of grass from different sources were planted in the Singalon experiment station and the grass from measured pieces of land is now being harvested and distilled, so that figures on the yield of oil per hectare in the Philippines will be soon available. While it can not as yet be stated whether great profits may be expected from the industry, still it is certain that lemon grass would prove attractive enough to be used as a catch crop for coconuts or hemp, to which it lends itself well because of the quick returns and small capital necessary for its utilization.

The fruit of *Pittosporum resiniferum* Hemsl., commonly known as petroleum nut, was found to yield 3 per cent of heptane, a very valuable oil for cleaning delicate fabrics, and 7 per cent of pinene,² the oil employed in the manufacture of artificial camphor. Boneol, a near relative of camphor, has been isolated from *Blumea balsamifera*, and fragrant oils have been distilled from the leaves of *Lantana camara* Linn. and from the bark of *Cinnamomum mercadoi* Vid. Other tropical perfume plants are being studied.

Work has been carried on during the year in conjunction with Mr. Gaña on the mangrove barks, with the idea of utilizing the immense supply of these substances in the leather industry. Results thus far obtained show that the Philippine barks average from 17 per cent of

² Since the above was written, the supposed pinene has been shown to be a reduced terpene, C₁₀H₁₈.

tannin for those collected in Mindoro to 24 per cent for those from Mindanao. United States forestry statistics show that mangrove tanbarks and more particularly their extracts are coming into general use in competition with oak and hemlock barks, for tanning purposes. With free entry into the United States of tanning extracts manufactured from Philippine mangrove barks, the outlook for a new industry is very promising.

Studies on the starch and alcohol production from a number of Philippine plants have shown that several of them promise to be of considerable economic importance. The cassava plant yields 25 to 26 per cent of fermentable matter. Other starch-producing plants which show value are *Tacca pinnatifida* Forst, which yields 22 per cent of high grade starch known commonly as Bermuda arrowroot. The common arrowroot, which yields the highest priced of all starches, grows wild in the Philippines and gives 18 to 20 per cent of the commercial article.

Some of the arrow poisons used by the wild tribes have been described during the year.

ROUTINE WORK OF THE CHEMICAL LABORATORY.

An analysis of the routine work accomplished by the chemical laboratory during the year further emphasizes the fact mentioned in the last annual report, namely, an increased appreciation and use of chemical analytical work by the commercial interests of the Islands. Requests for analyses of gums, resins, soils, waters, fertilizers, food stuffs, oils, rocks and minerals are constantly being made. The public is also frequently applying to the laboratory for consultation and the use of recorded analytical data for the commercial valuation of products in which merchants are interested. The collections which we have made are also frequently studied by persons not connected with the Bureau. Even merchants and prospectors from adjacent countries have recognized our facilities for rapid and efficient service and have submitted materials for analysis and asked our opinion as to values, rather than to employ the commercial laboratories of Europe and America. An assay of 48 samples of copra and cake made in this year for local dealers illustrates the growing tendency on the part of commercial firms to take advantage of the facilities offered by a well-equipped analytical laboratory in this part of the world.

OPIUMS.

Since the passing of Act No. 1761, "The Opium Law," 51 samples of pharmaceutical or proprietary preparations were examined for the presence of opium or its alkaloids. Eighteen positive and 13 negative reports were rendered.

MILKS.

During the year 270 samples of carabao milk were analyzed for the Bureau of Health. Carabao milk is the one principally used for public consumption and is perhaps one of the chief factors of the high infant mortality in the Philippine Islands. The samples were collected on the open market by medical inspectors and brought directly to the laboratory for chemical and bacteriologic examination. The fat content of these milks was found to vary from 3 to 20 per cent, whereas the percentage of fat in normal carabao milk averages 10.60, thus showing the general practice of watering the milk or its alteration in composition by other means before it reaches the hands of the consumer. Under the present conditions it would be absolutely necessary to have a chemical analysis of each individual milk before an intelligent attempt at modification to meet the demands of infant feeding could be made. Aside from the great variation in composition which we encountered, the usual average composition of normal carabao milk is such as to render it impossible to use as an infant food. One-half of the total solids of normal carabao milk consist of fat and one-third of proteid, a composition which does not admit of proper modification.

It is strongly recommended that further effort be made toward correcting the present conditions in this respect. The well-known satisfactory nature of goats' milk would seem to warrant a systematic undertaken looking to its general use in the Islands.

WATERS.

Work on Philippine waters has occupied nearly all of the time of one chemist throughout the year. The survey is nearly completed and when published will furnish valuable information on Philippine surface and well waters from many localities, both from the standpoint of their potability and their use for steaming purposes.

Water analysis is tedious and painstaking work, and bare mention of the total number of different waters analyzed does not indicate the time consumed. Seventy-two waters, representing 33 localities and 11 provinces of the Archipelago were examined during the year. The artesian well waters were most thoroughly investigated. Frequently two or more examinations of the same water were made at different periods. These waters were tested from the standpoint both of their sanitary and technical uses.

With very few exceptions, these artesian wells apparently furnish a much better source for drinking and domestic purposes than the surface or shallow well waters previously employed and their introduction is unquestionably a great sanitary measure. Philippine waters as a class are medium to hard. Of 28 artesian well waters examined for steaming purposes, 16 were considered satisfactory and the remaining 12

unsuitable, unless previously treated to reduce their hardness. The chief characteristics of these waters are their relatively high silica content among the scale-forming ingredients, and the temporary nature of the total hardness; hence they are rendered comparatively soft by the use of feed-water heaters. Calcium sulphate, which is the source of so much trouble in waters for locomotive use elsewhere, has not been encountered to any extent in Philippine ground water. A total of 8 mineral waters representing that number of thermal and non-thermal springs was also analyzed. The great variation in the composition of these does not admit of any conclusions regarding Philippine mineral waters as a class.

CEMENT.

The routine work of the cement-testing laboratory shows the greatest increase in volume of any class of analytical work. Over 1,200 samples representing the different brands of cement found on the local market were received and tested within the last six months. Variations in soundness and tensile strength of certain cements were encountered early in the work, and this variation led Mr. Reibling, who has conducted all of the tests, to begin a systematic investigation looking to the causes underlying these irregularities. The results thus far obtained will prove of great value to engineers who have encountered difficulties in the use of local cements in concrete construction in the Philippines. Mr. Reibling's paper on this subject is now in press and further work in this direction is in progress.

THE SECTION OF WEIGHTS, MEASURES AND MINERAL ANALYSIS OF THE CHEMICAL LABORATORY.

Act No. 1519, known as the Weights and Measures Act, has been partly in operation for over a year. A number of the provinces were supplied with sets of standards during the last fiscal year, but not all which had been ordered arrived with the first shipment so that the work of standardization in the provinces may be said to have only begun. However, all of the secondary provincial standards have passed this Bureau and have very recently been distributed. The following secondary standards were prepared for the provinces: Weights, 450; measures of length, 427; measures of capacity, 270.

Many municipalities have now expressed a desire also to own their own standards and consequently the Purchasing Agent has been directed to order for this purpose 160 sets of third-class weights from 10 kilograms to 1 gram and including fractional weights; the same number of measures of capacity; meter measures of length, and linear measures equal to one side of the cubic dimensions of certain measures of capacity. During the year this Bureau has itself been obliged to manufacture several weights, measures and instruments.

In addition to its work in standardization, this laboratory has also done a comparatively large amount of other paid routine work. In 1906, the price of gold assays was established at 2 pesos, Philippine currency each, which is extremely low for scattered work. This step was unquestionably an encouragement to the miners, for our statistics showed 621 assays in 1907 as against 233 for the previous year. The work has still further increased during the present fiscal year, in spite of the fact that several small assay plants have been brought to the Philippines and are in use by mines operating at a capacity which is so great as to render it no longer possible to send the samples to Manila. The number of assays for gold, silver or platinum during 1908 was 772, copper 245, lead 10, zinc 3, iron, manganese, nickel, tellurium, etc., 12. The list of gold and copper assays was somewhat augmented by the thorough investigation of certain large fields. Twenty minerals were analyzed in which over one hundred constituents were quantitatively determined. The proximate analyses of a number of coal samples have also been made and the calorific values of these determined. A few steaming tests have been undertaken for pay. Nearly 200 ounces of bullion passed through our furnaces. These figures do not include the work done for the division of mines and for other Bureaus of the Government or for the purpose of research.

RESEARCH.

The larger part of the work had to do with technologic or so-called "practical" questions, that is, with coal, cement and clays, for there is a very pressing demand for the exploitation of the country's natural resources in these materials. Coal, cement rock and clays, as well as gold, silver and copper, have aroused the interest of many in the Philippines. Dr. Cox has continued his investigations of the coals of the Philippines, giving especial attention to their practical utilization.

Two articles on coal have appeared in the Philippine Journal of Science during the year and a third, which gives a short summary of the information at hand at the time of writing, has appeared in the "Report on the Mineral Resources of the Philippines," prepared by the division of mines. Another paper, showing the economy and efficiency of the coals of the Philippine Islands as compared with the foreign coals offered on the market in this Archipelago, when burned under a boiler, will soon be printed in the Philippine Journal of Science.

There is an unfounded prejudice against Philippine coal, which however is gradually disappearing in the face of its utilization by various interests. Perhaps it is not generally known that 25,000 tons were mined in Cebu during Spanish times and the coal used very successfully on the steamships of the commercial companies and the Spanish navy. There is no doubt that Philippine coal will be employed largely as a fuel for steaming purposes, but it is still an open question how the

supply can be most economically used. The deeper beds of coal may prove to be exceptionally valuable as a steam-producing fuel, but in developing, opening up and working the mines now known, there is a large amount of outcrop coal and slack that is unsuited for steaming purposes and which for the sake of economy should be used.

In March of this year, Dr. Cox made a steaming test under regular operating conditions at this Bureau of coal from the military reservation, Batan Island, in which over 18 per cent of the fuel value of the coal passed through the grate and was lost to the test. This sample showed an evaporation of water from and at 100° C. of only 4.32; this figure would have been 5.27 had the combustible actually been consumed. Many Philippine coals are very fragile and even when they have been sacked with care, arrive at our boilers containing a fair amount of fine coal. When they are used in a steam plant they decrepitate and produce more fine coal, which falls through the grate, this loss causing a low evaporation. In May of this year another steaming test of a carefully selected and carefully sacked cargo of coal from the same source as above was undertaken and even in this case over 10 per cent of the fuel value passed through the grate and was lost to the test. This sample showed an evaporation of water from and at 100° C. of 6.54 which would have been 7.30 had the combustible actually been consumed. Attention should also be called to the fact that Philippine coals as a class give high temperatures in the stack and their use under a steam boiler does not appear to be the most economical means for their consumption.

