THE PHILIPPINE JOURNAL OF SCIENCE

EDITED BY

PAUL C. FREER M. D., PH. D.

CO-EDITOR,

RICHARD P. STRONG, PH. B., M. D.

WITH THE COLLABORATION OF

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* *No. 1, 1902, to No. 14, 1904.*

15. *No. 15, 1904, Biological and Serum Laboratories.*—Report on Bacillus Violaceous Manilæ: A Pathogenic Micro-Organism. By Paul G. Woolley, M. D.

* *No. 16, 1904, Biological Laboratory.*—Protective Inoculation against Asiatic Cholera: An Experimental Study. By Richard P. Strong, M. D.

17. *No. 17, 1904.*—New or Noteworthy Philippine Plants, II. By Elmer D. Merrill, Botanist.

* *No. 18, 1904, Biological Laboratory.*—I. Amebas: Their Cultivation and Etiologic Significance. By W. E. Musgrave, M. D., and Moses T. Clegg. II. The Treatment of Intestinal Amœbiasis (Amœbic Dysentery) in the Tropics. By W. E. Musgrave, M. D.

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25. *No. 25, 1904.*—Birds from the Islands of Romblon, Sibuyan, and Cresta de Gallo. By Richard C. McGregor. (*For first four bulletins of the ornithological series, see Philippine Museum below.*)

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36. *No. 36, 1905.*—A Hand-List of the Birds of the Philippine Islands. By Richard C. McGregor and Dean C. Worcester.

* Report of the Superintendent of Government Laboratories for the Year Ending August 31, 1902. (Appendix M of Third Annual Report of the Philippine Commission.)

* Report of the Superintendent of Government Laboratories in the Philippine Islands for the Year Ending September 1, 1903. (Appendix G of the Fourth Annual Report of the Philippine Commission.)

39. Third Annual Report of the Superintendent of the Bureau of Government Laboratories for the Year Ending August 31, 1904.

40. Fourth Annual Report of the Superintendent of the Bureau of Government Laboratories for the Year Ending August 31, 1905.

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101. Price and Exchange List of Philippine Bird Skins in the Collection of the Bureau of Science, Manila, P. I. (Effective January 1, 1908.)

102. *No. 1, 1909.*—A Check-List of Philippine Fishes. By David Starr Jordan and Robert Earl Richardson. *In press.*

103. *No. 2, 1909.*—A Manual of Philippine Birds. By Richard C. McGregor. Parts I and II. A systematic index to the orders, families, and genera. Paper, ₱8 for the two parts.

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* Out of print.

(Concluded on third page of cover.)

The editors regret very much the delay in the printing of the first two numbers of the JOURNAL for the year 1909; this delay has been due to the loss of the paper, upon which the JOURNAL was to be printed, caused by the sinking of the steamer *Kalomo* in Singapore Harbor in December, 1908. Other paper was immediately cabled for, but did not arrive in Manila until May 15.

The other numbers will be printed as rapidly as possible, and the full series will appear during the year.

THE PHILIPPINE

JOURNAL OF SCIENCE

B. MEDICAL SCIENCES

VOL. IV FEBRUARY, 1909 No. 1

ATOXYL IN THE TREATMENT OF MALARIA.

By J. J. VASSAL.

(From the Pasteur Institute, Nhatrang, Annam.)

In the native hospital of Nhatrang, I had the opportunity of studying the therapeutical action of atoxyl on seventeen different cases of malaria. The patients were Annamese and came from the gangs of workers on the railway line Phanrang-Nhatrang, now in construction. There is much severe malaria among them. During the two years employed in the construction of the earthworks the following cases occurred:

Cases treated.	1906.	1907.
In hospital	152	132
Outside hospital	6,286	974

The inequality in the figures is due to the fact that the workmen were more numerous during the first year than the second. The Annamese do not like being sent to the hospital and it is very difficult to keep them there for any length of time. Therefore our observations were difficult to pursue and in some cases were not carried out as thoroughly as we could have wished; some of them were even interrupted abruptly.

Atoxyl is enjoying a vogue in therapeutics which is almost without example. It has rapidly become the specific agent in sleeping sickness (Thomas, Laveran, Mesnil, Nicolle and Aubert, and R. Koch) and plays a prophylactic rôle of the highest importance in syphilis (Metchnikoff and Salmon.) Its action is again manifest on several forms of trypanosomiasis (Nicolle, Mesnil, Moore, Nierenstein and Todd); in acquired syphilis (Uhlenhuth, Hoffmann, Roscher, Metchnikoff, Hallopea, Lassar, etc.); in general paralysis (Marie); in the spirillosis of fowls (Uhlenhuth, Gross and Bickel); in pellagra (Babes and Vasiliu). On the other hand atoxyl has been inefficacious in tick fever (Breinl, Kinghorn and Vassal).

Arsenical preparations have been specified for some time as effective against malaria (Boudin, Mosler and Guerin), but the use of atoxyl for such a purpose does not appear to have given rise to many researches in this direction until the present time. R. Koch in Africa, has had the opportunity of studying its effects on the negroes attacked with sleeping sickness and malaria at the same time. The antiparasitic power of atoxyl was supposed to limit the action of the Trypanosoma Gambiense and only slightly to influence the evolution of Laveran's hæmatozoön.

THERAPEUTIC DOSES OF ATOXYL.

The experimental therapeutic tests have shown us the different qualities of atoxyl and the proper doses to be employed.

F. Mesnil, Nicolle, and Aubert for instance give 2.5 centigrams for every 1,000 grams of the animal's weight. Metchnikoff prevents the primary eruption of the syphilitic chancre in the monkey, by giving it 33 milligrams for every kilogram of the animal's weight. According to this investigator the prophylactic dose for a man of 60 kilograms of weight should be at the most 2 grams. Hallopeau keeps within these limits in his preventive treatment, but inoculates from 5 to 7.5 grams during a period of three weeks as a precautionary measure in syphilis. For sleeping sickness in the negro, R. Koch injects 0.50 gram of the drug every other day during two months.

Our patients here were composed exclusively of Annamese weighing on an average 35 to 40 kilograms. We used noncrystallized atoxyl "Martini Renfelde" from Berlin. The strength of the solution was 10 per cent; the injections were made as with quinine, deep into the muscles of the buttocks, except in one case (observation 7) where they were made under the skin of the abdomen. The solutions were always freshly prepared and boiled in a water bath for ten minutes before use. The maximum dose of atoxyl employed at one inoculation was 1 gram. The same solution (10 percent) was employed per os in the dose of 10 centigrams of atoxyl a day during ten days or for a longer period without interruption.

We administered the atoxyl in two different ways:

1. Alone in hypodermic injections.
2. Associated with hypodermic injections of hydrochlorate of quinine given either by injections or per os.

The results obtained are the subject of the present memoir. We will divide them into two parts: (I) Treatment by atoxyl alone; (II) treatment by atoxyl with quinine.

Part I.

TREATMENT BY ATOXYL ALONE.

We are able to report upon seven cases, of which four were of malignant, tertian malaria and three of single, tertian fever. These were numbers 2, 6, 8, 12, 15, 16, and 17.

No great weight must be attached to the observations on case number 12, as the treatment was interrupted by the abrupt departure of the subject. Three inoculations were made during six days, the two first consisted of 0.25 gram and the other of 0.50 gram. They were well supported.

On the other hand, the observations on case number 2 are complete.

The patient was a young Annamese 23 years of age and was suffering with malarial cachexia, with hypertrophy of the spleen, œdema of the extremities and pulmonary congestion. The treatment in hospital lasted eighty-five days. He was given only 1.50 grams of atoxyl in three injections during a period of nine days. All other medication was avoided. The fever remained above normal for sixteen days although there were some remissions. Therefore, the parasitic action of the drug seems *nil*, but the general state of health improved, and the spleen diminished in an appreciable manner.

Number 8 was a case of double tertian, malarial fever in a native of 22 years of age.

The first injection of atoxyl, 0.50 gram, was made during an exacerbation of the fever and when the blood showed an intense multiplication of the parasite. Three injections were made within six days in doses of 0.50 gram each. The patient was lost sight of at this period, but it was not long before he returned in a still worse condition, with advanced cachexia. The extremities were swollen and albumin was present in the urine. It was only too evident that the first injections had no effect. On his return he was given two more grams of atoxyl in four days (0.50 gram per day). An analysis of the blood left no doubt as to the failure of the specific treatment. The further increase of the young forms of the parasite continued regularly, there being at the previous examination from three to four parasites in a field and at the later examination, from ten to twelve; neither were the gametes in any way influenced by the drug. The effect on the general condition seemed favorable, but it is difficult to give a decided opinion on this point, as the patient was lost sight of again before his cure was terminated.

Number 6 was a typical case of tertian fever. Atoxyl was again employed; in nine days three injections were given consisting of 2.50 grams.

The chart of the temperature and the analysis of the blood proved that the infection followed its course without any modification whatever by the drug. The experiment was pushed as far as the resistance of the patient would permit. Sponging and antipyretics were necessary to keep the fever within bounds. The specific action compared to that of quinine was certainly nil. After some slight relapses, convalescence set in with a surprising rapidity. The patient left the hospital after a month having increased three kilograms in weight. He had received altogether 5.50 grams of atoxyl.

Case number 15 is interesting on account of the accidents caused by atoxyl. We will discuss them later. Four grams were injected in eight days. The fever showed a tendency to decline.

Another patient, number 16, was treated even more energetically; 4 grams were given in seven days; his high temperature was found to fall rapidly but a serious remission occurred. The drug was well borne, but the premature departure of the patient prevented any commentary on the future results of the treatment.

Observation number 17 was similar to observation number 6. This was also a case of tertian fever. There was no doubt again as to the failure of the specific treatment. As soon as quinine was given the temperature became reduced and pursued a normal course.

PART II.

TREATMENT BY ATOXYL AND QUININE.

A mixed treatment was tried in ten cases (1, 3, 4, 5, 7, 9, 10, 11, 13, 14) in the following manner:

1. Injections of quinine associated with injections of atoxyl.
2. Injections of quinine associated with atoxyl *per os*.

We used a solution of hydrochlorate of quinine in a dilution of 1 to 10. Number 13 was the only case in which injections of quinine were associated with injections of atoxyl.

The first nine days we gave injections of quinine, 0.50 gram each; these were immediately followed by three injections of atoxyl, 0.50 gram each, given the first, second, and sixth day. The affection was of long duration and crescents were frequently met with in the peripheral blood. The results on the whole were favorable, the patient's condition being much improved when he left the hospital.

The nine other cases concern the action of atoxyl *per os* combined with hypodermic injections of quinine.

In case number 1 quinine was injected for six days in succession. Six days later apyrexia set in. The hæmatozoa (*Laverania malariæ*) which had disappeared, showed themselves again in the blood in considerable numbers. Atoxyl was then administered *per os*, 10 centigrams a day; there was again a febrile reaction the third day, then the temperature became normal. The spleen diminished in size and improvement in the general state of health became manifest.

The principal fact to be noted in case number 3 is the occurrence of repeated febrile attacks of malignant, tertian fever against which atoxyl *per os* was quite ineffective. Quinine was efficacious the moment it was given by injection. It was continued nevertheless at the rate of 1 gram a day for five days. It is possible to suppose that although atoxyl itself was powerless against the parasite, it prepared the way for the action of the quinine. The patient left the hospital improved.

Number 4 was a particularly tenacious case of malignant, tertian fever which had never before been treated. The spleen was enlarged extending beyond the border of the short ribs. First, a series of six injections of quinine (0.50 gram) was given during a period of ten days, then atoxyl was administered *per os* for nine days. A serious relapse ensued. A second series of six injections of quinine was given in the usual quantities. From that moment recovery seemed certain, the spleen diminished in size, and the weight of the patient increased 1 kilogram in five days. The benefits of atoxyl and quinine seemed incontestable.