In connection with the study of the utilization of Philippine coal the question of increased power for this Bureau has also commanded attention. In order to supply the new hospital and Medical School additional power must be installed for, when both our present engines run steadily for twenty-four hours, a third must be provided to enable us to make the necessary repairs on the idle one. At present we have a battery of two boilers so arranged that while one is in use the other is being cleaned and repaired. The builder's rating for each is 74 horsepower, but we are operating them at an average of 112 per cent of the builder's rating. With the present equipment it is evident that both engines and boilers will have to be used at the same time, when the new institutions are built.

In enlarging our power plant we desire to do it in a way that will be satisfactory and at the same time give information of value to the Philippine Islands. Recent experiments carried on by the United States Geological Survey at St. Louis with a producer-gas plant have given unusually promising results. It was at first thought impossible to use poor coals in a gas producer to develop gas for a gas engine, but even lignites worked well and the gas had as high a calorific value as that from any other coal which was used.

Coal to be used under a boiler must have a certain calorific value, for

in that location, in a definite space, the coal must be burned to gas, the gas burning to make a sufficient quantity of steam and the steam used for moving the pistons in the cylinders. In a gas-producer plant the quantity or quality of the initial coal is of little consequence, so long as it produces gas of a good quality. The gas is conducted directly into the cylinder and exploded there in order to move the engine. This dispenses with the intervening steam and at this point the great advantage claimed for the producer-gas plant is gained. If we can successfully use low grade coals in the Philippines we have scored a valuable point.

Mr. A. J. Holmes, one of the committee in charge of the coal-testing plant in St. Louis, in 1904, says: "We were careful in any of this work, where we would get the boiler test, to find out how many pounds of coal were necessary to develop a horsepower per hour; and found that when we put that same coal through the gas producer it would require generally less than half the amount of coal in pounds to develop a horsepower that it required in the steam boiler. We worked through a series of averages, using nearly 150 tests made in that way, and comparing the results obtained from the same coals in the gas producer and under the boiler, and got on an average about 2.6 times as much power from every ton of coal in the gas producer as we did under the boiler."

Nearly all of the work of the United States Geological Survey has been from the standpoint of efficiencies, and data regarding first cost and cost of operation are difficult to obtain on this side of the water. A series of articles by J. H. Alexander has been printed in "The Engineer," with some data relative to the cost and operation of steam and gas power plants. In determining the first costs of the two plants the writer had access to the controlling companies' books and the costs given are actual and are per kilowatt, as follows:

Plant.	Steam plant.	Gas plant.
(1) Buildings and foundations.....	\$25.93	\$60.34
(2) Boilers, producer.....	23.65	40.83
(3) Engines.....	15.02	43.33
(4) Generators.....	14.98	20.00
(5) Switchboards.....	5.25	2.33
(6) { Auxiliaries.....	5.95	
{ Piping.....	17.95	9.30
Total.....	108.73	176.13

He says: "It would seem from the figures that producers are comparatively high priced, but this is not the case. The producer installation is of twice the capacity required, in order to provide for future enlargements, while the boiler capacity is just that required for the engine horsepower in the steam plant * * * The great difference in the cost per kilowatt of these two buildings can not be attributed to the type of plant. It is, however, due to the construction and size of the buildings themselves. The one occupied by the gas plant is extremely large * * * the one occupied by the steam plant is exceedingly small." After giving other figures he says: "These figures show conclusively that in this instance the producer is by far the cheaper unit."

The first cost of a gas plant of 200 horsepower capacity is given as follows:

(1) Buildings and foundations	\$3,620.00
(2) Producer	2,450.00
(3) Engines	2,600.00
(4) Generators	1,200.00
(5) Switchboards	140.00
(6) Auxiliaries and piping.....	558.00
Total	10,568.00

The following table shows cost of operation per kilowatt:

Item.	Steam plant.	Gas plant.
(1) Fuel	\$0.01880	\$0.00770
(2) Water	0.00059	0.00002
(3) Labor	0.00462	0.00817
(4) Supplies.....	0.00055	0.00070
Total	0.02456	0.01659

With the gas plant working at full capacity (in the above the 200 horsepower gas plant was operated at only 80 horsepower) the cost of operation would be very much reduced, so that it would be even still cheaper than for the steam plant. The difference is so great that it would not require long to counterbalance a much greater first cost.

The Engineering Magazine (1908), 34, 906, says "the gas producer and the gas engine plant is more economical than steam power where coal costs more than \$3 per ton."

It may be possible that a producer-gas plant can be so constructed that it will alternately manufacture producer gas and water gas for the laboratory, the hospital and the Medical School, thereby doing away with our present expensive and unsatisfactory system and obviating the expense of any further addition. Dr. Cox, at equal or even greater cost than a steam plant, recommends the producer system for the development of the future power at the laboratory. If we can demonstrate that this is by far the most economical method for the consumption of the fuel of this Archipelago, where a plant does not also need steam for drying and heating purposes, the excess cost of installation is fully justified. It would induce similar power plants to install like systems, a market would be created for the low grade Philippine coal and this would solve the problem of power for large manufacturing establishments.

Since this method for the utilization of fuels is so new and has developed and is developing so rapidly, and since reliable data regarding the successful operations, costs, etc., are so difficult to obtain, it has finally been deemed best to secure our information first hand by a canvass of the work being done on a commercial basis by commercial people in the United States at the present time.

The work on Philippine clay, begun last year, has been carried on as opportunity afforded. In December, 1907, the first article on the occurrence, composition and radio-activity of the clays from Luzon was published in the Philippine Journal of Science. This article was intended only to furnish preliminary information with respect to the possible use of these materials in the manufacture of a good grade of pottery, but some of the data there given have been useful to those interested in the search for cement materials. In May of this year Dr. Cox was able to visit Laguna Province to investigate the clay deposits there. The results of experimentation with the samples collected in this region will eventually be published in the Philippine Journal of Science.

Considerable effort has been expended in the attempt to produce cement from Philippine materials, but as yet we have been unable to obtain a sufficiently high temperature to burn quantities large enough for experimentation. This work will be continued during the coming year after we have constructed a small, rotary kiln.

Mr. Walker has continued the study of the coconut, the causes of rancidity and the prevention of deterioration in coconut oil. This work was begun in 1906, and since then he has paid special attention to the oxidation of commercial oils by air. He has studied the changes in composition taking place in the coconut while sprouting and he has also tried to discover if the coconut contains fat-splitting enzymes which will hydrolyze fat outside of the growing nut. An investigation of the action of certain bacteria and molds on copra in pure culture was also made (with Dr. Edwards). This work is foreign to that of mineral analysis, but, as it was begun before it became necessary to transfer Mr. Walker to his present work, it was advisable for him to continue as opportunity afforded.

Mr. Walker will be ready to leave for Negros before many weeks to carry on there the investigation on sugar and sugar cane which has been under consideration for a long time. He could not go sooner because of the press of work in Manila.

The publications of the chemical laboratory in the Philippine Journal of Science have been as follows:

Commercial Utilization of Some Philippine Oil-Bearing Seeds: Preliminary Paper, by George F. Richmond and Mariano Vivencio del Rosario; Philippine Terpenes and Essential Oils, I, by Raymond F. Bacon; Philippine Terpenes and Essential Oils, II, Ylang-Ylang Oil, by Raymond F. Bacon; The Composition of Horlick's Malted Milk, by George F. Richmond and W. E. Musgrave; The Occurrence, Composition and Radioactivity of the Clays from Luzon, Philippine Islands, by Alvin J. Cox; Starch Production in the Philippines Islands (editorial), by Raymond F. Bacon; The Relationship Between the External Appearance and the Ash Content of Philippine Coal (editorial), by Alvin J. Cox; Philippine Arrow Poisons (editorial), by Raymond F. Bacon; The Purification of Coconut Oil (editorial), by George F. Richmond.

THE LABORATORY FOR FOOD AND DRUGS INSPECTION.

Mr. H. D. Gibbs, in charge of the work on foods and drugs, makes the following report:

The United States Food and Drugs Act, June 30, 1906, in its intention applies to the Philippine Islands, as is evidenced by section 12 which states that "the term Territory as used in this Act shall include the insular possessions of the United States," and section 10 which mentions "the District of Columbia or the Territories or Insular possessions of the United States." For the purpose of simplifying the enforcement of the law by the officials of the Government and the courts of the Philippine Islands, the Philippine Commission on May 18, 1907, passed an Act which is parallel with that of the Federal Government in all essential points excepting in the designation of the officials in whom the enforcement of the law rests. The most important differences are:

FEDERAL ACT.

SEC. 3. That the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor shall make uniform rules and regulations for carrying out the provisions of this Act, including the collection and examination of specimens of food and drugs. * * *

SEC. 4. That the examination of specimens of foods and drugs shall be made in the Bureau of Chemistry of the Department of Agriculture, or under the direction and supervision of such Bureau, for the purpose of determining from such examinations whether such articles are adulterated or misbranded within the meaning of this Act. * * *

SEC. 5. That it shall be the duty of each district attorney to whom the Secretary of Agriculture shall report any violation of this Act, * * * to cause appropriate proceedings to be commenced and prosecuted in the proper courts of the United States. * * *

SEC. 10. * * * The proceedings of such libel cases shall conform, as near as may be, to the proceedings in admiralty, except that either party may demand trial by jury of any issue of fact joined in any such case. * * *

PHILIPPINE ACT.

SEC. 3. The Insular Collector of Customs, the Director of Health, and the Collector of Internal Revenue shall make uniform rules and regulations, subject to the approval of the Secretary of the Interior of the Philippine Islands, for carrying out the provisions of this Act. * * *

SEC. 4. The examinations of specimens of foods and drugs shall be made in the Bureau of Science, or under the direction and supervision of that Bureau. * * *

SEC. 5. It shall be the duty of the Attorney-General of the Philippine Islands, to whom the Secretary of the Interior of the Philippine Islands shall report any violation of this Act, * * * to cause appropriate proceedings to be commenced and prosecuted in the proper courts of the Philippine Islands.

SEC. 10. * * * The proceedings hereinbefore mentioned shall conform as near as may be to the proceedings in admiralty in the Courts of First Instance of the Philippine Islands. * * *³

³ There are no trials by jury in the courts of the Philippine Islands.

FEDERAN ACT—continued.