Observation number 7 was made upon a similar case. From the gravity of the febrile attacks and the curve of the chart, atoxyl was soon abandoned and replaced by quinine, three injections of 1.50 grams in three days were given. Then atoxyl was again administered *per os* for fourteen consecutive days. At this time a slight relapse necessitated the employment of quinine. In consequence, atoxyl again failed as a febrifuge, but was probably not useless as a reconstituent, for the patient became convalescent and gained 2 kilograms in twenty days weighing 36 kilograms; at the end of this time moreover he was able to undertake his rough work on the railway again after remaining only one month ill in the hospital.

The cases numbered 7 and 9, who were in an advanced stage of cachexia, were certainly benefited by the combined treatment, since they were able to undertake their work again after two months in the hospital. During this time an increase of weight occurred, their general condition improved, and their spleens decreased in size. Number 7 was given atoxyl at the same time as the quinine and number 9 directly after it as the respective charts indicate.

If observation 10 seemed favorable to the routine employment of atoxyl, observation 11 shows its impotence, but I must add that number 11 was an exceptional case, rebellious against all treatment.

Observation 14 was interrupted.

ACCIDENTS DUE TO ATOXYL.

We already possess much knowledge concerning accidents which may arise from the use of atoxyl. Passing troubles, such as loss of appetite, nausea, and diarrhœa, are common to all forms of treatment with arsenic and are easily overcome. The complications which occur as a result of the localization of atoxyl in the nervous centers are more serious.

B. Waelsch relates that Bornemann observed an atrophy of the optic nerve due to hypodermic injections; it is true that the doses were large, 27 grams. R. Koch relates several cases of amaurosis among the negroes suffering with sleeping sickness, who were treated with large doses of atoxyl. A dose of 1 gram continued for some time provokes nausea, giddiness, attacks of colic, and finally amaurosis. Koch thought that this amaurosis was transitory and would disappear when all medication was eliminated; such was not the case, the patients recovered otherwise, but remained blind.

This is a danger of capital importance which should make the physician very cautious whenever atoxyl is employed as an adjuvant.

At first we only noted phenomena of little importance (cases numbered 2 and 7). In the course of treatment, number 7 had a passing diarrhœa. Number 2, who had been injected subcutaneously, seems to have felt a pain like that of a wasp's sting at the time of the injection, while the other patients found no difference between the injection of atoxyl and that of quinine. Case 2 after each dose suffered from itching all over the body, which was particularly violent about the nostrils, on the scalp, and about the pubis. Finally he had diarrhœa and a metallic taste in the mouth.

The only serious accidents were those in case number 15 who had received 4 grams of atoxyl in eight days. Less than twenty-four hours after the last injection, an erythema broke out on his face, and at the same time diarrhœa set in, with decided anorexia and nausea. From the beginning the itching was violent. The following day the whole trunk, the arms and hands, and the front of the thighs became covered with rubeoloid spots, which became confluent on the lower part of the back and there formed patches about the size of the hand. The pruritus was very intense. The eruption attained its maximum the third day; it was confluent on the chest and back, and spread out over the thighs; the face, feet, and legs were œdematous. Albumin appeared in small quantities in the urine on the third day. The spots on the fourth day were paler and the œdema of the lower limbs had diminished; on the fifth day the erythema had totally disappeared and the other symptoms had improved. Under an appropriate treatment recovery was the work of a few days.

It follows from the above that therapy with atoxyl must be kept within certain limits. As a general rule with the Annamese more than 2 grams should not be given hypodermically within a week.

There is no object in using large doses of atoxyl for malaria, as the drug is of really no value in the acute stages of the disease. The dose of 10 centigrams a day *per os* seems one that could be continued for some time, but my experience is not complete enough and is too recent for me to speak positively upon this question.

THE ACTION OF ATOXYL IN MALARIA.

Atoxyl alone, in large therapeutic doses, is incapable of stopping or modifying a febrile attack of malaria. It is not a febrifuge, nor is it even moderately antipyretic in its action.

Its direct action on the hæmatozoa of tertian and malignant, tertian fever is inappreciable, whether it is given in single large doses or is continued without interruption in small ones. It is powerless against the acute symptoms of malaria. It does not prevent relapses. In short its specific action is *nil.*

As an adjuvant to quinine on the contrary, atoxyl shows an unquestionable efficacy. We have cited numerous examples. It rapidly improves the general condition and restores strength. It is a reconstituent which is superior to the other well-known arsenical compounds. In cachectic enlargement of the spleen, where quinine itself often fails, atoxyl, combined with quinine, proves efficacious.

Malarial patients given the mixed treatment tend to increase in weight to a remarkable degree.

The red cells undergo no modification and do not increase in number. The percentage of the different leucocytes remains the same; however, the size of the large mononuclear leucocytes seemed increased after the employment of atoxyl.

CONCLUSIONS.

1. Used alone, atoxyl does not exercise a specific action in malaria.
2. Associated with quinine, it is capable of bringing about a rapid improvement in health and of hastening convalescence.
3. In cachexia and chronic forms of malaria, quinine with atoxyl appears to be more officacious than quinine alone.
4. Atoxyl in large doses is sometimes borne with difficulty and may even give rise to accidents.

REFERENCES.

Babes, V., and Vasiliu, A., *Berl. klin. Wchnsch.* (1907), **44**, 879; 1189.

Breinl, A., and Kinghorn, A., *Mem. Liverpool School Trop. Med.* (1905), **21**, 1.

Eguerin, *Ann. méd. colon.* (1902).

Hallopeau, *Bull. Acad. méd.* (1907), III, **57**, 702; 722.

Koch, R., *Deutsche med. Wchnsch.* (1907), **33**, 49; 1889.

Lassar, O., *Berl. klin. Wchnsch.* (1907), **44**, 684.

Laveran, *Bull. Acad. méd.* (1907), III, **57**, 325.

Marie, *Soc. Therap.* (1907).

Mesnil, F., Nicolle, M., & Aubert, P., *Ann. Inst. Pasteur* (1907), **21**, 1.

Mesnil, F., & Nicolle, M., *Ibid.* (1906), **20**, 417.

Metchnikoff, *Ibid.* (1907), **21**, 753.

Moore, B., Nierenstein, M., Todd, J., *Bio-Chem. Journ.* (1907), **2**, 300.

Mosler, *Deutsches Arch. f. klin. Med.* (1875), **15**, 53.

Salmon, P., *Compt. rend. Soc. biol.* (1907), **62**.

Thomas, H. W., *Brit. Med. Journ.* (1905), 1, 1140; *Proc. Roy. Soc. London* (1905), s. B, **76**, 590.

Uhlenhuth, P., Hoffmann, E., Roscher, K., *Deutsche med. Wchnsch.* (1907), **33**, 873.

Uhlenhuth, P., Gross, & Bickel, *Ibid.* (1907), **33**, 129.

Vassal, J. J., *Compt. rend. Soc. biol.* (1907), **62**.

Waelsch, *Münchener med. Wchnsch.* (1907), **54**, 937.

METHODS OF STUDYING THE STRUCTURE OF THE CENTRAL NERVOUS SYSTEM.[1]

By Robert Bennett Bean.

(*From the Anatomical Laboratory, Philippine Medical School, Manila, P. I.*)

The object of teaching the anatomy of the central nervous system is to make clear to the student what is obviously complex. This can be done best by presenting a comprehensive study of the gross structural details, followed by an intricate dissection of the fiber paths with a parallel study of cross sections (gross and microscopic). Practical work with demonstrations of the general morphology of the central nervous system should precede lectures, which are mainly to present features that can not be seen, and are secondary or explanatory.

Not only should the subject be presented topographically in order that the student may familiarize himself with the position of the most important structures, but the recent works of Sherrington(8), Johnson(4), and others should be utilized. Thus, the functional significance of the structures may be emphasized. The older methods of study should not be discarded where they have proved effective, but they should be combined with recent methods and subordinated where necessary. No dissection of the association bands equals the breaking up of the cerebrum as practiced by Meynert(6). Horizontal, coronal, and sagittal sections of the brain continue to be profitable for study. Brief, descriptive outlines of the gross external morphology are valuable. Flechsig's(2) masterly contributions should be utilized with the results of degenerations to demonstrate localized areas and fiber tracts. Sabin's(7) model is the best possible means to a clear understanding of the complex medulla and midbrain regions. Embryology and comparative anatomy are indispensable(9). Accurate drawings should be made with each step as it is finished and at the end all the principal fiber tracts of the nervous system should be reconstructed by diagrams.

A clear presentation of any subject is necessary in teaching Filipinos through the medium of the English language with which the most proficient students are somewhat unfamiliar, but this is especially true

[1] Read at the 6th Annual Meeting of the Philippine Islands Medical Association, Manila, February 11, 1909.

of the anatomy of the central nervous system, and the more objective the presentation, the better will it be understood. The present first, second, and third year classes in the Philippine Medical School composed of Filipinos from all parts of the Archipelago have utilized successfully a scheme of study that is presented in brief below. The first portion of this scheme was employed by me when teaching "brain dissection" at the University of Michigan (1905–1907), and I am indebted to Professor J. Playfair McMurrick for the essential outline, but the details have been somewhat altered. The study of the central nervous system follows the dissection of the human body, and is the conclusion of the course in histology and embryology.

First dissect the spinal cord and study the gross details, then examine the brain box with the dura mater, sinuses, and emerging nerves, after which survey the brain as follows:

The *dura mater* is left in the skull because of its intimate adherence to the base:

The *arachnoid*, a fibery web between the dura and pia mater, is adherent to the pia mater for the most part, but separated from it by a distinct space, the *subarachnoid space*.

The *pia mater* is on the surface of the brain.

Behind the cerebellum is the *cerebellomedullary subarachnoid cistern.*

At the base of the brain occupying the interval between (*a*) the pons, (*b*) the temporal poles, and (*c*) the optic commissure is the *interpeduncular subarachnoid cistern* pointed like a five-rayed star by prolongation into (α) the tentorial fissures between the cerebrum and the cerebellum, (β) the lateral fissures (Sylvius) anterior to the temporal lobes, and (γ) the longitudinal fissure anterior to the optic commissure. The subarachnoid space is continuous with the same space around the spinal cord and also with the brain ventricles and the central canal of the cord through (a') the *median aperture* of the *fourth ventricle* (Magendie), and (b') the two *lateral recesses* for the choroid plexuses at the base of the temporal lobes.

Note the arrangement of the blood vessels: veins mainly in the roof; arteries at the base. The direction of blood flow is upward in each, with downward return through the sinuses.

Arteries: Three sets, namely (*a*) on the brain surface, *anterior, middle,* and *posterior cerebral;* (*b*) *median ganglionic* branches into the base of the brain and basal ganglia; (*c*) *choroid* arteries to the brain cavities.

The circle of Willis is formed by:

I. The *basilar* artery, produced by the union of the vertebrals from the subclavian. Ventral to the pons it divides into two equal branches:
   1. Posterior cerebral arteries from which are given off: *Superior cerebellar* arteries. The third nerve between (*a*) and (*b*) should be noted.

II. The internal *carotid* arteries which give off:
   1. *Posterior communicating* arteries to join the posterior cerebral.
   2. *Middle cerebral* arteries which enter the lateral fissures (Sylvius).
   3. *Anterior cerebral arteries,* the ventral continuation of the internal carotid arteries, and
   4. *Anterior communicating* connecting the two (*c*).

Next study the cranial nerves, as follows:

1. *The hypoglossal or XII* arises between the pyramid and the olive by three or four roots. How does it leave the skull? What is its distribution? Somatic motor.
2. *The accessory or XI* runs lengthwise along the medulla, receiving roots from it. It starts in the cervical cord and enters the cranium at the foramen magnum. How does it leave the skull? What is its distribution? Somatic motor.
3. The *Vagus or X.*
4. The *Glossopharyngeal or IX.*

   Lateral to the medulla just ventral to the upper, cut end of XI. The small bunch of roots anterior belong to IX.

   How does it leave the skull? What is its distribution? Visceral sensory and motor.
5. *Acoustic or VIII.*—Dorsal to pons close to the cerebellum. A large bundle. Its exit from the brain case? What is its distribution? Somatic sensory.
6. *Facial or VII.*—Medial to VIII. Its exit from the brain case? From the skull? Its sensory root is the intermediate nerve of Wrisberg associated with VIII. Visceral sensory.
7. *Abducent or VI.*—Near the median line just behind the pons. Its exit from the skull? What is its distribution? Somatic motor.
8. *Trigeminal or V.*—Lateral to the middle of the pons, a large nerve. The smaller motor root is at times distinctly mesial to the sensory. Its exit from the skull? Its distribution? Somatic sensory.
9. *Trochlear or IV.*—Emerges from the tentorial fissure. (Its origin is from the roof of the IV ventricle, seen later.) Its exit from the skull? Its distribution? Somatic motor.
10. *Ocular motor or III.*—Mesial to the peduncles of the cerebrum, a rather large nerve. Its exit from the skull? Its distribution? Somatic motor.
11. *Optic or II.*—Three parts. (1) Nerve, (2) commissure, (3) tract between commissure and brain. Its exit from the skull? Somatic sensory.
12. *Olfactory or I.*—Not shown. Is the olfactory bulb in the preparation? Are the nerves left in the skull? Their exit from the skull? Visceral sensory.

The embryology and comparative anatomy of the brain should be given at this period.

Remove the pia and arachnoid taking with them the blood vessels, and, if necessary, the nerves.

A. On the dorsal surface of the brain note:
   - I. The upper surface of the *medulla.*
   - II. The posterior part of the *fourth ventricle,* seen by depressing the medulla. Note that the ventricle seems to have no roof; this is thin and has been torn away, usually in removing the brain from the skull.
   - III. *The cerebellum.*—Note the color and the convolutions.
   - IV. Between the cerebellum and the cerebrum is the *tentorial fissure.*
   - V. *The two cerebral hemispheres.* Note the color.
     1. Between them is the *longitudinal fissure.*
     2. At the dorsal extremity of this is an opening in the pia mater which transmits the *internal cerebral veins* (Galen) and the *choroid plexuses* of the III and lateral ventricles to the straight sinus.

3. Gently separate the two hemispheres, cutting through the strands of arachnoid which prevent this, until you come to a white band.
   (*a*) The *corpus callosum.*
   (*b*) Note running along the median line of this the *vein of the corpus callosum.*

B. On the basal surface of the brain note:
  I. In the medulla:
    1. The *anterior median fissure:*
    2. On each side of this a longitudinal band, the *pyramid.*
    3. Lateral to this a narrow, curved band and ventrally a small, oval eminence, the *olive.*
    4. The *restiform body,* external.
  II. In the midbrain region:
    1. A narrow, transverse band of fibers over which the pyramids run, *trapezoid body.* (This is covered by the pons in the human brain).
    2. A broad, transverse band, the *pons.*
  III. In the midbrain region:
    1. Passing forward and outward from the pons, the *peduncles* of the *cerebrum.*
    2. The triangular space between, *posterior perforated substance.*
    3. Forming the anterior boundary of the posterior perforated substance—a rounded, whitish body indistinctly divided by a longitudinal fissure into 2, the *mammillary bodies.*
    4. In front of these a slit, the *infundibulum.*
  IV. In the forebrain region:
    1. *Temporal lobes.*
    2. The *lateral fissure* (Sylvius), separating them from the remainder of the brain.
    3. The lower end of the longitudinal fissure.
    4. Anteriorly, the *olfactory bulb.*
    5. Leading back from these, the *olfactory tracts.*
       (*a*) Passing out and back to the summit of the temporal lobes, the *outer olfactory tracts.*
       (*b*) Passing back and inward and soon lost from view by turning into the longitudinal fissure, the *inner olfactory tract.*
    6. Passing transversely from the tip of the temporal lobes to the longidinal fissure and lying underneath the optic commissure is the so-called *crus of the corpus callosum.*
    7. Between the two olfactory tracts and 6 is the *anterior perforated* substance on each side. The anterior part of each space is called the olfactory trigone in which a third or *median olfactory tract* can be seen to have its termination.

Make a median, longitudinal (sagittal) section of the brain.

I. Note the arrangement of the white and the gray matter in the median section of the cerebellum.

II. Note the *anterior velum* forming the roof of the anterior part of the IV ventricle and lying below the cerebellum.

III. Note the depression on the under surface of the cerebrum where the *superior* (*anterior*) velum is attached and where the *inferior* (*posterior*) *velum* starts.

IV. Separating the cerebellum from the cerebrum, note in bending backwards and outwards, the *brachium conjunctivum* of the cerebellum.

1. The anterior velum attached laterally to these.
2. The *IV. nerve* leaving the brain through the anterior velum and passing out across the peduncles.

V. At the side, immediately in front of the V. nerve, the *brachium of the pons* continuous below with the transverse pons fibers.

Now cut through the brachium of the pons and the brachium conjunctivum, enter the substance of the cerebellum and continuing to cut backwards remove the cerebellum.

I. Note the cut surface of the brachium conjunctivum, the brachium of the pons, and the restiform bodies.

II. Make a cut through the cerebellum parallel to the median cut surface, passing through the brachia and note:

1. The arrangement of the white matter.
2. In the white matter a patch of grayish matter the *dentate nucleus.*

In the medulla observe:

I. The *posterior funiculi* of the cord.

II. These are continuous above with a spindle-shaped enlargement bending outwards, the *clava.*

III. The *restiform body.*

IV. The *fourth ventricle.*

In the midbrain region:

I. The *aqueduct of the cerebrum* (Sylvius).

II. The *superior hillocks of the quadrigeminal bodies.*

On the outer surface of the midbrain note:

III. A band of white fibers passing forward and downward from the inferior hillocks, the *inferior brachium.*

IV. This (III) ends anteriorly as a large swelling, the medial *geniculate body.*

V. Note the fibers of the optic tract covering the anterior portion of the side of the midbrain and concealing the superior *brachium and the laterial geniculate body.*

VI. In front of the optic tract is the posterior extremity (pulvinar) of the *optic thalamus.*

VII. Anteriorly the front part of the entrance to the aqueduct of the cerebrum, the roof of the III ventricle, bends somewhat ventrally and then returns upon itself. At the lowest point of the bend is the *posterior commissure.*

VIII. The upward bend of the roof in front of the posterior commissure is the posterior part of the *habenula,* a round, or elongated body.

IX. At the summit of the habenula is the *pineal body* or *epiphysis.*

X. Passing from behind forward over the epiphysis is a bunch of vessels which join the roof of the III ventricle in front of the epiphysis and pass forward in it. This is the choroid plexus of the III ventricle and the portion of the roof of the ventricle in which it lies is the *velum interpositum.*

XI. Anteriorly, the velum interpositum is attached to the *lamina terminalis.* This is relatively thick above, but becomes thinner below and ends by becoming attached below to the front edge of the optic commissure. The ventricle forms a slight prolongation forward above the optic commissure which is the *optic recess.*
1. Note, entering the upper part of the lamina terminalis, the *pillars of the fornix.*
2. Just behind the upper part of the lamina terminalis and bounded above by the velum interpositum is the *interventricular foramen of Munro.*
3. In the lamina terminalis, a little below the level of the foramen of Munro, is the *anterior commissure.*

XII. The floor of the III ventricle is formed of, in front:
1. The *optic commissure.*
2. Behind, the *tuber cinereum* from which the infundibulum projects downward.
3. From behind the tuber cinereum and just in front of the mammillary body, the floor ascends obliquely to join the floor or the *aqueduct of the cerebrum.*

XIII. In the lateral walls of the III ventricle are the large *optic thalami.*
1. Connecting these and passing across the middle of the ventricle is the *intermediate mass.*

On the mesial surface of the forebrain are seen:

I. The *corpus callosum.* Note:
1. The posterior end slightly rolled under, the *splenium.*
2. Anterior to this a narrow, constricted portion, the *Isthmus.* (1).
3. The *trunk* or *body* forming the main part of the callosum.
4. The prominent anterior end, the *knee.*
5. A portion bending back from the knee to join the lamina terminalis, the *beak.*

II. The *fornix.*
1. The crura come from the floor of the lateral ventricles and bend down in the lamina terminalis.
2. The greater portion of that seen is the *body* of the fornix composed of fibers extending between the two crura.
3. Note that the body of the fornix behind fuses with the splenium of the corpus callosum.

III. Across the triangular area inclosed by the callosum and the *fornix* stretches a thin membrane—the *transparent septum*—which separates the two lateral ventricles.
1. The septum is really double, *i. e.,* consists of 2 parallel membranes. The space between the two is termed the *V. ventricle.*

In one half-brain, cut away the roof down to and parallel with the upper surface of the corpus callosum. In doing this you will probably have removed a portion of the lateral ventricle. Remove the remainder of the roof of the ventricle cutting at first forward and taking care not to cut away the corpus callosum. You will thus expose the body of the ventricle and an anterior prolongation of it which extends forward and downward, the *anterior horn.*

Now cutting backward you will find that the ventricle soon turns and extends outward and then downward and finally forward to the tip of the temporal lobe. This is the *inferior horn*. A *posterior horn* arises from the inferior horn and extends into the occipital lobe.

In the floor of the anterior horn, note on the outer side:

1. A large, rounded eminence tapering off behind. This is the intraventricular part of the corpus striatum, *caudate nucleus*.

Internal to this:

2. The *choroid plexus* of the lateral ventricle which enters by way of the foramen of Munro and extends to the tip of the inferior horn.

3. Internal to and behind this a rounded eminence, the hippocampus. Snip off a piece of the surface of this and note that the main mass is gray matter, the white being a thin layer covering it. Note differences in the brain ventricles.

Make vertical, transverse sections (coronal) of one half-brain: 1. Just behind the olfactory bulb. 2. Just in front of the knee of the corpus callosum. 3. Through the middle of the infundibulum. 4. Through the corpora albicantia. 5. Through the superficial origin of the III nerve.

Study these in connection with similar microscopic sections at the same time that the dissection of this basal region is made. Observe especially the *optic thalamus, caudate* and *lentiform nuclei,* with the internal and external capsule and *claustrum* forming the *corpus striatum.*

At this point the dissection of the brain by Johnston's method (3) may profitably be undertaken, using the outline he gives in so far as the somatic and visceral divisions are concerned. The greatest objection to Johnston's outline is that he overemphasizes the olfactory apparatus, devoting two pages to this and only seven pages to the whole remaining structure of the central nervous system.

The work previously outlined has been most successfully carried through by giving one hour periods each day for two weeks, but it may be condensed into longer periods each day for a shorter time. Additional work, such as the making of models from macerated scrap paper and flour paste by the method of Mendoza, Ramirez, and Valencia (5), may be done after having finished the brain dissection according to Johnston's outline.

Students in the Philippine Medical School who are well advanced may undertake elective work of this kind or they may work on original problems suggested by previous studies. During the intersessional vacation the majority of them elect some special topic for investigation, and devote six weeks to an occupation that is particularly refreshing and zestful.

The surface morphology of the brain is studied as follows (this, if expedient, should precede Johnston's method of brain dissection):

Take a human brain and study the lobes, fissures and convolutions.

1. The *lateral fissure* (Sylvius).
2. The *central fissure of Rolando.*
3. On the mesial surface the *occipito-parietal fissure.*

These three fissures divide the brain into lobes.

1. Above the lateral fissure and in front of that of Rolando, the *frontal lobes.*

2. Above the lateral fissure and between that of Rolando and a line prolonging the occipito-parietal fissure on the outer surface of the brain, the *parietal lobes.*

3. Behind this line and the occipito-parietal fissure, the *occipital lobes.*

4. Below the lateral fissure, the *temporal lobes.*

(These lobes are merely topographical divisions. They have no special physiologic or morphologic significance.)