SEC. 11. The Secretary of the Treasury shall deliver to the Secretary of Agriculture upon his request from time to time, samples of foods and drugs which are being imported into the United States. * * *

PHILIPPINE ACT—continued.

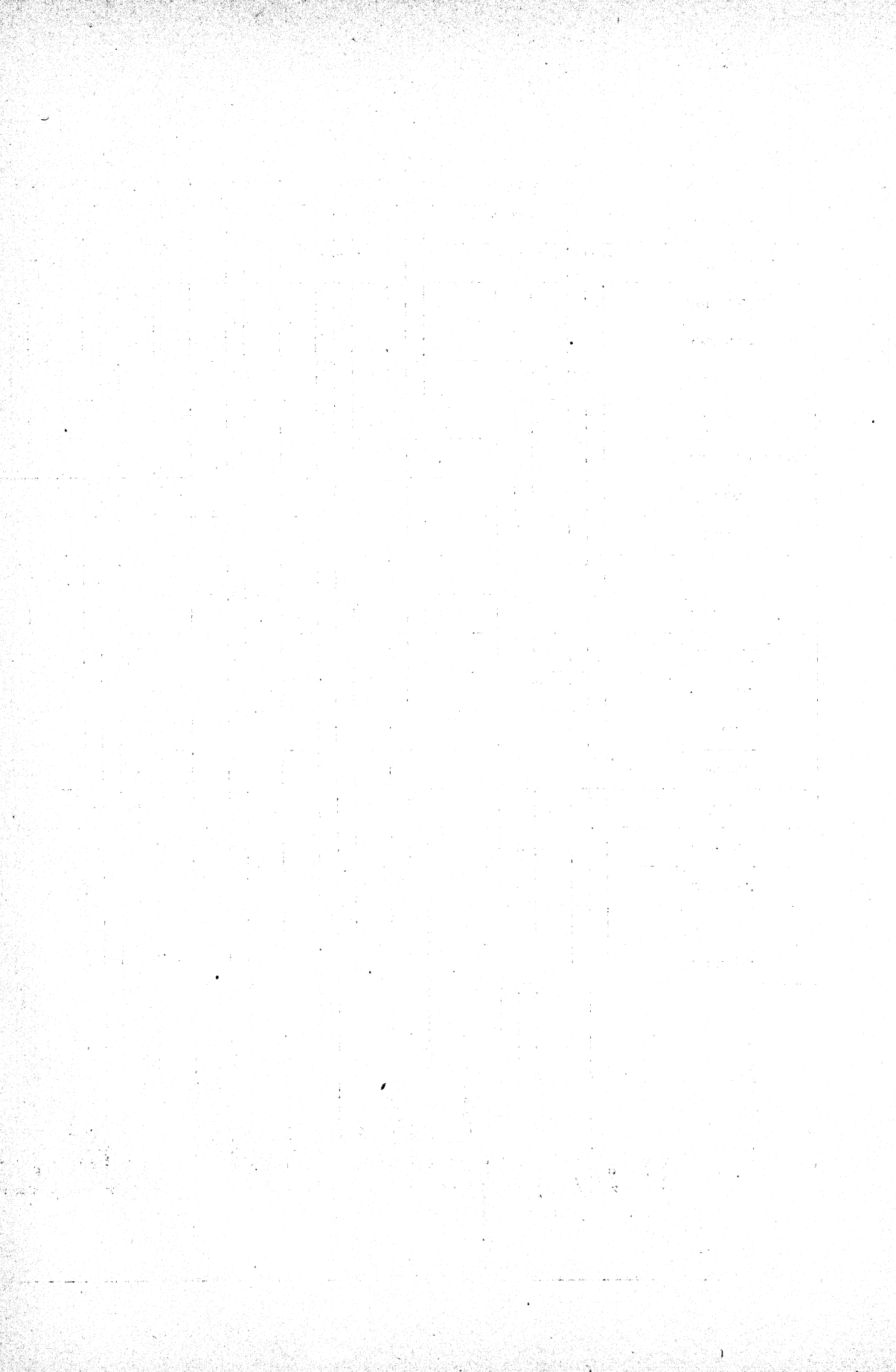
SEC. 11. The Insular Collector of Customs shall deliver to the Director of Health, upon his request from time to time, samples of foods and drugs which are being imported into the Philippine Islands. * * *

The work of actively enforcing the Food and Drugs Act of May 18, 1907, began in the month of August, 1907, by the inspection of foods and drugs passing through the custom-house of the port of Manila. Later, the collection of samples was extended to other ports of entry of the Philippine Islands and to articles on sale in the local markets. The main part of the work has been upon the samples passing through the Manila custom-house. These importations are principally from the United States, Spain, Germany, France, Italy, Switzerland, Great Britain, China, Japan, and Australia, and are most varied in character and composition. The small laboratory force engaged in the food and drug work, while almost entirely occupied with these importations, has also begun the examination of native products. It is hoped that this work can be extended more rapidly in the near future, for many of these foods and drugs promise an interesting field for investigation.

The food and drugs inspection from the beginning of the enforcement of the law to the end of the fiscal year, June 30, 1908, has consisted in the examination of 623 samples of foods and 99 samples of drugs. These are classified and arranged in tables to show their origin and adulteration. A large number of samples have been found to be misbranded and in every case the importer has been allowed the option of relabelling in the custom-house under Government supervision or reëxporting the shipment. The majority of the cases of misbranding are not mentioned in the following tables:

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Summary of the samples examined.

Kind.	Number of samples.	Illegal.	Kind.	Number of samples.	Illegal.
ANIMAL PRODUCTS.			VEGETABLE PRODUCTS—ctd.		
Bacon	15	2	Infant's food	1	
Ham	38	13	Canned fruits	23	1
Caviar	7	3	Preserves	10	
Lobster	3	1	Soups	5	
Sardines	12		Camote	1	
Fish in tins (miscellaneous)	18	3	Canned vegetables	77	20
Sausages	39	13	Vegetable products (miscellaneous)	22	5
Meats (miscellaneous)	59	1	Sugar and related substances	12	2
Lard	11	5	Condiments	15	2
Sterilized milk	16	6	Flavoring extracts	19	11
Condensed milk	16	8	Edible oils	5	
Sweetened condensed milk	1		Coconut oil	3	
Condensed skim milk	2	1	Chocolate	2	
Evaporated cream	9	7	Beverages	64	53
Butter	31	33	Vinegar	3	
Imitation butter	6	2	Artificial colors	13	12
Cheese	43	21	U. S. Pharmacopeial preparations	12	8
VEGETABLE PRODUCTS.			Proprietary medicines	87	76
Bean flour	1		Total	722	310
Vermicelli	1	1			

A number of problems requiring a more or less extended research investigation have arisen in addition to the analytical work tabulated above.

One of these is the formation during transit of salicylic acid from its esters which have been used in the preparation of various medicines and beverages. One phase of this work has already been described in the Philippine Journal of Science and others are still under investigation.

Another problem of interest to the Islands is the effect which copra cake fed to hogs has upon the fat of the animal. It is well known that cotton-seed cake has an effect which is manifested in lards made from hogs fed with that material. Feeding experiments are now being conducted on hogs and the analytical work upon the fats will shortly be taken up. Other studies are being carried on upon coconut oil.

Formaldehyde, having been found to be a constituent of a number of food products shipped to the Tropics, is being studied in respect to some of its reactions and chemical behavior. Codeine, occurring in many proprietary medicines, has shown some peculiarities in its behavior which appear worthy of investigation. The effect of tropical sunlight upon some chemical reactions is also being studied.

It is hoped that some of the investigations at present in progress will be completed within the next year.

THE DIVISION OF MINES.

STAFF.

At the beginning of this fiscal year the division of mines had the following authorized positions: One geologist, who acted as chief of the division, and who was in charge of the section of geology and paleontology; one mining engineer, who was in charge of the section of mineral resources; one mining engineer, who was in charge of the section of surveying and maps; one geologist, who was in charge of the section of petrography and ore deposits; one assistant geologist; two topographic assistants; one draftsman; and one employee who was also engaged in the making of petrographic slides. There existed at this time three vacancies in the division; one in that of the assistant geologist whose field was to comprise particularly the subject of nonmetallic minerals, and two in those of topographic assistants. One of these latter positions was filled on September 1, 1907, and Dr. George I. Adams, who has satisfied all the requirements of the civil service and who, to judge from his record, appears to be well qualified for the position, has accepted the appointment of assistant geologist, and he is now en route to the Islands.

During the past year the division suffered a great loss in the deaths of two of the most faithful members of the former Bureau of Mines and afterward of the division. Hugo Navarro had been a draftsman in the Government service for about twenty-eight years, having served successively in the Spanish *Inspección General de Minas*, in the old Mining Bureau, and in the present division of mines. On November 2, 1907, after a very brief illness he died and the division lost the services of a most faithful and reliable man. At the time of his death all the members of the division of mines were in the field and so it was deemed best to postpone the appointment of a draftsman to fill the vacancy until the return of some of the men. This was done four months later, March 2, 1908, and the present incumbent of the position, who happens to have been a pupil of Hugo Navarro, has filled the place satisfactorily since then.

The second and more recent misfortune which has befallen this division, and which has so shocked not only the members of the division and the Bureau, but the public in general, was the cruel and treacherous murder of our colleague, Harry M. Ickis. The details of this sad affair which we have been able to obtain make it appear that Mr. Ickis was slain in the mountains about two days' journey east of Malaybalay in the subprovince of Bukidnon, while he was engaged in a geologic reconnaissance of that portion of Agusan Province. As far as we have been able to learn, the general cause of this atrocious act was the ignorance of the Manobos supplemented, probably, by a desire for revenge of supposed wrongs inflicted during the Spanish régime. Lest it be said that Mr. Ickis took unnecessary risks in venturing into this country it is well to

state that he was not the man to display an unseemly bravado; that while admirably fearless, he was not reckless, and took no chances he did not believe were necessary. From a knowledge of the inhabitants of the region that he had gained on a previous trip into their country, he had reason to believe that, as he expressed it in an official report, "The inhabitants of the interior are harmless and peaceable. * * * Travel and prospecting can be carried on without molestation." Furthermore, it was arranged with the governor of Agusan Province before Mr. Ickis and Mr. Goodman separated that the governor with a small Constabulary guard would accompany Mr. Ickis on the trip from Talacogan to Malaybalay. While Mr. Ickis expected to suffer hardships and privations during his travel through this very sparsely inhabited territory, it is evident that he had no reason to expect any real physical danger. The journey was actually begun as planned, but it appears that the governor of Agusan received an urgent summons which compelled him to return. Mr. Ickis and one Constabulary private continued the trip and both were killed. The following are the words of Mr. Goodman, acting chief of the division of mines: "While I realize that a eulogy of Mr. Ickis may be considered out of place in a report of this nature, I can not refrain from stating that the division of mines has lost a most loyal and conscientious worker, one who, because of his ability, integrity and character, had won the admiration and confidence of the entire mining fraternity in the Philippine Islands, and one whom it will be difficult to replace."

FIELD WORK ACCOMPLISHED.

The field work done by the members of the division of mines during the past fiscal year may be summarized as follows:

The completion of a geological reconnaissance of the Batanes Group by Mr. Ferguson, about one month; a triangulation survey of the Aroroy mining district in Masbate, by Messrs. Goodman and Ickis, about two months; a brief trip to Cebu for the purpose of collecting supplementary data for his paper on the Compostela-Danao Coal Fields, by Mr. Smith, about two weeks; an underground survey of "The Big Copper" in Lepanto, by Mr. Goodman, about one and one-half months; a topographic survey and a geologic reconnaissance of the Aroroy mining district in Masbate by Messrs. Ferguson and Clark, about four and one-half months; a geologic reconnaissance of portions of Mindanao, by Messrs. Smith (four months), Ickis (six and one-half months), Clark (one month), and Goodman (four months).

This last reconnaissance was made up of a number of expeditions by different members of the division, traveling either singly or in pairs, to various reported outcrops of mineral deposits and over hitherto but little known portions of the Island of Mindanao, for the purpose of mapping and collecting geologic data. As a result our knowledge of the physiography of Mindanao has been considerably increased and several route maps of the interior of the island have been made for the first time, as for instance from Cagayan de Misamis to Sevilla; from the Mindanao River to the Gulf of Davao; from the Gulf of Davao to Mati

and from the Gulf of Davao to Surigao. Furthermore, several mineral prospects have been investigated, among these are the coal deposit of Sibugey, of Tarragona, and of San José de Bislig. The placer deposits of the Pulangui, of the Tumaga and of the Cansuran Rivers, as well as the quartz veins near the town of Placer were examined. Some of these maps and reports have already been published, while others are now in the course of preparation.

ARTICLES PREPARED FOR PUBLICATION.

The following papers on geologic or mining subjects, by members of this division, have appeared in various publications during the last fiscal year or have practically been completed in manuscript form.

A Description of the Geology and Mining Operations in the Camarines Gold Fields, by H. M. Ickis; Notes on the Geology and Geography of the Baguio Mineral District, with map, by A. J. Eveland; The Petrography of some rocks from Benguet Province, by W. D. Smith; The Gold placers of Nueva Eeija, by Maurice Goodman; The Sulphur Deposits of Leyte, by Maurice Goodman; The Sulphur Deposits of Camiguin Island, by H. G. Ferguson; A Geological Reconnaissance of the Batanes Islands, by H. G. Ferguson; The Stone Quarry of Mari-veles, by H. M. Ickis; Notes on the Manila Lime Supply, by Maurice Goodman; Contributions to the Physiography of the Philippine Islands: Batanes Islands, by H. G. Ferguson; the Geology of the Compostela-Danao Coal Fields, by W. D. Smith, with map; Note on the Occurrence of Rhyolite in Cebu, by H. G. Ferguson.

THE ANNUAL BULLETIN.

The first annual bulletin of the mineral resources of the Philippine Islands, the collection of data terminating on January 1, 1908, issued by W. D. Smith, appeared during the year. This publication, in addition to the mineral statistics for the year 1907-8 compiled by Mr. Smith, also contains the following contributions:

The Nonmetallic Minerals, by W. D. Smith; The Metallic Mineral Resources, by Maurice Goodman; Mining and Geologic Notes on a portion of Northwestern Mindanao, with map, by H. M. Ickis; Mining Prospects on and near the Zamboanga Peninsula, by W. D. Smith; Summary of the Chief Characteristics of the Philippine Ores, by W. D. Smith; and a summary of the Chief Characteristics of Philippine Coals, by A. J. Cox, of the chemical division.

FUTURE WORK.

The future work contemplated by this division comprises:

The preparation of a base map of the Mabulao and Paracale gold fields in Ambos Camarines, together with the geologic reconnaissance of the district; a preliminary geologic reconnaissance of the coal deposits of southern Mindoro; an exploratory reconnaissance for the purpose of investigating the iron-ore bearing district between Bosoboso and Angat; an exploratory reconnaissance of the Cagayan River Valley in northern Luzon, with particular reference to known coal and gold deposits; an investigation of the earthy minerals with the view of locating practicable sites for cement manufacturing, ceramic and other allied industries, and the collection and publication of data and statistics referring to the mineral resources and the mining and milling conditions of the Islands in general.

It is very gratifying to be able to report that during last year the mining industry in the Islands has taken a new impetus and from all signs, this new development appears to be a healthy and honest growth. The industry is still small, but it is believed it will increase more rapidly now that it has obtained a fair start. Nothing promotes the mining industry in a district so much as successful operations. During the past year this division made the first attempt systematically to collect statistics regarding the mineral output. While the results as a whole are not such as can be pointed to with any great amount of pride, it must be remembered that the industry here is still in its infancy and that the work now being done is more in the way of development, rather than of mining proper. While it may not be safe to prophesy on the future of so young an industry, it is safe to predict that the output from the gold mines, and perhaps also the coal mines, will be more than doubled or even trebled during the coming year. The annual bulletin of the mineral resources of the Philippine Islands next year will show a decided advance over this. We were compelled to make a beginning at some time, and perhaps it is just as well to start in a small way and advance upward, than it is to go in the reverse direction.

RECOMMENDATIONS.

It is only proper that the division of mines should grow in importance with the increase of the business which it is created to foster. To this end the facilities of the division should be increased. With the advance of development, more particularly of coal mines, a system of inspection of timbering, ventilation, safety devices, etc., will need to be inaugurated. In carrying out such inspections the system of course would be so planned as to be a help to the owners of the properties as well to provide additional security to the men. The present force of the division of mines is inadequate to carry out inspections.

Recently the Bureau adopted the policy of making free assays and analyses on such samples as were authentic and promising, coming from prospectors in new districts and accompanied by ample information so as to render them of value in our work. We can expect a still greater increase in our geologic and mineralogic collections from this source. In the past, for lack of space, we have been accustomed to distribute our duplicates to school-teachers and to others to whom they might be of value or interest, but with the new influx of material we are rapidly becoming overstocked and have to pack away collections and specimens, some of which it would be advisable to retain in a permanent museum.

The subject of increased and suitable museum space, and the need of a better disposition of the offices and working rooms of the division, has been discussed ever since the inception of the division of mines. With the present crowded condition of the laboratory building, but little improvement can be effected in this respect.

One considerable improvement in the present facilities is also necessary so that a practical, working test could be made upon 3- to 5- ton samples of ores. At the present time prospectors must send such samples to the United States or to foreign countries, in order to obtain the desired tests and reports. By the purchase of a small amount of machinery (principally a small stamp mill) and the construction of another out-building, such analyses could be made in the laboratory at a great saving of time and money to the miner. The installation of such machinery, with the facilities already at hand, would so encourage the demands for ore tests that the fees charged therefor should in a short time to a large extent repay the Bureau for the original cost.

Another step which might be taken in the interests of the gold miners of these Islands would be the establishment of a system whereby the Government of the Philippine Islands would become the purchaser of all the bullion product of the mines, or by the putting in of facilities, probably in the same building as the stamp mill and cyaniding plant, to smelt and refine large quantities of gold to be cast into standard bricks to be purchased by the banks. At the present time the banks act merely as intermediaries between the miners and smelters, advancing an approximate value on the bullion, and they must charge a certain amount of interest for this advance, besides commissions, freight and insurance. They pay in full for the bullion received only after the returns are obtained from the smelters in the United States. If this bullion were bought by the Government, it would merely be necessary for the miner to bring his gold to the laboratory to be assayed, smelted and cast into bars and to receive therefor a certificate giving its valuation. This certificate would then be honored at the Treasury of the Philippine Islands, which would become the depository of all bullion. If found necessary, the treasurer could set a certain standard of fineness for all gold which he would purchase, and all bullion falling below this standard could be refined in the laboratory and the cost thereof deducted from the value of the bar. This system is in line with the policy carried out by other Governments, would put the Government itself to but very little expense, would tend to increase the amount of currency in circulation, and would assure the miner correct, prompt and slightly larger returns for his bullion. If it were not deemed advisable for the Government to do this business, the bars, if properly stamped with the laboratory mark, would readily be taken by the banks at a good valuation for disposition in other countries. The inauguration of this system would put the Government to some expense for furnaces, balances, safes, and other appliances necessary to give us a complete plant, but this could be entirely covered by a slight charge for smelting.

The mining laws of the Philippine Islands stand to-day much as they did in 1902. The crying need of the repeal of section 33 and the

amendments of sections 36, 56 and 75 of the law of Congress of July 1, 1902, is felt to the same degree to-day as it has been in the past, when Mr. McCaskey so vehemently and persistently urged these changes at every favorable opportunity. Considerable benefit resulted from his efforts, in fact the bill embodying the necessary changes was actually introduced in Congress by Senator Lodge, and advanced to a second reading. However, no vote was ever taken and so far as we know it still rests with the Committee on the Philippines to which it was referred. It seems that further agitation and appeal to the Congress of the United States might be prosecuted with benefit to the mining industry of the Philippines.

THE DIVISION OF ETHNOLOGY.

In August, 1907, the property of the division, including office furniture and museum material, was moved from the Bureau of Education building to the Museum Building on Calle Anloague formerly occupied by the Bureau of Architecture.

Mr. Christie, who was in charge of the division in the absence of Dr. Miller, immediately began installing the museum specimens in the south and middle rooms. The north room had not at that time been fitted up. Mr. Christie carried along so effectively the work of the museum that, with the exception of the labeling, the preliminary installation was practically done by the time of Dr. Miller's return from the United States on October 15. Since that time he has been labeling the collection and working on his paper on the Subanuns. It is impossible at the present time to label the museum material properly because the necessary data are lacking. A large part of this material was sent to the Exposition at St. Louis and through constant handling and packing several times many of the labels were either misplaced or lost. These we will replace gradually as we are able to identify the specimens.

Through various interruptions caused partly by Dr. Miller's absence in the United States and trips taken into the provinces, Mr. Christie's paper on the Subanuns has long been delayed, but it is hoped that he will soon have it ready for publication.