In the frontal lobe, on the outer surface note:

1. Parallel to the fissure of Rolando, the *precentral sulcus* usually divided by a small convolution into two parts.

2. The convolution between this and the fissure of Rolando is the ascending frontal or *precentral convolution.*

3 and 4. The *superior and inferior frontal sulci* extend tangentially forward from the precentral sulcus. They are somewhat irregular in their course. These divide the anterior part of the frontal lobe into:

5, 6, and 7. The *superior, middle, and inferior or 1st, 2d, and 3d frontal convolutions.*

8 and 9. Two arms pass upward from near the beginning of the lateral fissure; these are the *ascending and anterior horizontal limbs of the lateral fissure* forming the three opercula 10, 11, and 12, *fronto-parietal, frontal, and orbital.*

Elevate the opercula and examine the long and short convolutions of the island and the circular sulcus of Reil.

On the inner surface of the frontal lobe:

1. The *sulcus of the corpus callosum* is immediately above the corpus callosum.

2. Above this the *fornicate convolution.*

3. Above this the *sulcus of the cingulum.*

4. Above this the *marginal convolution.*

Note that behind, the sulcus of the cingulum bends upward to meet the upper edge of the brain, and that the upper end of the fissure of Rolando is 1 to 2 centimeters in front of the point where the sulcus of the cingulum reaches the edge.

5. Note a fissure coming down from the edge of the brain about 3 centimeters or more in front of the upturned portion of the sulcus of the cingulum. This cuts off the hinder portion of the marginal gyrus, known as the *paracentral lobule.*

The sulci and convolutions on the orbital surface of the frontal lobe form an H with the gyrus rectus mesial to it.

On the outer surface of the paracentral lobule:

1. The *postcentral sulcus* is parallel with the fissure of Rolando.

2. Between Rolando and the postcentral sulcus is the *ascending parietal or postcentral convolution.*

3. Running backward horizontally from the postcentral sulcus is the *interparietal sulcus.*

4. Below this, and ascending round the posterior end of the lateral fissure is the *supra-marginal convolution.*

5. Below 3 and behind 4 and arching around the posterior end of the first temporal sulcus (*i. e.*, the first sulcus below the lateral fissure) is the *angular convolution.*

On the inner surface of the parietal lobe:

1. A quadrangular area between the upturned portion of the sulcus of the cingulum and the parieto-occipital fissure, the *quadrate lobe* or *precuneus.*

On the inner surface of the occipital lobe:

1. The *calcarine fissure* running from behind forward, joining the lower end of the occipito-parietal and then being continued forward on the under surface of the temporal lobe.

2. The triangular area between the occipito-parietal and calcarine fissures, the *cuneus.*

On the temporal lobe:

Beginning above on the outer surface and counting downward there are five sulci and six convolutions. The first three are called *superior, middle, and inferior.* The inferior convolution always forms the lower edge of the temporal lobe.

The fourth sulcus sometimes produces a small elevation on the inner surface of the brain, *i. e.*, in the floor of the lateral horn, termed the *collateral eminence,* hence the sulcus is called the *collateral fissure.*

The fifth convolution is the hippocampus. The fifth sulcus produces the hippocampus in the floor of the ventricle, hence it is called the *hippocampal sulcus.*

The sixth convolution is termed the *dentate fascia.*

The intimate structure of the brain may be studied after having examined its surface. By parboiling a fresh brain, the gray and the white substance may be separated, the gray cortex peeling off, leaving the white medullary portion intact. In this way the relative thickness of the cortex at any point may be determined, and the method may be useful in calculating the relative amounts of gray and white substance.

Meynert(6) says: "The structure of the cerebral cortex, like that of a crystal, can be studied best from its cleavage-surface." Brains that have been preserved in formalin for some time are used for the purpose of studying the cleavage-surface. When such brains are divided by a sagittal cut into two hemispheres, one of the latter may be torn asunder at the central sulcus of Rolando, and the break thus made passes through the isthmus of the corpus callosum(1).

Examination of the broken surface reveals sections of long and short *fibræ propriæ* which connect contiguous and adjacent convolutions, the *decursus* of the *cerebral fibers* which forms the *radiation* of the *corpus callosum and striatum,* and also the *corona radiata* and the broken ends of the *arcuate fibers* of the *cerebrum* which connect the frontal lobe with other parts of the brain. However, all of these structures may be seen best, by unrolling the cortex of the remaining hemisphere. By rolling out the marginal convolution from above and the fornicate convolution from below, the *cingulum* lies revealed and it may be traced anteriorly around the knee of the corpus callosum into the subcallosal convolution, and posteriorly around the splenium into the convolution and hook of the hippocampus, connecting intermediate parts of the cortex.

The *inferior longitudinal fasciculus* may be uncovered between the temporal and occipital lobes. The *optic radiation* and the *internal basal fasciculus* (Burdach) may be seen in the occipital lobe beneath the calcarine fissure.

Next, the convex cerebral surface is to be unfolded.

Starting the removal of the opercula, and of the island and convolutions of Reil, the *lentiform nucleus* is exposed with the corona radiata emanating from it. The *uncinate fasciculus* appears and connects the frontal pole and orbital convolutions with the anterior portion of the temporal lobe. Working outward into the four lobes of the brain by breaking away the cortex, the *superior longitudinal fasciculus* is uncovered and its three terminal bundles in the frontal, occipital, and temporal lobes may be seen. With special care the *anterior commissure* of the *cerebrum* with its radiating connections to the cerebral lobes may be shown, especially the temporo-occipital radiations, and at the same time the *amygdaloid nucleus* is uncovered, inferior and lateral to the basal ganglia, and the *occipito-frontal radiation* may be seen. It is of interest to note that 4 of the 5 well established arcuate fiber paths of the cerebrum connect the frontal lobe with other parts of the brain. See plates I–V.

The above outline of study is valuable because it combines approved old methods with promising new ones.

The gross morphology is described clearly and concisely, leading up naturally to the more difficult dissection and sectioning methods. The student moves along swiftly from the simple to the complex, beginning with the spinal cord and terminating with the breaking up of the cerebrum. The study begins with the analysis of the gross morphology, then goes to the synthesis of the somatic and visceral systems, to end by the analysis of the intricate mechanism of the cerebrum, having a simple introduction and conclusion, but a complex body to the work. The time given to the course is 120 hours, 6 mornings each week for 4 weeks, after the preliminary, 1 hour each morning for two weeks.

It is to be hoped that others will freely criticize and suggest regarding the above plan of study, for only by tearing down and rebuilding can perfection be attained in the art and the science of teaching, and thus we may hope to move forward.

REFERENCES.

(1) Bean, Robert Bennett. Some racial peculiarities of the negro brain. *Am. Journ. Anat.* (1906), 5, 388.

(2) Flechsig. Einige Bemerkungen über die Untersuchungsmethode der Grosshirnrinde, insbesondere der Menschen. Dem Centralcomité für Hirnforschung vorgelegt. *Ber. sächsischen Ges. d. Wiss.*, Leipzig (1904), 56.

(3) Johnston, J. B. A new method of brain dissection. *Anat. Rec.* (1908), 2, 345 to 358.

(4) *Ibid.* The nervous system of vertebrates. Philadelphia, 1907.

(5) Mendoza, Maria P., Ramirez, Manuel, and Enriquez, Pio Valencia. An improved method of modeling especially adapted for the central nervous system. *This Journal, Sec. A.* (1908), 3, 293.

(6) Meynert, T. Psychiatry. Part I. The anatomy, physiology, and chemistry of the brain. Translated (under authority of the author) by B. Sachs. 1892.

(7) Sabin, Florence. A model of the medulla and midbrain region of a new born babe. Baltimore, 1905.

(8) Sherrington, C. S. The integrative action of the nervous system. London, 1906.

(9) Streeter, G. L. The Development of the Cranial and Spinal Nerves in the Occipital Region of the Human Embryo, *Amer. Journ. Anat.* (1905), 4, 83. On the Development of the Membranous Labyrinth and the Acoustic and Facial Nerves in the Human Embryo, *Ibid* (1906–7), 6, 139. The Cortex of the Brain in the Human Embryo During the Fourth Month with Special Reference to the So-called "Papillæ of Retzius," *Ibid.* (1907–8), 7, 337. The Peripheral Nervous System in the Human Embryo at the End of the First Month, *Ibid.* (1908), 8, 285. A Recent Tendency in Descriptive Neurology, *Anat. Rec.* (1906–8), 1, 9. The Nuclei of Origin of the Cranial Nerves in the 10 MM. Human Embryo, *Ibid.* (1908), 2, 111.

ILLUSTRATIONS.

[Cleavage method of Meynert. Plates I, II, and V are the same hemisphere. Plates III and IV are from the opposite hemisphere of the same brain, that of a normal, male Filipino.]

PLATE I.

FIG. 1. Association fibers. A, Part of the superior longitudinal fasciculus (occipital-frontal band); B, cingulum; C, fibers from the frontal lobe to the cingulum; D, cingulum.

2. Association fibers. A, Cingulum; B, inferior longitudinal fasciculus; C, a band of fibers from the cingulum to the temporal pole; D, hippocampus; E, fibers from the mesial frontal convolutions to the cingulum.

PLATE II.

FIG. I. Association fibers. A, Fibers of the corpus callosum; B, choroid plexus under which lie the fornix and fimbria; C, part of the temporal pontile path (Türk's bundle); D, fibers from C, E, and F to temporal and occipital lobes; E, anterior commissure; F, genu of corpus callosum.

2. Association fibers. Corona radiata. A, Frontal pontile path (Arnold's bundle); B, uncinate fasciculus; C, brain stem cut off; D, inferior longitudinal fasciculus; E, part of optic striation [cccipito-mesencephalic path (Flechsig's secondary optic radiation)].

PLATE III.

FIG. 1. Association fibers. A, Central sulcus of Rolando; B, Short fibræ propriæ; C, Corona radiata and occipito-frontal fasciculus; D, Uncinate gyrus; E, Same as C, dorsal part; F, Superior longitudinal fasciculus and temporal pontile path; G, Superior longitudinal fasciculus; H, Long fibræ propriæ.

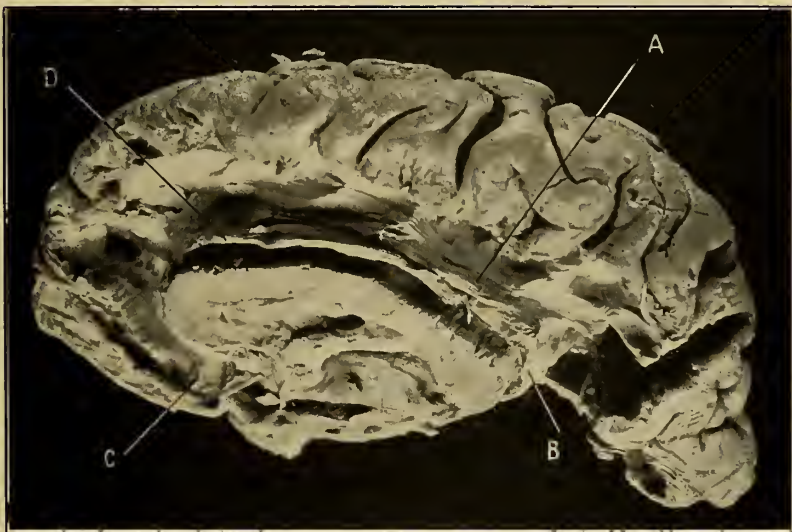


FIG. 1.

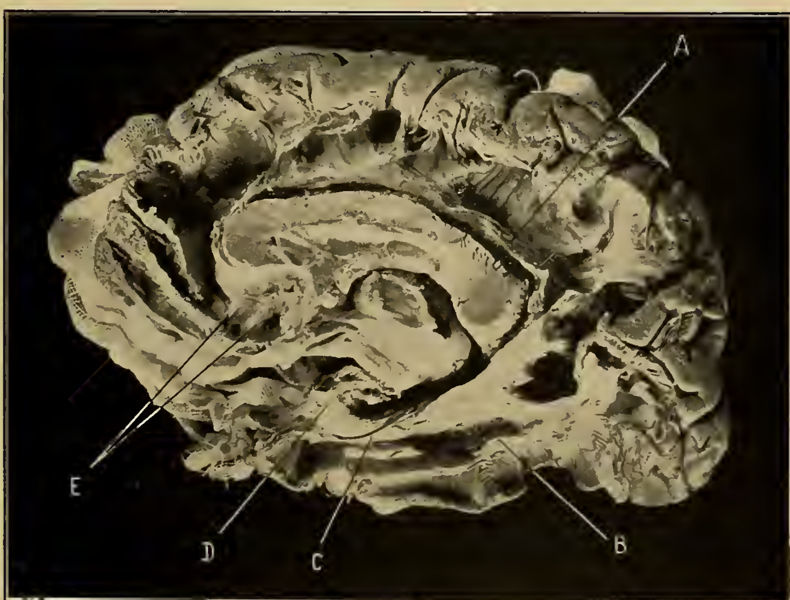


FIG. 2.

PLATE I.

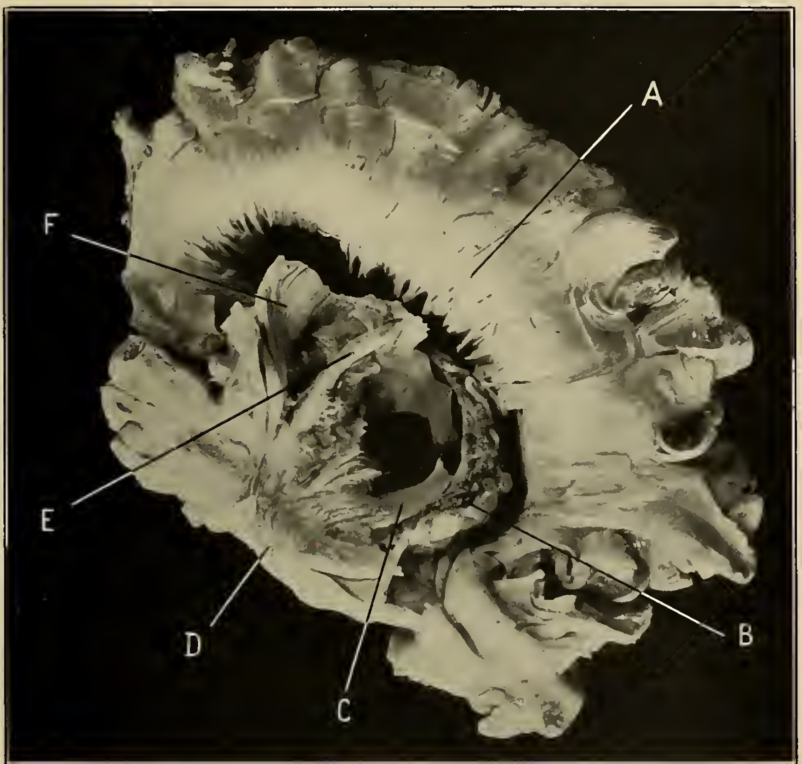


FIG. 1.

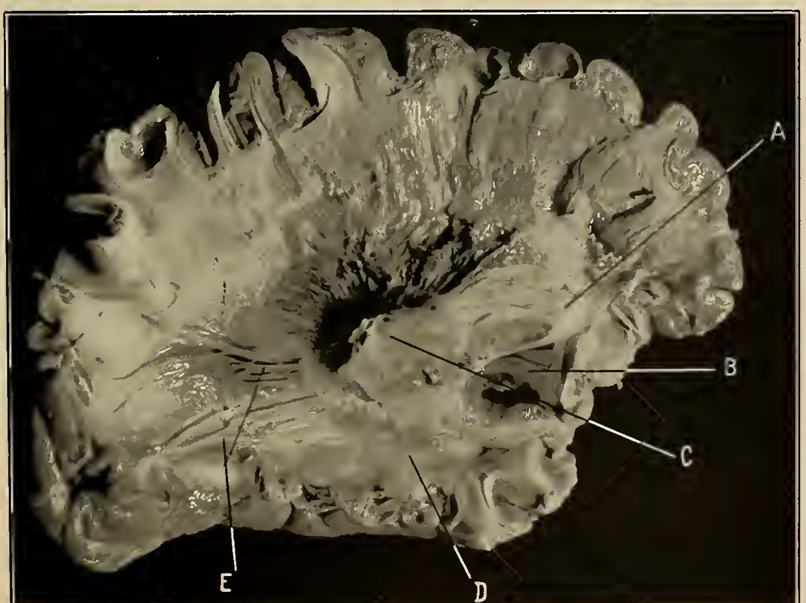


FIG. 2.

PLATE II.

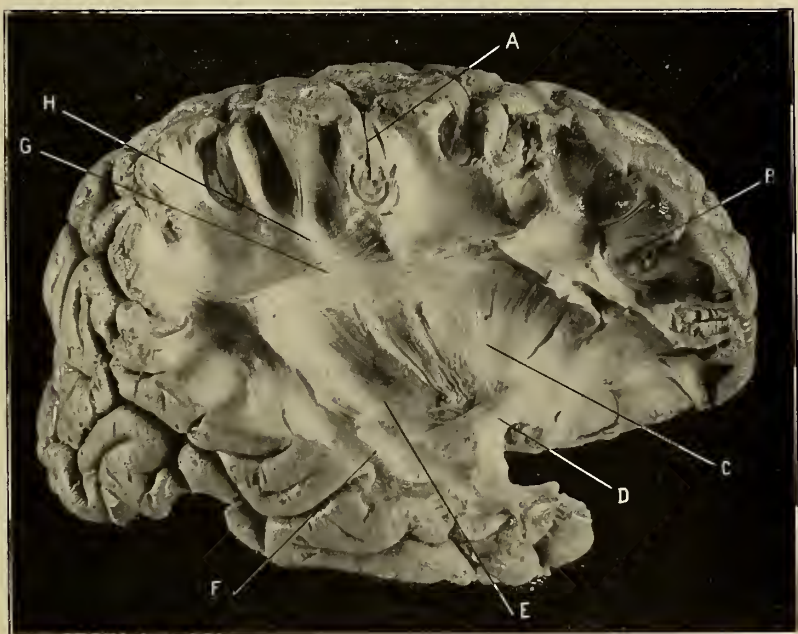


PLATE III.

DENGUE IN INDO-CHINA: EPIDEMIC ON BOARD THE "MANCHE."[1]

By J. J. VASSAL and A. BROCHET.
(*From the Pasteur Institute, Nhatrang, Annam.*)

An epidemic prevailed in May, June, and July, 1907, on the advice-transport *La Manche* of the French navy, which was off the coast of Indo-China doing hydrographic work. There were 108 Europeans on board; 94 were affected and 2 died. This epidemic was one of those which are described in Indo-China under the name of dengue, but it seemed to us that it was distinguished from the classic dengue by some peculiarities.

One of us was surgeon on board the *Manche* and therefore was able to follow the epidemic closely and to note all the features and symptoms as they appeared, including those on himself. Together we witnessed the principal phases of the malady which took place during our sojourn in the waters of Nhatrang.

Circumstances did not permit us to make an experimental investigation of the disease, but our bacteriologic verifications and our blood analyses will not be useless for the discussion of the diagnosis and for further researches which we hope to pursue on dengue.

In the following paper these researches are divided in the following manner:

(1) History of the epidemic on the *Manche* and similar forms of dengue in Indo-China; (2) etiology; (3) immunity; (4) symptomatology; (5) diagnosis; (6) treatment; (7) conclusion.

HISTORY.

The facts in regard to the epidemic on the *Manche* will first be given, then those which have been observed previously on the same boat, and finally the forms of dengue of Indo-China, about which local archives and different publications might be able to furnish us with details, will be discussed.

The *Manche* is a wooden vessel of 1,625 tons, formerly employed in cruises in the regions of Iceland and Newfoundland. She came into China Sea for the

[1] Read by Abstract at the 5th Annual Meeting of the Philippine Islands Medical Association, February 29, 1908.

first time in November, 1905, on a hydrographic mission; passed the year 1906 in Tonkin in the Bay of Halong, and came to the Cape Saint Jacques in Cochin-China in January, 1907.

The first case of dengue broke out on board the vessel while she was stationed at Saigon, from May 14 to May 31, 1907. The patient, a sailor, was nursed on board at Saigon from the 21st to the 28th of May. The *Manche* went directly from Saigon to Camranh. There were two more cases on the 5th of June, on the 6th another, on the 7th two, and on the 8th two more. In short, nearly everyone on the boat caught the fever. On June 20, there were 32 patients ill at the same time. The entries into the hospital succeeded one another as follows:

Date.	Number of patients.	Date.	Number of patients.
May 21	[a]1	June 18	4
June 5	[b]3	June 19	6
June 6	1	June 20	14
June 7	2	June 21	7
June 8	4	June 22	8
June 9	4	June 23	7
June 10	2	June 24	4
June 11	4	June 25	3
June 12	4	June 26	3
June 13	1	June 27	0
June 14	1	June 28	2
June 15	3	June 29	1
June 16	1	Total	94
June 17	[c]4		

[a] At Saigon. [b] At Camranh. [c] At Nhatrang.

The crew of the *Manche* on June 1 consisted of 140 men, of whom 108 were Europeans and 32 natives of Annam. The following figures show the proportion in which they were attacked:

	Europeans.		Natives.	
	Number.	Patients.	Number.	Patients.
Officers	14	10		
Petty officers	10	10		
Sailors	84	74	23	0
Servants			9	0
Total	108	94	32	0

The European crew with the exception of 6 men had arrived from France in April, 1907. The sailors were for the most part young men between 20 and 23 years of age, never before having been in the Tropics. Ten officers had been in service on the *Manche* since the second half of 1906; the other 4 since January, 1907. Nearly all the Annamese had been on board at least a year before the Europeans came.

The *Manche* only remained about two weeks at Camranh; she then set sail for Nhatrang. The first death occurred on the 17th of June. The patient was an officer habitually in good health and of a strong constitution. The boat was put in quarantine and isolated in a bay off the Island of Trê. If the number of entries on the sick list are noticed it becomes evident that the maximum was attained on June 20, with 14 entries, then the number diminished progressively till June 27; but on June 23, there was a second fatal case. This man, of robust constitution, died on the sixth day of his illness from a cardiac complication which was quite unforeseen.

On July 25, the *Manche* went to the *lazaretto* of the Nha-Bê in Cochin-China. The men were sent ashore and were distributed in isolated pavilions, while the boat was disinfected by means of Clayton gas.

The epidemic was completely at an end on June 29. Some convalescent sailors were sent afterwards to the Saigon Hospital. There was no contagion either in this town or off the coast of Annam, where communication with Europeans and natives had been held unceasingly until the quarantine was declared.

The disease spread in so peculiar a manner that it is worth while to call attention to this phase of the question. The ship's reservoir of water is situated in the hold at the rear, and opens just under the midshipmen's and officers' quarters, as the plan shows. The epidemic began particularly at the rear of the boat and the man in charge of the reservoir was the first victim. The midshipmen and the other officers then became sick, in fact, the first focus of the disease was formed there. The commander, whose appartments were large and airy and also in that part of the ship, caught the disease toward the end of the epidemic.

The quarters of the sailors situated in the bow became infected a very short time after those of the officers. The mechanics were also attacked *"en masse"* and nearly all on the same day.

Mosquitoes and flies were very numerous on board during the whole period during which the epidemic continued.

PREVIOUS EPIDEMIC OF DENGUE ON THE "MANCHE."

The epidemic of 1907 was not the first which had occurred on board the *Manche*. Dengue fever had already made its appearance during the previous year when she was lying at anchor near Hongay in Tonkin.