It will begin with a historical chapter. This will contain, first, a résumé of references made to the tribe by earlier observers, beginning with Pigafetta, and an account of the historical relations of the tribe with Church and State in the Philippines. The second section will treat of the relations between these pagans and the Mohammedan incomers and will give an account of the amount and manner of payment of tribute to the Moros down to the advent of the American régime.

The next chapter will give an account of the material culture of the Subanuns and will consist of three sections, the first dealing with the Subanun house, clothing, furniture, implements, etc., the second, with their agriculture, and the third, with their trade.

The third chapter will treat of the individual in his or her social relations. It will deal with such subjects as the customs regarding birth, marriage and burial.

Social control will be the subject of the fourth chapter. Such subjects as the chieftainship and the exercise of the punishing power will be considered; a scale of punishments as prescribed by the customary law will be given.

The next three chapters will deal, respectively, with Subanun religion, tales and language. The chapter on religion will include an account of several religious ceremonies, and a translation of some fifteen set formulæ and prayers.

The chapter on language will give a vocabulary of some four hundred words, a number of illustrative sentences in Subanun, and an historical tale in Subanun, Bisayan and English.

Immediately upon his return from leave Dr. Miller began preparing for the press Dr. Saleeby's "History of Sulu," forming the second part of his "Studies in Moro History, Law and Religion." This paper is now being printed. It will form a volume of about 280 pages and gives the history of Sulu from the earliest times about which anything could be learned to the present. It will contain four maps, one of the Sulu Archipelago, one of Sulu Island and two of the town of Jolo, besides two diagrams showing the relationship of the various rulers of Sulu. It will be the most complete and authoritative account that has yet been published of the long struggle of the Spaniards with the Sulus and of American dealings with that fanatical tribe of Moros.

Before work on the History of Sulu was completed, the translation was undertaken of a pamphlet published by the Royal Museum of Ethnology in Berlin, entitled "Directions for Ethnographic Observations and Collections in Africa and Oceanica." After a few minor changes had been made this was found to be well adapted to our use in the Philippines and has been published by the Bureau of Science.

Dr. Miller also began work on a dictionary of the Bontok Igorot language the material for which had been collected by Reverend Walter C. Clapp, of Bontok. He found, however, that there were so many inaccuracies and inconsistencies and so many omissions to be filled in that it was necessary on the return of Father Clapp from the United States in March to ask him to revise the manuscript. This has been received again and will be sent to the printer very soon.

A paper by Otto Scheerer on "The Batan Dialect as a Member of the Philippine Group of Languages" and another by Carlos Everett Conant on "F and V in the Philippine Languages" have just been received from the printer. These papers will not be of popular interest, but are valuable contributions to the study of Philippine etymology. They form parts 1 and 2 of Volume V of the publications of this division.

During March and April the north room of the museum building was fitted up and early in July the new cases ordered for it were received. These cases have not yet been accepted owing to the failure of the contractors to carry out the specifications in some details. As soon as they have been made satisfactory, some of the specimens now in the south and middle rooms will be installed in the north room thus relieving the crowded condition of the two former. This transfer is made es-

pecially necessary by the purchase from Dr. N. M. Saleeby in June of this year of a collection amounting to over 200 pieces and consisting mainly of Moro and Bagobo material. The Moro part of this collection together with the Moro specimens which were the property of this division previous to this purchase, when properly installed, will very nearly if not quite fill the north room of the museum. The most nearly complete of the collections now in the museum is that from the Moros. This consists of an excellent series of weapons, coats of mail and brass work. We have also a large assortment of Moro cloths, ranging from the coarse variety to a good quality of silk.

Next in importance to the Moro specimens come those from the Igorot country. These consist of cloth, clothes, baskets, pipes, spears, headaxes, carrying frames and copper pots. The Bagobo and Bilan tribes of Mindanao are represented by weapons, cloth and clothes made of Manila hemp fiber, and carrying baskets made of hemp and elaborately decorated with beads.

The remainder of the collections is made up of small lots of specimens from the Manobos, Mandayas, Subanuns, and Bukidnons of Mindanao, the Mangyans of Mindoro, the Kalingas, Tinggians and Ifugaos of northern Luzon and some cloth, weapons, hats and a few other things from the Christian population of the Islands.

What we particularly need now is more material to fill up the cases which we have and the others soon to be ordered. We should have a large collection of specimens illustrating the life and handiwork of the Christian tribes of the Islands. We have almost nothing from these seven great divisions of the Filipino people. Hitherto more attention has been paid to making collections from the non-Christians because their customs are rapidly changing, their old styles of dress are giving way to that worn by the Christian Filipinos and certain arts are falling into disuse. It is believed that a considerable part of the lower floor which is soon to be fitted up in the museum building should be given over to an exhibit made from the Christian population of the Islands.

An attractive feature of the Museum will be a series of colored transparencies, eleven of which have already been finished by Mr. Martin. These will show people of the various tribes, dances and characteristic scenes colored as they are in life.

Besides those who are regularly connected with this division, Mr. Fay Cooper Cole and Dr. William Jones of the Field Museum have been working in the Islands for more than a year. Both of these men are employees of the Bureau of Science without pay. We expect to obtain from each some specimens from the tribes among which they have worked in exchange for some duplicate Moro articles which we have. We also anticipate that they will contribute articles on ethnological subjects to the Journal of Science. Mr. Cole has spent a large part of his

time among the Tinggians of Abra and Dr. Jones among the Ibilao of Isabela.

One other specialist in ethnology, Miss Laura E. W. Benedict, has also been in the Islands for more than a year past, leaving within a few weeks. She has made an unusually complete and careful collection of specimens from the Bagobos of Mindanao. On her arrival in Manila from Davao, Mindanao, she spent several weeks in the museum building, classifying and arranging her collection.

In April and during the first two weeks of May, Dr. Miller was away from Manila making a hasty trip through the Province of Ambos Camarines to determine if possible to what tribe the non-Christian inhabitants of that province belong. These non-Christians may be divided roughly into three groups; first those who live on the slopes of Mount Isarog and Mount Iriga. In Spanish times these people are said never to have come down into the lowlands and never to have permitted people from the lowlands to come among them. Now they seem to be entirely peaceable and orderly. Ethnologically they are either a remnant of some former Malayan population or a mixture of the present Malaysians with Negritos. Although Dr. Miller saw no people who seemed to be pure Negritos there were many who showed traces of Negrito blood in hair, eyes and lips and a few in whom there appeared to be a large amount. Dr. Miller is inclined to think that these people are the result of crossing between a former Negrito population and the Malaysians who surrounded them.

On the shores of the mainland about Siroma, on the Kalawat Islands, and in a few other places are found scattered groups of the so-called "Dumagat" people who form the second division of non-Christians of this province. They appear also to have some Negrito blood in them. They live for the most part in small groups by themselves, however not far from the settlements of the Christian Filipinos.

The third group of non-Christians is made up of settlements of Negritos scattered throughout the northern Camarines from the Pacific Ocean to the China Sea. These are as pure blooded Negritos as any Dr. Miller has seen in the Islands.

On the 12th of June Dr. Miller went to Nueva Vizcaya under directions from the Secretary of the Interior to attend an Ibilao *cañao* at Dupax and Ifugao *cañaos* at Banawi and Kiangán. So far as he could learn the *cañao* at Dupax was the first which the Ibilao had ever attended. There were 46 people present, a few of them women and children. It is believed that next year many more people will come. At both Banawi and Kiangán there were many hundreds, if not even several thousand.

These meetings of the people from various *rancherías* are doing much good. They make the people acquainted and as they get acquainted

they are much less inclined to fight one another and to go on head-hunting expeditions. They also furnish an occasion to make gifts to those chiefs who have been efficient in keeping their people in order and in capturing criminals. Dr. Miller returned from this trip to Nueva Vizcaya on July 12.

This recent trip to attend *cañaos* illustrates one of the most important functions of this division. The Secretary of the Interior, by virtue of the law placing the non-Christian inhabitants of the Islands under his charge, has to make frequent trips of inspection, either in person or by a representative, to the provinces and *rancherías* occupied by the non-Christians. As his duties in Manila do not always permit him to go when occasion demands, it has become one of the essential functions of this division to represent him.

The importance of having a representative of the Central Government visit the various provinces, especially those occupied by the non-Christian tribes can not be overestimated. It not only furnishes an opportunity to the visitor to see that no abuses are being committed and that the Government is being properly administered, but it arouses the ambition of the people to have their settlements neat and their houses well built and in good condition.

To carry on properly the work of this division we need another trained ethnologist to make studies and collections in the provinces. There are but two men now to do this work and as either Mr. Christie or Dr. Miller must always be in Manila, the work of increasing the collections and of getting material for publication progresses slowly. We shall begin soon to make a card catalogue of the museum collections, beginning with the recently purchased Saleeby collection and adding to the catalogue as we identify the specimens about which we are now uncertain. Slow progress will however be made on this work with the present museum force and while that of rearranging the collections is going on.

FISH AND FISHERIES.

OUTLINE OF WORK.

The work on our fisheries outlined at the beginning of the year has been steadily carried forward with the following ends in view.

1. To secure as complete a collection as possible of all Philippine fishes, cataloging the specimens under the native, English and scientific names.
2. To study the foods, life histories, distribution and migration of useful fishes.
3. To discover the nature of the feeding and spawning grounds of the food fishes, to ascertain the period of spawning, the characteristics of the ova, the time required for, and conditions favorable to hatching.
4. To see what methods and apparatus are used by the natives in the catching, curing and drying of fishes and to suggest such improvements as we know to be practicable.

5. To determine what protection can be given to young fish during the early stages of their growth.

6. To find places where fishes could be introduced profitably, or where pond culture could be inaugurated, or practical fish cultural methods carried out.

7. To ascertain what are the enemies and the causes of the disappearance of useful fishes.

8. To list the price paid in each locality for fresh and salted fish, the quantity secured and the amount exported and imported.

9. To obtain figures as to the quantity and value of all other fishery products.

10. To make an investigation of the pearl, sponge and coral fisheries.

To carry on this work Mr. Seale has had the help of three native assistants, one of whom is an artist who has reproduced in colors the chief characteristics of the specimens assigned to him, another is a practical fisherman and the third is a water Moro who is an expert diver and experienced fisherman.

FIELD WORK.

Five months of the past year have been spent in the field and a fairly representative collection of Philippine fishes, to the number of about 8,000 specimens, has been secured. Numerous new species and others hitherto unrecorded from the Philippines have been taken. During the investigation in the Gulf of Davao, Mindanao, 212 different species were taken in one day. It is believed that this record has never been equaled. Considerable time while in the field has been given to the study of the pearl fisheries.