The epidemic lasted two months, from July 21 to September 15, during which time 114 out of 127 Europeans were affected and not a single Annamese out of 30. The disease extended by little groups, the entries into the hospital succeeded each other regularly, from 2 to 7 a day. The type of fever in which two attacks were present was clearly observed in 85 cases, 5 cases were different from the classic type and the others only showed one paroxysm.

We will only enumerate the principal symptoms, reserving the discussion until later. Sudden attack, headache, rachialgia, and pains in the muscles were constantly noted. The initial eruption seemed simply a congestive state of the face; a final eruption which was more emphasized, showed itself in half the cases; it had in general a furfuraceous aspect with ulterior desquamation. A tendency to syncope was noted in some of the patients. There was anorexia and nausea as well as great constipation. The complications consisted only of boils. The illness lasted from five to six days. Sometimes the convalescence was long.

The report mentions the presence of a great number of mosquitoes (*Culicidæ* exclusively) during the epidemic. The boat had been in the Baie d'Halong since December, 1905; the six preceding months she had been anchored off Hongay and Haiphong. An epidemic of dengue prevailed simultaneously among the sailors of the "defense mobile" of Hongay. The colonial troops in barracks ashore do not appear to have been attacked.

EPIDEMICS OF DENGUE IN INDO-CHINA.

There is no doubt that dengue has existed for a long time in Indo-China. It rarely manifests itself in the form of a generalized epidemic, as in 1866 (d'Ormay) and in 1895–6 (Nogué). On the other hand, it gives rise to local epidemics which are in general restricted to the coast, Saigon and the Baie d'Halong constituting the principal areas. The epidemics attract little attention and often very little importance is attached to them.

Sporadic cases of dengue do not appear to be rare at Saigon, on boats as well as on shore. Such cases have been observed at certain epochs and in small groups. New arrivals who pay their tribute to the disease often apply the vague term of acclimatization to it.

The epidemics of 1895–6 have been described by Nogué. We will first discuss a recent epidemic on the *Kersaint* which Dr. Cazamian, of the French Navy, has described comparable to that on the *Manche*. This boat coming from Shanghai and Tonkin, anchored off Saigon on July 7, 1905. The first case of dengue appeared on July 11, 115 men out of 150 were affected and from 1 to 6 entered the hospital per day. The epidemic came to an end at the beginning of September.

There is no reference in this instance to the susceptibility of the Annamese.

The author, striving to reconcile dengue with inflenza, is tempted to accord an important rôle to secondary phenomena, but in spite of this, he traces such a complete picture of the epidemic that no doubt on the subject can remain. The temperature charts are very characteristic. The pains in the muscles, rachialgia, and headaches were not absent. The initial rash was longer and more distinct. The complications were not without gravity, since Cazamian noted albuminuria twice, and cardiac symptoms three times, which he connects with angina pectoris.

There were many flies and mosquitoes on the *Kersaint* during the epidemic.

It is stated that in May, 1904 or 1905, dengue broke out in Saigon, especially severely on the boats of the "defense mobile." We have not been able to procure the documents relative to this epidemic, but we know that three patients succumbed very quickly.

The epidemics of 1895 and 1896 raged principally at Saigon. According to Nogué, who has described them, they spread thence over all Indo-China. The *Loire*, the *Pourvoyens*, and the *Baiomette*, war ships of the navy, and the mail boats of the "Messageries Maritimes" which were anchored in the Saigon River, were affected. The *Adour* of the French navy was at that time visited by dengue in Tonkin. The epidemic prevailed among the civil as well as the military population of Saigon. The writer does not give us the figures, but it seems that it extended over a considerable part of the town. He has published nine observations in detail, those of 5 sailors, 3 soldiers of the "infanterie de marine," and 1 civilian. Four cases were fatal. The post-mortem examinations were only partially made in 2 cases, but completely in 2 other. Among the most characteristic symptoms must be noted a high fever during five to six days with two paroxysms. There were also cephalgia periorbital pains, rachialgia, muscular and articular pains, a coated tongue, and constipation. The recovery was rapid. Pulmonary complications were not rare. Nogué found them in the post-mortem examinations; these were the only lesions which were mentioned. However, twice it seemed he found a slight inflammation of the meninges.

There is no doubt that Nogué describes true dengue. His examinations of blood were always negative and quinine had no effect. The epidemic broke out in the Saigon River and chiefly affected those people recently arrived from France. Seven out of 8 officers of the *Pourvoyens*, who had landed a week before, contracted the disease and entered the hospital on the same day. Nogué thinks that the dengue is endemic in Saigon; he connects these epidemics of 1895–6 with those of 1866, described by M. d'Armay, the head of the medical service in Cochin-China. It is not possible to find out from the memoir of Nogué, if the Annamese really had the dengue. At any rate he does not mention any cases among natives in Saigon or on the warships, but the administrator's reports speak at the same time of a disease in the interior, which was endemic, but which does not seem to be dengue.

ETIOLOGY.

The majority of writers on dengue have remarked for some time that it is propagated only in countries where mosquitoes abound.

Graham, who studied an epidemic in Beyrouth in 1901, was able to specify the rôle of mosquitoes in the dissemination of the infection.

Ashburn and Craig, in the Philippines, lately have given decisive arguments. They have shown that the blood contains the infectious germ, and that intravenous inoculation of the blood of a patient into a healthy man reproduces the illness after an incubation period of from two and one-half to seven days. They have even succeeded in transmitting dengue fever by mosquito bites (*Culex fatigans* Wied.). The epidemiologic facts favorable to the transmission of the disease by mosquitoes abound throughout the memoir.

E. R. Stitt also writing of the Philippines said that an epidemic affected all the patients of the Cavite Hospital, full of mosquitoes, while it did not spread in the Cañacao Hospital near by where there were no mosquitoes. The *Baltimore* sent part of its crew to Cavite; 20 out of 24 men caught the disease, while there was not a single case on board.

Our own observations argue in the same sense. During all the epidemics in Indo-China, the abundance of mosquitoes has been commented upon.

The prevalence of dengue at certain seasons at Saigon is very noticeable. The epidemic of the *Kersaint* began on the 11th, that of the *Manche* on the 21st of May. This is also the hottest and most unhealthful month of the year, besides being the one in which there are the most mosquitoes. The epidemic of 1895 and 1896 raged in April, May, and June (Nogué).

In 1907, the *Manche,* while anchored in the River of Saigon, became infested with mosquitoes and the officers could not succeed in ridding her of them. On the contrary, the mosquitoes found many collections of water and particularly the bilge water for breeding purposes. The men not using mosquito-nets were unable to sleep at night, and some of them, through continual scratching, became covered with boils. In June the numbers of mosquitoes increased. They were exclusively *Culicidæ* among which *Culex fatigans* Wied. predominated. Is it not significant that the first case which appeared, was in the sailor who was in charge of the bilge water and that the epidemic spread first to the persons nearest the reservoir? The *Manche,* being a wooden vessel, enjoyed a moderately even temperature and did not suffer from the abrupt changes which sometimes are so disturbing on iron ships. However, conditions favorable to man are also favorable to the mosquito. This boat, constructed for the cold regions of the north, was not adapted to a tropical climate. For instance, the deck was surrounded by high ports which hid the sea from view and prevented a thorough ventilation. Conditions on this vessel seem favorable for the development of dengue, since it is the second time in two years that this disease has visited it. The origin of the actual epidemic was probably in Saigon.

The other etiologic circumstances are of little importance. In June, the meteorological phenomena were normal. The barometer remained between 755 and 760 millimeters; the thermometer oscillated between 25° and 31°.6, giving an average of 28°.5 C. The hygrometric readings were high during the whole time of the epidemic. In spite of the numerous showers and frequent storms, the atmosphere was continually heavy. Life on board ship is favorable to the spread of any epidemic, but particularly to those disseminated by insects. To sum up, the rôle played by mosquitoes on the *Manche* in connection with this epidemic appeared to be of considerable importance. It is in fact the only important etiologic factor to be considered.

IMMUNITY.

"Dengue prevails indiscriminately in spite of age, sex, or race," says de Brun. We were, therefore, astonished to observe that not a single Annamese servant or sailor developed the disease. They had also shown a marked immunity during the epidemic of 1906. These natives were quite as much exposed as the Europeans and their diet was the same.

There are no differences between the naval regulations for Annamese and European sailors.

In short, 12.96 per cent of the Europeans escaped infection in 1907 and 100 per cent of the Annamese; in 1906 the Annamese again escaped infection while but 10.3 per cent of the Europeans were not attacked.

The natives of the *Manche* were questioned one by one with the greatest care; they declared that they did not remember ever having had, at any time, a like disease either on board or at home. If these declarations are worth anything, it must be admitted that the Annamese have not the same susceptibility as the French, or else that dengue is a disease so common in the country that repeated light attacks have protected them. It is this latter hypothesis that has been adopted in order to explain the immunity of negroes to yellow fever.

It is also interesting to consider the reasons why some of the Europeans escaped the epidemic of 1907. Their number was so small that an individual inquiry was possible. Those which escaped were 4 officers and 10 sailors.

Inquiry developed the fact that two out of the four officers had already had dengue on the same boat in 1905. As to the other two, they had previously taken part in a hydrographic mission off the coast of Madagascar, where epidemics of dengue are by no means rare. (See Vincent.) Their immunity was probably gained while at that station. As to the sailors who escaped dengue in 1907, three had served at Madagascar, one in the Senegal and in China, one in Guiana, and one at Saigon. The last two had already contracted dengue, one on the *Manche* in 1906, and the other on the *Kersaint*.

The susceptibility of the French in comparison with that of the Annamese has been amply demonstrated by the above considerations. All the young French sailors (100 per cent), the crew being almost entirely composed of these, were affected; we further observed that in four different instances a previous attack had given immunity for from one to two years. The immunity of the other cases seems to depend somewhat upon former visits to dengue infected countries, where attacks have either passed unrecognized, or been taken for malaria.

SYMPTOMATOLOGY.

The disease begins, in general, very abruptly, either in the morning on wakening, or in the course of the day, during work. The patient feels a violent headache in the region of the forehead and around the eye sockets, sometimes he is so dazed that he scarcely can stand upright. The fever rises almost immediately. Sometimes it mounts at once to 39°.5 or 40° or more, sometimes it does not at first exceed 38°.5, but rapidly increases to 40°. In some instances the attack is less sudden, the patient only coming into the hospital in the afternoon, having felt ill since the morning, but his condition soon becomes worse. Appetite fails, the tongue becomes coated, in some cases nausea is present. We never noted diarrhœa or constipation in this first period.

Cephalalgia is very characteristic and plainly localized. There is no photophobia, but the movements of the eyes are painful and a feeling of pressure on them may be experienced. The patient is unable either to look up or to one side on account of the pain. The pain in the forehead continues without exacerbations; it diminishes rapidly.

After the second day of the disease, the patient complains only of a slight headache; the ocular and periorbital pains persist for several days. In general the fever appears suddenly, but rarely is it accompanied with a chill. The skin is hot and dry, there is at times excessive perspiration. The pulse does not always increase in rôle in conformity with the temperature; it is about 100 for 40°. In the case of one patient the pulse was at 100 only when the temperature reached 42°.

None of our cases had rachialgia or severe muscular pains. They complained only of stiffness in the back and limbs. There was no arthralgia; they were all able to stand upright and to walk. No eruption appeared either on the skin or on the mucosa. Later, the fever abated and the pains in the limbs and head diminished. The fever is the constant and important symptom.

We have collected during this epidemic 85 cases which may be divided into the following three categories:

(1) Attacks with one paroxysm.

(2) Attacks with two paroxysms.

(3) Unusual and attenuated attacks.

The fever in the first category reaches its maximum in about 24 hours and falls in five or six days by lysis, more rarely the descent takes from two to six days. The following are examples:

Case No. 18, high temperature for 2 days.

Case No. 71, high temperature for 3 days.

Case No. 67, high temperature for 4 days.

Case No. 16, high temperature for 5 days.

Case No. 14, high temperature for 6 days.