THE DAVAO PEARL BANK.

The Davao pearl bank received Mr. Seale's undivided attention for several days, most of the time being spent on the pearling boats that were working on the spot. Numerous specimens of shells and oysters were secured. This bank is located in Pagquipuan Strait, the most prolific part of the bed being in the narrow portion of the strait between Points Laua and Linao. The bed seems to owe its existence to the protection of the big reef called Arboles Island in the upper part of the strait and to a strong eddy at the lower part which permits the spat to settle down and attach. The bed is in from 16 to 30 fathoms of water. The bottom is smooth, of coral sand and broken shell, the banks drop abruptly down from the fringing coral reef into 15 to 16 fathoms, except in one or two places where the shore is of sand sloping at a sharp angle into deep water.

About 60 tons of shells valued at 43,000 pesos were taken from this bed between January 1 and May 1, 1908. The yield of pearls was small, probably not worth more than 10,000 pesos, most of them being of very irregular shape, but of good luster. It was a pleasure to find that the bed was fairly well stocked with young oysters and that the adults were

spawning freely. If the laws are properly obeyed the Davao pearl bank will continue for a long time to yield a fair number of shells each year.

At the date of Mr. Seale's report (May 20, 1908), four pearl boats were still at work on this bed whenever the current would permit, but the large shells were so well gathered that the results were small, the average number of shells being not more than 3 for each dive.

Nine pearling licenses have been issued at Davao since January 1, 1908. They were to the following nationalities: 1 Arab, 1 Japanese, 2 Assyrians, 1 Greek, 1 Spaniard, 2 Filipinos.

It is probable that other pearl banks will be found along the south coast of Mindanao and a marked increase of interest in pearling will probably develop during the coming year.

It would be expedient to bar corporations from this industry and to permit only people having the political rights of citizens of the Philippine Islands to hold licenses. The pearling laws should be uniform for the entire Archipelago. It would also be advisable to have each diver register and take out a license, forfeiture of the license being the penalty for bringing up undesired shells.

SPONGE FISHERIES.

Sponge fisheries which will prove to be of considerable value commercially have been located during the past year. The first shipment from the Sitanki sponge bank arrived in Zamboanga on June 3, and will be shipped to Singapore. These sponges are of fine, soft texture, very tough and elastic. They compare favorably with the best grade of the Florida "sheep's wool sponge" and doubtless a good price will be realized from them. Twenty thousand sponges have been taken at Sitanki.

CURING SPONGES.

The curing of sponges is a very simple process. When in the water the commercial sponge is black and slimy, growing in a depth of from 30 centimeters to 30 meters or more. The sponge is first taken up either with the hands or with a hook on the end of a pole. It is then placed on shore or on a platform in the sun for a day or two, until dead. Afterwards it is placed in an inclosure built on the edge of the salt water and allowed to remain for eight or ten days, a man going over the sponges each day, or as often as is necessary, squeezing them out and beating out shell or pieces of coral. They are then threaded on strings and allowed to dry. They may also be bleached by dipping them in soapsuds two or three times and placing them in the sun. Chemicals are also used, but they cause more or less damage to the fiber.

REGULATION OF SPONGE BANKS.

Prompt regulation of the sponge fisheries is urgently needed. Even the very youngest sponges are being taken and unless some measure is introduced to prevent this, the beds will be entirely destroyed. A law should be enacted prohibiting the taking of sponges less than 10 centimeters through their least diameter at the center. In the opinion of Mr. Seale it would be well to declare all inshore sponge grounds to be Government property, subject to lease for a long period at a nominal rent. In this way every sponger will care for his ground and allow the sponges to grow to full size, instead of depleting it as would be the case under a short lease. Each man should buoy and enter his claim, a given amount of work should be required each year. One thousand yards square would be a fair size for a claim, with provision that an additional claim or even two might be taken by the same individual on payment of a larger fee to the Government. Corporations should be rigidly excluded. The law should be uniform for the entire Archipelago, as there are also good sponge banks in the vicinity of Masbate and Cebu.

OTHER WORK.

In addition to carrying on the work outlined above we have been able to supply considerable information to commercial fishermen regarding the drying, salting and curing of fishes for the trade. It is our opinion that improvement can be effected in the curing of fish and a much better product secured. Experiments to that end are now being conducted. It is also our endeavor to interest investors in establishing a fish-canning establishment. This enterprise would be justified owing to our abundant supply of fine anchovies and sardines. Such a cannery would relieve us of the necessity of importing \$85,000 worth of sardines from foreign countries each year.

OTHER FISHERY PRODUCTS.

Mr. Seale found some precious red coral while carrying on the investigation in the Gulf of Davao. Only a small spray was encountered but this was enough to prove the existence of this organism. This specimen was found in a little bay at Digos on the west side of the gulf. The coral beds of Japan yield 600,000 pesos worth of coral each year and it is to be hoped that those which undoubtedly exist in the Philippines will soon be located.

In the Gulf of Davao the sea slug (*Holothurian*) called *trepan* or *bot* when dry) is extremely abundant.

FISHERY EXPORTS AND IMPORTS.

During the nine months from January 1 to September 30, 1907, the Philippines imported 125,452 pesos worth of fish from the United States, 28,234 pesos from Canada, 166,948 from Spain (chiefly sardines) and

76,576 shellfish from China. We exported to the British East Indies during this time 110,000 pesos worth of pearl shell, 32,582 of tortoise shall and 56,448 of other fish products. The list of exports and imports as given in the Quarterly Summary of the Commerce of the Philippine Islands, prepared in the Bureau of Insular Affairs for the nine months from January 1 to September 30, 1907, is as follows:

Exports:	Pesos.
Pearl shell	111,124
Tortoise shell	33,082
Fish	97,918
Trepang, etc.....	64,762
Total	<u>306,886</u>
Imports:	
Salmon	148,020
Other fish	197,890
Shellfish	86,910
Other sea products	65,942
Total	<u>498,762</u>

Thus, our fishery imports for this period exceeded our exports by 191,876 pesos, a condition for which there can be no good excuse, as it simply shows our failure to utilize the rich natural resources of the Philippine waters.

THE LIBRARY.

For the first time in the history of the library it is possible to report satisfactory progress in the work of permanent organization.

PERSONNEL.

The position of assistant librarian provided for in the appropriation bill for the fiscal year 1908 was filled by the appointment of Miss Sarah E. Osgood on January 15, 1908. Temporary employees selected from lists of students submitted by teachers in the various schools of the city have been of great assistance and have proved very satisfactory. During the school year these students work only in the afternoons, but for two months of the long school vacation we had several of them for all day.

REARRANGEMENT OF STACKS AND FURNITURE.

In order to secure a greater degree of quiet for the readers in the library, a rearrangement of stacks was effected during December, 1907, and January, 1908, by which a work room was secured containing no book stacks except those around the walls. In this room have been placed all typewriters except such as are needed for special pieces of work and it is hoped that this need may soon be met in some other way so that all typewriters may be banished from the main library room. In the work room the classification, shelf-listing and cataloguing are

carried on with greater freedom from interruption than would be possible in that used for reading; all incoming mail is sent at once to this room also, thus avoiding the danger of loss of publications before record is made. Such an arrangement of stacks and furniture was impossible so long as the main library room needed to be kept free for an assembly hall, but with the establishment of the Philippine Medical School a hall was available for this purpose, giving opportunity for a more economical and convenient arrangement of the library.

At the time the above changes were made, the stacks and shelves were carefully inspected and put in good condition by the staff of the engineer's division, who also extended the stacks to the ceiling on one wall of the work room, thus adding 84 feet of shelving. These upper shelves are used for duplicate material and stores, thus relieving the shelves in the regular stacks. Six double periodical stacks of red narra, matching other library furniture, have also been secured during the year, furnishing 432 additional feet of shelving for current periodicals and serials.

The needs of shelf space will be a pressing one in the near future. It would seem that a fireproof library placed in the proposed new wing would be the most economical solution of this problem, which must be met in some way within the next two years.

ORDERS OUTSTANDING AND FILLED.

Orders for 188 titles have been placed through the Bureau of Supply during the year, and all old orders with the exception of 70 titles (many of which have been filled in part) have been received. Among the more important sets may be mentioned the following:

Annals and Magazine of Natural History, *Proceedings of the Zoölogical Society of London*, *British Journal of Dermatology*, *Library Journal*, *Public Libraries*, *Dingler's Polytechnisches Journal*, *Compte rendu de la IX Session du Congress géologique international (Vienna, 1903)*. In all 1,834 bound volumes and approximately 950 unbound volumes and parts have been added to the library. Several hundred single numbers of periodicals ordered during 1907 have come in and the completed volumes bound; orders have been forwarded every few months claiming numbers not received and supposed to have been lost in the mail. Lists have also been sent to our dealers from time to time for such publications as it was evident that we could not secure from the publishers. A large number of these orders are still unfilled and as a result many volumes are waiting, incomplete, for binding. This will doubtless remain one of our most troublesome problems because of the long distance between our library and the place of publication of our subscriptions and exchanges.

ACCESSIONING.

All bound volumes received by purchase or by transfer before June 1, 1906, and all bound volumes received from any source since that date have now been accessioned, making up a total of 15,283 volumes. All unbound publications received prior to October 23, 1906, have been

accessioned, giving a total of 8,760. Besides the unbound material received since the above date, there remain a number of gifts, exchanges, etc., received bound before June 1, 1906, yet to be accessioned.

CLASSIFICATION AND SHELF-LISTING.

Since February, 1908, work has progressed rapidly on permanent classification and shelf-listing, 10,364 complete volumes and 534 unbound parts have been classified and marked, and shelf-list cards completed for all. It is planned to make a copy of the shelf-list as rapidly as it is completed to serve in the reading room as a classified catalogue until the dictionary catalogue is available for use.

PRINTED CARDS.

One large shipment of printed cards from the Library of Congress has been received and filed. Proof of all cards issued by that library is sent regularly; from this proof, orders are made by checking numbers desired and reporting on order cards furnished for this purpose. The proof is then cut to card size and filed for reference.

Printed cards for the bulletins of the United States Geological Survey, for the annual reports of the Smithsonian Institution and for the receipts of the John Crerar Library, Chicago, during 1905 and 1906 have also been received and filed.

ACCESSION RECORD FOR CURRENT PERIODICALS.

The scheme for recording current periodical receipts was changed at the beginning of 1907 from the accession book to cards, but until the plan was tested, only a temporary list was made up. At the beginning of 1908 cards were prepared which will serve for a number of years without rewriting titles (for monthly publications space is available for twenty years). Care was taken in deciding upon the form of entry to make each title uniform with the entry form in the shelf-list and catalogue. It is proposed to print this list to show the resources of the library in periodical and serial publications. Publications of which we have complete sets will be indicated. This list now includes a number of titles which will be withdrawn when the permanent catalogue of the library is available for use. The Bureau of Printing has delivered 885 bound volumes to the library and still has 523 volumes to be bound.

EXCHANGES.

Many valuable publications have been added to the exchange list of the Philippine Journal of Science and a number of institutions have donated complete sets of their publications in return for the previous publications of the various divisions of the Bureau of Science. It is regretted that a complete list of these donations and other gifts can not be included in this report. There is a growing demand for the earlier

publications of the Bureau, many of which are now out of print. Requests from institutions and libraries and also of individuals especially interested in the particular publication requested are filed, and as rapidly as these publications are received from any source, the particular numbers desired are forwarded. It has been possible to fill a number of such requests during the past year through the courtesy of the Secretary of the Interior, who returned many copies of the earlier bulletins to the library.

The preparation and mailing of the circulars for the Philippine Journal of Science has been supervised in the library during the past year, but the routine mailing of the journal has been attended to by the business office and stenographers. Cards to contain records of publications sent from all divisions of the Bureau and of all advertising matter concerning the Philippine Journal of Science have been printed and a careful revision of the mailing list is now in progress.

USE OF THE LIBRARY.

With the greater freedom from noise and from interruptions in the reading room, the use of books in the library has noticeably increased. Reference books have for the first time been reserved. No record is kept of these, but in addition 8,135 books, periodicals and pamphlets were withdrawn from the library by 177 borrowers. Statistics of the number of publications borrowed from the main library and from other Bureaus of the Department of the Interior have been tabulated to December 31, 1907.

LOAN DESK.

The service at the loan desk is still far from satisfactory, but plans have been formulated which it is hoped will bring about an improvement. However, these can not be carried out until the work of organization has been further perfected nor until we can keep a clerk at the desk during the entire time that the library is open each day.

THE PHOTOGRAPHER.

The routine work of the photographer is given by the following table:

Prints sold to other Bureaus, individuals, and prints made for the various departments of the Bureau of Science.....	6,694
Prints made for the album.....	1,700
Enlargements, 14 by 17.....	36
Negatives, 5 by 7.....	610
Negatives, 8 by 10.....	218
Skiagraphs, 8 by 10.....	12
Skiagraphs, 11 by 14.....	4
Transparencies, 8 by 10.....	78
Transparencies, 5 by 7.....	3
Lantern slides	315

Mr. Martin, the photographer of the Bureau, was closely occupied with the work in Manila during the greater part of the year, but he was able to make a trip to Taal Volcano and another trip of three weeks to La Laguna Province during the month of January, 1908. All of our negative envelopes have been typewritten and catalogued during the year, the work keeping 4 typewriters employed for five weeks and another for three months.

THE CLERICAL DIVISION.

This work, which has greatly increased in volume during the past year, was in charge of Mr. A. D. Tanner during Mr. Nell's absence on leave, and since the return of the latter we have practically had a full force, so that many needed improvements in filing and bookkeeping could be carried through.

There is only one question seriously hindering the work of this division. At the beginning of each fiscal year we have endeavored to have our books on appropriations balance with those of the Auditor, but so far have been unsuccessful, due mainly to the fact that our bookkeeper signifies on each voucher or warrant the proper fiscal year to which the expenditure should be charged, whereas the Auditor may disregard our notations and charge them against some other account without notification. As long as this method is continued it is obviously impossible for our bookkeeper to make his books balance with those of the Auditor.

This question is a very serious one because the law provides that the officer having charge of an appropriation must certify on each requisition that funds are available. The Auditor has not heretofore given us a statement showing the actual balance available at certain periods, nor does he advise us in each instance of any changes in the charging of vouchers and warrants. It is therefore impossible for the Director of this Bureau to know authoritatively from the Auditor at all times whether or not funds are actually available—the balances as shown by our books naturally not being accepted by the Auditor.

A great improvement would be instituted if that official were to furnish each Bureau with a statement of the appropriation accounts at the end of each month, showing thereon the balance available at the end of the previous month and an itemized statement of the vouchers and warrants charged against the separate appropriation accounts. If such a statement, in his opinion, would take too much time, the Bureaus themselves could make them up and have them audited so as to be returned within a short time.

PAUL C. FREER,

Director of the Bureau of Science.

To the Honorable,

the SECRETARY OF THE INTERIOR, Manila, P. I.

TABLE I.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1908, as compared with the fiscal year 1907, by number or quantity.

[July 1, 1908.]

Division of the Bureau.	1907.	1908.	Decrease.	Increase.
Chemical laboratory division:				
Oils, paints, pigments, etc.....	41	103	-----	62
Clays, soils, fertilizers, cements.....	24	1,357	-----	1,333
Gas, petroleum, woods.....	*30	11	19	-----
Foods, alcohols and beverages.....	285	1,057	-----	772
Waters.....	113	74	39	-----
Urines, clinical and toxicological analyses.....	1,033	408	630	-----
Miscellaneous.....	760	299	461	-----
Total.....	2,286	3,304	-----	1,018
Section of mineral analysis and standardization of weights and measures:				
Assays.....	621	575	46	-----
Weights and measures standardized, sets.....	148	1,640	-----	1,492
Calorimetric tests of fuels.....				
Coal tests.....	(*)	6	-----	6
Coal analyses.....	(*)	6	-----	6
Rocks and minerals.....	6	35	-----	29
Metals and alloys.....	3	5	-----	2
Total.....	778	2,267	-----	1,489
Biological laboratory division:				
Fæces.....	6,300	7,233	-----	933
Sputum.....	1,682	818	864	-----
Blood.....	2,377	1,732	645	-----
Gonococci.....	14,169	14,051	118	-----
Waters.....	150	310	-----	160
Necropsies.....	250	188	62	-----
Miscellaneous.....	1,521	3,352	-----	1,831
Total.....	26,449	27,684	-----	1,230
Serum section of the biological laboratory:				
Vaccine virus—	<i>Units.</i>	<i>Units.</i>	<i>Units.</i>	<i>Units.</i>
Prepared.....	2,804,042	3,021,644	-----	217,602
Disposed of.....	2,846,687	3,008,945	-----	162,258
Anti-rinderpest serum—				
Prepared.....	947,800	1,900,700	-----	925,900
Disposed of.....	1,376,550	1,887,750	-----	511,200
Plague prophylactic—				
Prepared.....				
Disposed of.....		6,390	-----	6,390
Mallein—				
Prepared.....	837	5,828	-----	4,991
Disposed of.....	830	5,394	-----	4,564
Diphtheria antitoxin—				
Prepared.....		719,500	-----	719,500
Disposed of.....	69,500	647,000	-----	577,500
Tetanus antitoxin ^b —				
Prepared.....	416,092	64,000	351,992	-----
Disposed of.....	181,117	391,850	-----	210,733

^a In the statement for 1907 calorimetric tests of fuels, coal tests and coal analyses are included under the one heading "Fuels, coals, woods, gas, petroleum."

^b The unit was changed twice during the year.

TABLE I.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1908, as compared with the fiscal year 1907, by number or quantity—Continued.

Division of the Bureau.	1907.	1908.	Decrease.	Increase.
Serum section of the biological laboratory—Cont'd.				
Cholera prophylactic—				
Prepared -----	1,710		1,710	
Disposed of -----	1,650	30	1,620	
Anti-plague serum—				
Prepared -----	205	1,470		1,265
Disposed of -----	30	6,120		6,090
Anti-cholera serum—				
Prepared -----		1,980		1,980
Disposed of -----		1,620		1,620
Anti-dysentery serum—				
Prepared -----		2,250		2,250
Disposed of -----		210		210
Anti-typhoid serum—				
Prepared -----		450		450
Disposed of -----		120		120
Anthrax prophylactic No. 1 and No. 2—				
Prepared -----		3,947		3,947
Disposed of -----		160		160
Tuberculin, human—				
Prepared -----		113		113
Disposed of -----		5		5
Tuberculin, bovine—				
Prepared -----		116		116
Disposed of -----		3		3
Anti-gonococcus prophylactic—				
Prepared -----		390		390
Disposed of -----		1		1
Anti-staphylococcus prophylactic aureus and albus—				
Prepared -----		450		450
Disposed of -----		2		2
Typhoid reagent (for diagnosis)—				
Prepared -----		65		65
Disposed of -----				
Cholera reagent (for diagnosis)—				
Prepared -----		150		150
Disposed of -----				
Normal horse serum—				
Prepared -----		11,640		11,640
Disposed of -----		1,840		1,840
Normal ox serum—				
Prepared -----		2,910		2,910
Disposed of -----		130		130
Normal carabao serum—				
Prepared -----		900		900
Disposed of -----				
Miscellaneous—				
Shop orders -----	131	160		29
Photographs -----	18,655	6,694	11,961	
Natural history specimens sold -----		54		54
Miscellaneous work and supplies -----	3	48		45

TABLE II.—Comparative table of routine work performed (free and cash) and supplies manufactured and sold during the fiscal year 1908, as compared with the fiscal year 1907, by value.

[July 1, 1908.]

Division of the Bureau.	1907. ^a	1908.
Chemical laboratory division:		
Oils, paints, pigments, etc		₹738.00
Clays, soils, fertilizers, cements		16,146.00
Gas, petroleums, woods		202.50
Foods, alcohols and beverages		17,129.50
Waters		2,535.00
Urines, clinical and toxicological analyses		1,278.00
Miscellaneous		5,427.50
Total		43,456.50
Section of mineral analysis and standardization of weights and measures:		
Assays		2,108.00
Sets weights and measures standardized		975.40
Calorimetric tests of fuels		
Coal tests		600.00
Coal analyses		190.00
Rocks and minerals		317.00
Metals and alloys		22.50
Miscellaneous		
Total		4,212.90
Biological laboratory division:		
Fæces		21,703.00
Sputum		2,451.00
Blood		5,200.00
Gonococci		42,153.00
Waters		8,240.00
Necropsies		4,700.00
Miscellaneous		12,795.00
Total		97,242.00
Serum section of the biological laboratory:		
Vaccine virus		30,117.60
Anti-rinderpest serum, bottling, standardizing, etc., only		6,695.45
Mallein		5,314.00
Miscellaneous preparations		825.85
Total		42,952.90
Miscellaneous:		
Shop work	(^b)	
Photographs		2,305.50
Natural history specimens sold		19.00
Miscellaneous work and supplies		2,137.43
Total		4,461.93
Grand total	₹162,925.96	₹192,326.23

^a Not itemized for the fiscal year 1907. ^b Not estimated. ^c Increase, ₹29,400.27.