The fever in the second category may reach its maximum in twenty-four hours, or more rarely not until two days have passed, it then falls one or more degrees, rises again on the sixth day and ends on the sixth or seventh. This is illustrated in the charts of cases 7, 9, 10, and 41.

The chart of spirillum fever does not resemble that of dengue; indeed there could be no confusion between the two except in the case of spirillum fever with two paroxysms, but in the latter the ascent takes longer and stays at a high level, and the relapse is complete and lasts for several days.

The third category includes 5 attenuated fevers, in which the temperature did not rise to 39°, such as for example in cases numbered 6, 39, and 48; these were fevers associated with malaria, hepatitis, etc.

Anorexia persists during the evolution of the disease, the tongue is covered with a deep and brownish coating, the breath is foul. We noticed only a few cases of nausea and vomiting was never seen. As a rule there was constipation, but no abdominal pain. Only two patients suffering from malaria had an enlargement of the spleen and another with a long career in the Tropics suffered from hepatitis and his chart was modified by this fact. None of the cases suffered disturbances in the respiratory organs. No albumin was found in the urines which were analyzed. In only one case did we have mild delirium, the temperature at that time being 40°.4 C.

The majority of the patients were depressed and tired, but their appearance did not give the impression of a serious illness. The convalescence was always rapid.

It is important to state that there were no relapses in our epidemic. In about ten cases we observed a slight desquamation on the arms, mostly in places where there was already prickly heat; but this also appeared on men who did not contract dengue.

Many writers agree in saying that dengue is extremely benign. This does not seem to be the rule in the Indo-Chinese epidemics and especially not in Saigon where the death rate was 2.12 per cent. We had two fatal cases, death being due in both instances to disturbances of the circulation. A lesion of the myocardium was present in one; it was revealed by the movements of the heart, which became at the same time weak and accelerated, by the enlargement of the cardiac area on percussion, and finally by the presence of embryocardia. A systolic murmur was heard at the apex of the heart in the second case. Bulbar disturbances, which affected the heart, also appeared at the same time.

DIAGNOSIS.

The differential diagnosis of dengue offers some difficulties; it may be confounded with certain other diseases, so that the distinctions on which we based our diagnosis are given below.

(1) The temperature chart, the absence of haematozoa, and the inefficacy of quinine permit us to exclude malaria.

(2) The symptoms have no analogy with typhoid fever, moreover our numerous serum reactions were negative.

(3) Influenza would have been accompanied by catarrh and respiratory troubles.

(4) We have already given reasons for dismissing spirillum fever by a study of the temperature charts, and it is also true that spirilla would have been discovered in the blood.

(5) Scarlet fever is accompanied by sore throat with glandular swelling, continued fever, and an eruption, none of which symptoms was present in our cases.

(6) Typhus fever, without eruption, might be confused with dengue, but only at the beginning of the illness. Later, the extreme prostration, high fever lasting for 10 or 12 days, and the terminal crisis in no way resemble our disease.

Even now, after the latest discoveries which, though important, have not revealed the cause of the disease and its specific lesions, the diagnosis still is often difficult. Formerly the confusion was so great that dengue was known by twenty-one different names in French and nineteen in English.

The eruption is a great help in the diagnosis of dengue, but to always expect this symptom may lead to many errors. Certain writers have preferred to call an epidemic of dengue, influenza or malaria, rather than admit that dengue exists without eruption. De Brun, on the contrary, writes "the skin eruption is inconstant," and later "dengue distinguishes itself (from scarlet fever and measles) by the contingency of its eruption, which not only may not exist, but also presents the greatest variability in its aspect and in its time of appearance." Cotholendy states as follows: "Some medical men affirm that eruption sometimes fails," and Martialis adds, "the eruption is not always regular and constant."

What are the relations between the different epidemics of dengue in Indo-China? The epidemic of 1907 on the *Manche* was certainly related to that of 1906, since three persons having had the first were immune against the second, although the 1906 epidemic had its origin in Tonkin and that of 1907 in Cochin-China, as we have already stated. Eruptions were present in the first, but not in the second epidemic. Consequently, in Indo-China, dengue can exist either with or without eruption. The inconstancy of the eruption, the relative malignancy, and the very divergent susceptibility of Annamese and Europeans might be mentioned as distinguishing the dengue of Indo-China from other known forms of dengue. New experimental investigations will doubtless bring forward facts which will emphasize these arguments or render them void.

TREATMENT.

(1) *Medicinal.*—Anorexia and coated tongue require laxatives. The patient should then be given a light diet. In the usual course of the disease there is no other general indication for treatment. There are no specific remedies and the different symptoms should be treated by ordinary medication. If the hyperpyrexia should become alarming, cold baths should be given. Iced compresses relieve the headache. In malignant forms, hypodermic injections of caffein and cold baths are recommended.

(2) *Prophylactic.*—Preventive measures should be directed against

mosquitoes. As in malaria and yellow fever, a patient is not himself infectious, but it is necessary to protect him against the bites of mosquitoes and to destroy these insects in the neighborhood.

The line of conduct particularly on a boat is clear. The patients should be isolated and put in rooms protected by wire gauze or landed in a place where contagious agents are lacking. The collections of water on board, as well as the bilge water, should be drained, and the boat later disinfected by means of Clayton gas. This will kill all vermin and insects. A boat infected by dengue should be put in quarantine and anchored far from the shore and from other boats. It is evident that a disease with such a great epidemicity, and which may have a death rate of 2.12 per cent warrants strict regulations. Although quarantine means an economic loss, the disorganization and cessation of work in a community caused by even a slight epidemic of dengue is still more detrimental; moreover, as the incubation period of the disease is not more than four days (Ashburn and Craig), quarantine need not be prolonged over this time, after the boat is disinfected.

CONCLUSIONS.

(1) The dengue of the *Manche* is related to other forms of dengue in Indo-China.

(2) It was distinguished by the absence of an eruption, a mortality of 2.12 per cent and the absolute immunity of the Annamese as compared with the extreme susceptibility of the Europeans.

(3) Endemo-epidemic areas of dengue exist in Indo-China, the best known and most important area being that of Saigon.

(4) The epidemic of the *Manche* again confirms the mosquito transmission theory; therefore, prophylactic measures should be directed against mosquitoes.

LITERATURE.

(1) Ashburn P. M., and Craig, Charles F. Experimental investigations regarding the etiology of dengue fever with a general consideration of the disease. *This Journal, Sec. B.* (1907), 2, 93.

(2) de Brun. Maladies des pays chauds, Paris, 1, chap. 4.

(3) van der Burg, C. L. Handbuch der Tropenkrankheiten herausgegeben von Dr. Carl Mense, Das Dengue Fieber, Leipzig (1905), 11.

(4) Cazmian. Quelques considérations sur une épidémie de dengue à bord du "Kersaint" (Saigon, juillet-août-september-1905). *Arch. méd. nav.* (1906), 85, 241.

(5) Cotholendy. Relation de l'épidémie de dengue qui a régné à St. Denis (Réunion) pendant les mois de février, mars, avril, et mai, 1873. *Ibid.* (1873).

(6) Graham, H. (Beyrouth.) The dengue: a study of its pathology and mode of propagation. *Journ. trop. Med. & Hyg.* (1903), 6, 209.

(7) Martialis M. La dengue d'après les documents anglais de Madras et de Calcutta et les observations recuillies dans les possessions françaises de l'Inde. *Arch. méd. nav.* (1874).

(8) Nogué, J. Notes et observations sur deux épidémies de dengue observies en Cochin-chine en 1895–96. *Ibid.* (1897).

(9) Stitt, E. R. A study of the blood in dengue fever with particular referenee to the differential count of the leucocytes in the diagnosis of the disease. *This Journal* (1906), **1**, 513.

(10) Vineent. Epidémie de paludisme sur "La Ranee" (mission hydrographique de Madagasear). *Arch. méd. nav.* (1907) **87**, 371.

ILLUSTRATION.

PLATE I. Schematic longitudinal section of the dispatch boat *Manche*.

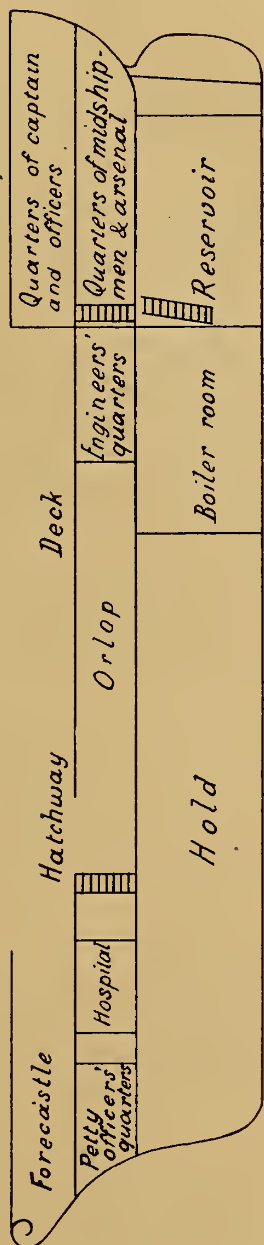

Poop
Quarters of captain and officers
Quarters of midshipmen & arsenal
Reservoir
Engineers' quarters
Boiler room
Deck
Orlop
Hatchway
Hold
Hospital
Forecastle
Petty officers' quarters

PLATE I.

FILTRATION EXPERIMENTS ON THE VIRUS OF CATTLE PLAGUE WITH CHAMBERLAND FILTERS "F".[1]

By E. H. RUEDIGER.

(*From the Serum Section of the Biological Laboratory, Bureau of Science, Manila, P. I.*)

Nicolle and Adil-Bey[2] in the year 1902 reported that the artificial peritoneal fluid (prepared by injecting a quantity of salt solution into the peritoneal cavity of a bullock sick with cattle plague and collecting the fluid about two hours later) frequently is infectious after it has been passed through the Chamberland filter marked "F."

Yersin[3] repeated the experiments of Nicolle and Adil-Bey and verified their results.

In previous reports on this subject, I was not able to verify the results obtained by the foregoing authors with the Chamberland filter "F." As only a small number of filters had been used, and those that were used were chosen at random, I decided to repeat the experiments with selected filters.

I selected four of the coarsest from a large number of Chamberland filters marked "F," the permeability of which I tested by passing distilled water through them. I designated these as b, c, d, and e. Filter b delivered a liter of distilled water in four minutes; filter c in five minutes; filter d in six minutes, and filter e delivered a liter in eight minutes.

EXPERIMENTAL.

A quantity of artificial peritoneal fluid (for which I am indebted to Dr. Thomson of the Bureau of Agriculture) was divided into five parts, *a, b, c, d,* and *e.* Part *a* remained unfiltered; part *b* was passed through filter b; *c* through filter c; *d* through filter d, and *e* was passed through filter designated as e.

Five bullocks were inoculated.

Bullock No. 1 received 50 cubic centimeters of part *a* under the skin on the 6th day of January. On the ninth day of January the temperature rose rapidly

[1] Read at the 6th Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

[2] *Ann. Inst. Pasteur* (1902), 16, 56.

[3] *Ibid* (1904), 18, 429.

to 40°.7 C. Symptoms of cattle plague declared themselves and on the eleventh the bullock was bled to death. (Chart No. 1.)

Bullock No. 2 was inoculated with 50 cubic centimeters of filtrate *b*. It remained well. Fourteen days later it received an injection of 10 cubic centimeters of virulent blood from which it contracted cattle plague and was bled to death. (Chart No. 2.)

Bullock No. 3 received 50 cubic centimeters of filtrate *c* on the sixth day of January and remained well. On the twentieth he was inoculated with 10 cubic centimeters of virulent blood; cattle plague soon made its appearance and he was bled to death on the twenty-sixth. (Chart No. 3.)