TABLE III.—Comparative table of cash receipts for the fiscal year 1908 as compared with the fiscal year 1907.

[July 1, 1908.]

Division of the Bureau.	1907. ^a	1908.	Decrease.	Increase.
Chemical laboratory division:				
Oils, paints, pigments, etc.....		₱288.10		
Clays, soils, fertilizers, cements.....		8,243.00		
Gas, petroleum, woods.....		25.00		
Foods, alcohols and beverages.....		513.50		
Waters.....		505.00		
Urinæ, clinical and toxicological analyses.....		238.00		
Miscellaneous.....		213.00		
Total.....	₱2,737.30	10,020.60		₱7,283.30
Section of mineral analysis and standardization of weights and measures:				
Assays.....	1,222.00	2,096.00		874.00
Sets weights and measures standardized.....		30.00		
Calorimetric tests of fuels.....				
Coal tests.....		200.00		
Coal analyses.....		190.00		
Other fuel analyses.....				
Rocks and minerals.....		242.00		
Metals and alloys.....		13.50		
Miscellaneous.....				
Total.....	1,222.00	2,771.50		1,549.50
Biological laboratory division:				
Fæces.....		96.00		
Sputum.....		36.00		
Blood.....		24.00		
Gonococci.....		9.00		
Waters.....		210.00		
Necropsies.....				
Miscellaneous.....		127.00		
Total.....	753.70	502.00	₱251.70	
Serum section of the biological laboratory:				
Vaccine virus.....	28,422.97	30,117.60		1,694.63
Anti-rinderpest serum.....	22,288.05	6,695.45	15,592.60	
Mallein.....	830.00	5,314.00		4,484.00
Miscellaneous preparations.....	632.92	825.85		192.93
Total.....	52,173.94	42,952.90	9,221.04	
Miscellaneous:				
Shop work.....		118.58		
Photographs.....	3,948.32	1,999.14	1,949.18	
Natural history specimens sold.....		19.00		
Miscellaneous work and supplies.....	3,582.20	2,137.43	1,444.77	
Total.....	7,530.52	4,274.15	3,256.37	
Grand total.....	64,417.46	60,521.15	3,896.31	

^a Not itemized.^b In 1908 charge made for bottling, standardizing, etc. only; previous year charge made for drawing serum, etc.^c Difference in this table and Table V: This is work completed; Table V is cash received.

TABLE IV.—*Showing free and cash work performed and supplies sold to the various departments of the Government for the fiscal year 1908.*

(Free work estimated in accordance with Act No. 807, sec. 1, Bureau of Government Laboratories, last paragraph.)

[July 1, 1908.]

Bureau or department.	Free.	Cash.	Total.
Bureau of Health:			
Foods, alcohols and beverages	₱16,380.00		₱16,380.00
Waters, chemical	315.00		315.00
Urines, clinical and toxicological analyses	1,024.00		1,024.00
Miscellaneous chemical examinations and analyses	3,932.00		3,932.00
Fæces	2,679.00		2,679.00
Sputum	795.00		795.00
Blood	1,941.00		1,941.00
Gonococci	42,141.00		42,141.00
Waters, biological	7,565.00		7,565.00
Necropsies	3,800.00		3,800.00
Miscellaneous biological examinations	11,223.00		11,223.00
Photographic work		₱48.60	48.60
Shop work		5.79	5.79
Vaccine virus		27,979.75	27,979.75
Other serums and preparations		289.75	289.75
Total	91,795.00	28,323.89	120,118.89
Bureau of Public Works:			
Fertilizers, cements, clays, soils	7,010.00		7,010.00
Waters, chemical	1,090.00	40.00	1,130.00
Waters, biological	400.00		400.00
Oils, paints, pigments, etc	20.00		20.00
Rocks and minerals	20.00		20.00
Supplies		17.64	17.64
Total	8,540.00	57.64	8,597.64
Bureau of Navigation:			
Fertilizers, cements, clays, soils	735.00		735.00
Oils, paints, pigments	10.00		10.00
Waters, chemical	15.00		15.00
Waters, biological	40.00		40.00
Fuels, woods, gases, petroleums	20.00		20.00
Total	820.00		820.00
Bureau of Agriculture:			
Miscellaneous, chemical	160.00		160.00
Photographs		120.72	120.72
Anti-rinderpest serum, bottling		6,695.45	6,695.45
Mallein		4.00	4.00
Miscellaneous, biological	77.00		77.00
Total	237.00	6,820.17	7,057.17
Bureau of Audits:			
Assays	2.00		2.00
Fertilizers, cements, clays, soils	20.00		20.00
Total	22.00		22.00

TABLE IV.—Showing free and cash work performed and supplies sold to the various departments of the Government for the fiscal year 1908—Continued.

Bureau or department.	Free.	Cash.	Total.
Bureau of Customs:			
Miscellaneous, chemical	₱371.50		₱371.50
Oils, paints, pigments, etc	245.00		245.00
Food, alcohols and beverages	54.00		54.00
Waters, chemical	15.00		15.00
Total	685.50		685.50
Bureau of Science:			
Waters, chemical	350.00		350.00
Miscellaneous, biological	780.00		780.00
Photographic	306.36		306.36
Miscellaneous, chemical	86.00		86.00
Rocks and minerals	24.00		24.00
Assays	10.00		10.00
Coal tests	200.00		200.00
Weights and measures standardized, sets	3.00		3.00
Necropsies	350.00		350.00
Shop work (not estimated.)			
Total	2,109.36		2,109.36
Bureau of Printing:			
Miscellaneous, chemical	528.00		528.00
Supplies		₱10.00	10.00
Total	528.00	10.00	538.00
Bureau of Supply:			
Miscellaneous, chemical	227.50		227.50
Coal tests	200.00		200.00
Sets weights and measures standardized	931.90	7.00	938.90
Oils, paints, pigments	145.00		145.00
Waters, chemical	30.00		30.00
Supplies		43.85	43.85
Total	1,534.40	50.85	1,585.25
Bureau of Internal Revenue:			
Foods, alcohols and beverages	88.00		88.00
Miscellaneous, chemical	100.00		100.00
Sets weights and measures standardized	10.00		10.00
Supplies		9.14	9.14
Total	198.00	9.14	207.14
Sewer and water works construction of the city of Manila:			
Cements		7,555.00	7,555.00
Total		7,555.00	7,555.00
Bureau of Constabulary:			
Vaccine virus		52.00	52.00
Waters, chemical	150.00		150.00
Rocks and minerals	10.00		10.00
Miscellaneous, biological	150.00		150.00
Total	310.00	52.00	362.00

TABLE IV.—Showing free and cash work performed and supplies sold to the various departments of the Government for the fiscal year 1908—Continued.

Bureau or department.	Free.	Cash.	Total.
Public Health and Marine-Hospital Service:			
Vaccine virus		P472.00	P472.00
Department of sanitation and transportation of the city of Manila:			
Serums		24.00	24.00
Philippine Medical School:			
Miscellaneous supplies		907.91	907.91
Photographs		44.80	44.80
Total		952.71	952.71
United States Army and Navy:			
Cements, fertilizers, clays, soils		80.00	80.00
Coal tests and coal analyses		305.00	305.00
Miscellaneous supplies87	.87
Waters, chemical		155.00	155.00
Waters, biological		200.00	200.00
Miscellaneous, biological		15.00	15.00
Vaccine virus		850.95	850.95
Mallein		5,310.00	5,310.00
Serums		229.00	229.00
Total		7,145.82	7,145.82
Bureau of Education:			
Photographs		161.70	161.70
Miscellaneous, biological	P375.00		375.00
Miscellaneous, chemical	30.00		30.00
Fertilizers, cements, clays, soils	15.00		15.00
Total	420.00	161.70	581.70
Bureau of Prisons:			
Fæces	18,924.00		18,924.00
Sputum	1,620.00		1,620.00
Blood	3,234.00		3,234.00
Necropsies	550.00		550.00
Miscellaneous, biological	43.00		43.00
Miscellaneous, chemical	48.00		48.00
Total	24,419.00		24,419.00
Grand total	131,618.26	51,634.92	183,253.18

TABLE V.—Comparative statement showing expenditures (including obligations incurred) for the fiscal year 1908 as compared with the fiscal year 1907.

[July 1, 1908.]

Item.	1907.	1908.	Decrease.	Increase.
Apparatus, supplies, etc:				
Miscellaneous supplies, chemical and apparatus.....	₹24,130.20	₹41,035.01	-----	₹16,904.81
Supplies for power plant, oil, coal, and materials for shop work, etc..	10,479.72	15,584.55	-----	5,104.83
Small animals and feed.....	5,472.32	2,218.51	₹3,253.81	-----
Large animals and feed.....	25,488.71	4,731.75	20,756.96	-----
Office supplies.....	2,485.79	2,234.04	251.75	-----
Photographic supplies.....	3,987.87	3,364.60	623.27	-----
Books and subscriptions.....	11,573.72	11,187.01	386.71	-----
Total.....	83,618.33	80,355.47	3,262.86	-----
Transportation and freight:				
Transportation, travel expenses, per diems, launch hire, freight.....	8,046.74	11,931.45	-----	3,884.71
City transportation.....	2,084.71	3,336.77	-----	1,252.06
Total.....	10,131.45	15,268.22	-----	5,136.77
Miscellaneous:				
Telephones and fire-alarm boxes.....	446.79	496.60	-----	49.81
Postage, telegrams, cablegrams.....	2,589.21	2,399.78	189.43	-----
Repairs to apparatus, furniture, etc..	1,542.52	1,301.31	241.21	-----
Laundry.....	382.79	246.77	136.02	-----
Printing and binding.....	20,613.08	25,190.47	-----	4,577.39
Advertising.....	-----	216.08	-----	216.08
Building construction, maintenance and incidentals.....	7,000.00	24,576.70	-----	17,576.70
Total.....	32,574.39	54,427.71	-----	21,853.32
Salaries and wages:				
Salaries and wages.....	184,008.71	199,259.89	-----	15,251.18
Accrued leave, foreign transportation, half salary en route, etc.....	27,855.16	13,727.29	14,127.87	-----
Total.....	211,863.87	212,987.18	-----	1,123.31
Grand total.....	338,188.04	363,038.58	-----	24,850.54

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