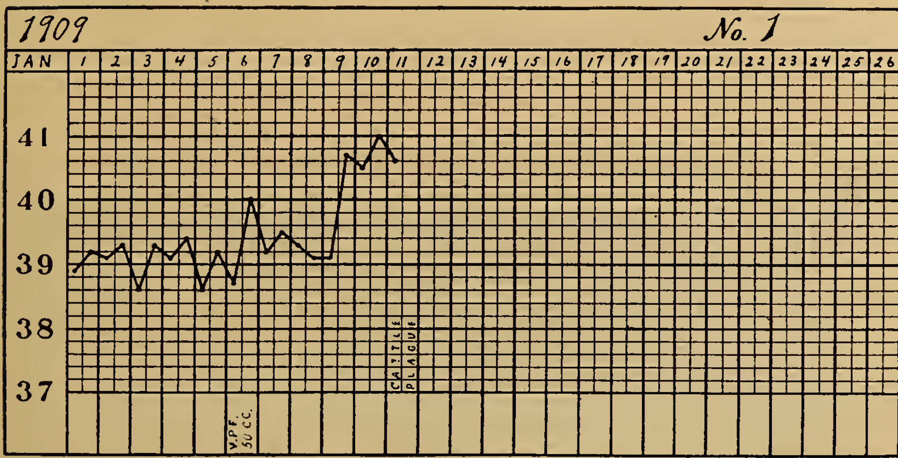
Bullock No. 4 was inoculated with 50 cubic centimeters of part *d* and remained well. Fourteen days later he received 10 cubic centimeters of virulent blood; he contracted cattle plague and was bled to death on the sixth day after inoculation. (Chart No. 4.)

Animal No. 5 remained well after a subcutaneous injection of 50 cubic centimeters of filtrate *e* on the sixth day of January. Ten cubic centimeters of virulent blood were injected on the twentieth. On the twenty-sixth day of January he was bled to death suffering from typical cattle plague. (Chart No. 5.)

CONCLUSION.

From the experiments previously reported and those recorded here it is evident that even on carefully selecting the most porous of the Chamberland filters marked "F" none have been found which allowed the virus of cattle plague to pass.

ILLUSTRATIONS.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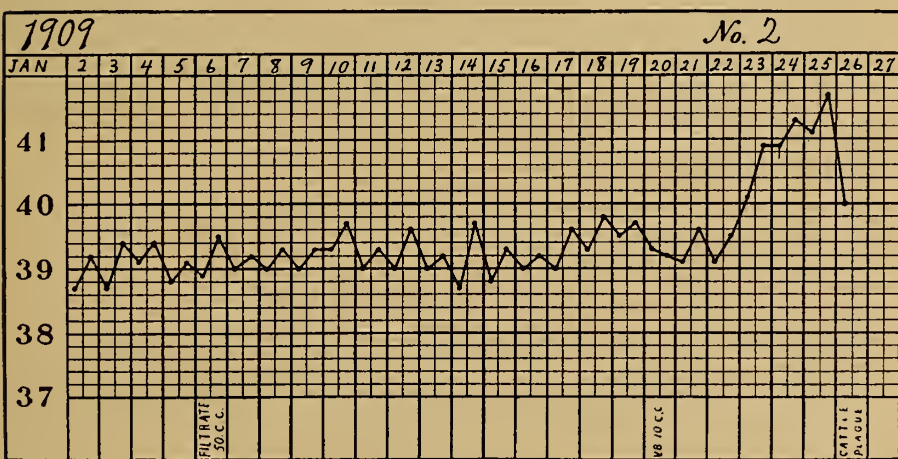
V.P.F. 50 CC.
CATTLE PLAGUE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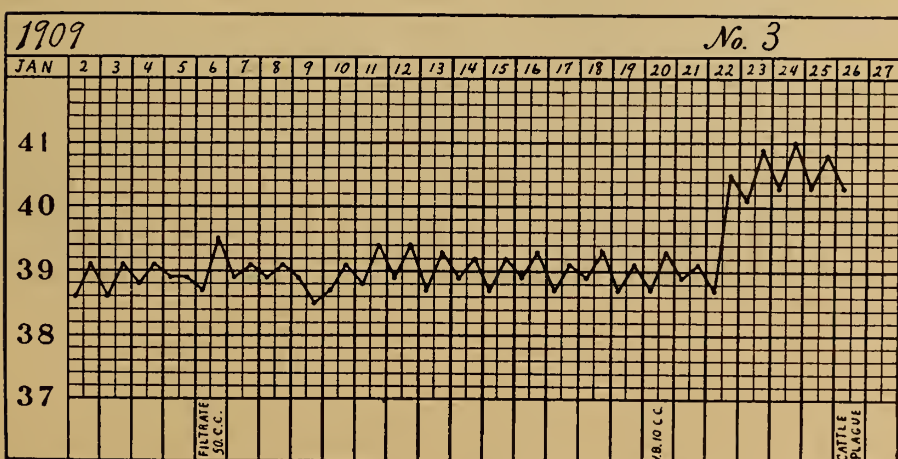
FILTRATE 50 C.C.
VB 10 C.C
CATTLE PLAGUE


1909
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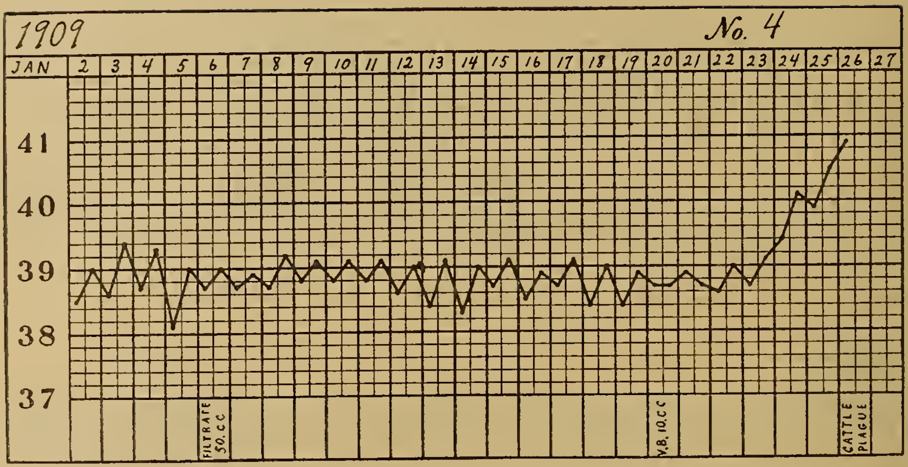
FILTRATE 50 C.C.
V.B. 10 C.C.
CATTLE PLAGUE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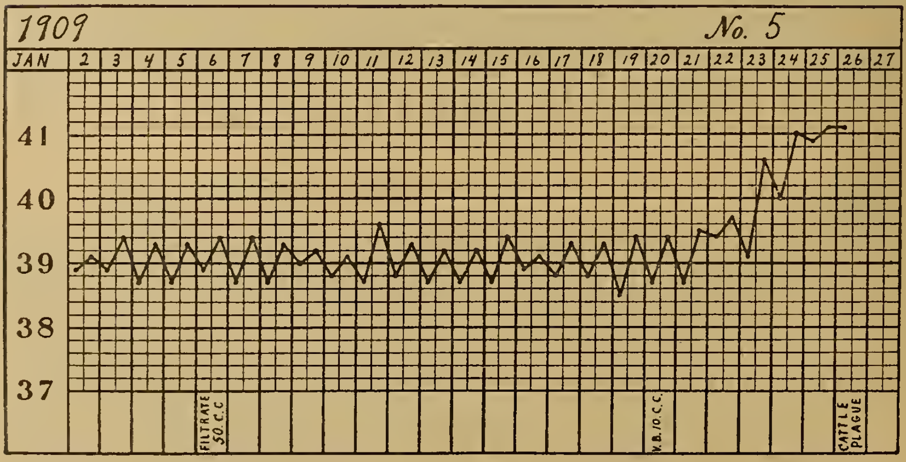
CATTLE PLAGUE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CATTLE PLAGUE

THE SUPPRESSION OF A CHOLERA EPIDEMIC IN MANILA.[1]

By Allan McLaughlin.[2]

The cholera epidemic of September, 1908, was probably a continuation of the outbreak which had its greatest intensity in January of the same year.

There were 184 cases of cholera in Manila in January, 1908. In February, 14 cases of cholera were registered, and in March 3 cases. In April, cases resembling cholera clinically began to present themselves, which bacteriologically were negative. In May, one case bacteriologically positive was reported on the 14th. One case of true cholera was found on the 11th of June, and suspicious cases, resembling cholera clinically, but negative bacteriologically, were found on the 3rd, 4th, 18th, 19th, 24th (2), 27th, 28th, and 29th. These cases resembled the true clinical picture of cholera more closely from day to day. Some were fatal in a few hours, and the intestinal contents yielded a motile vibrio which resembled the cholera vibrio, but did not respond to the agglutination test.

These suspicious cases continued in July as follows:

Date.	Cases of suspected cholera.	Bacteriologic findings.
July 4	1	Negative.
July 8	1	Do.
July 11	1	Do.
July 13	1	Do.
July 14	1	Do.

[1] Read at the meeting of the Manila Medical Society, October 19, 1908.

[2] Passed assistant surgeon, Public Health and Marine-Hospital Service, Acting Director of Health for the Philippine Islands.

On July 16 a case of typical cholera was found and thereafter cases appeared in July as follows:

Date.	Number of cases.	Bacteriologic findings.
July 21	1	True cholera.
July 22	1	Do.
July 26	2	Do.
July 28	4	Do.
July 29	3	Do.
July 30	4	Do.
July 31	2	Do.

In August, cases of cholera, bacteriologically confirmed, were as follows:

Date.	Number of cases.	Date.	Number of cases.
August 1	2	August 20	1
August 2	1	August 21	1
August 3	2	August 23	3
August 5	1	August 24	4
August 6	4	August 25	2
August 7	1	August 26	3
August 8	2	August 27	6
August 9	2	August 28	1
August 10	2	August 29	2
August 13	3	August 30	5
August 17	1	August 31	5
August 19	1		

September, 1908. These cases need only to be seen at the bedside or at autopsy to recognize the possibility that they may be cases of cholera in which the vibrio has lost some of its properties, including its agglutinability with high dilutions of anticholera serum.

Kolle,[3] in a series of vibrios taken from cases in Egypt, which clinically were cholera, found only a few vibrios which did not agglutinate with anticholera serum. Kolle's conclusion was that these cases were cholera, but that the cholera organism was not isolated because of faulty technique. His contention is that other vibrios are sometimes found in the human intestine; these, in the enriching fluid, grow more vigorously than the cholera vibrios, and so the investigator may easily fail to isolate the cholera organisms. This seems unlikely to occur in any considerable number of cases, especially if the transfer to the hard media is made directly from the stool, or after a very short time of growth in the peptone solution.

In September, from the 1st up to the 9th, there was an average of about three cases daily. On the 10th the cases reached seven, on the 11th nine, and on the 12th seventeen. The course of the disease is well

[3] *Ztchr. f. Hyg. u. Infectionskrankh.* (1903), 44, 1.

defined on the chart showing the cases from September 1 to October 12, 1908.

Date.	Number of cases.	Date.	Number of cases.
September 1	3	September 17	25
September 2	1	September 18	24
September 4	6	September 19	43
September 5	4	September 20	60
September 6	4	September 21	55
September 7	4	September 22	38
September 8	5	September 23	45
September 9	3	September 24	40
September 10	7	September 25	44
September 11	9	September 26	37
September 12	17	September 27	14
September 13	11	September 28	18
September 14	10	September 29	13
September 15	16	September 30	11
September 16	37		

Date.	Number of cases.	Date.	Number of cases.
October 1	12	October 7	8
October 2	10	October 8	13
October 3	5	October 9	8
October 4	9	October 10	6
October 5	11	October 11	3
October 6	6	October 12	4

The high-water mark of the epidemic was reached on September 20, when 60 cases were reported in twenty-four hours.

When the number of cases reached 9, on September 11, I recognized the probability of an epidemic, and took personal charge of the operations. Upon September 12 the number reached 17, 12 being in the Meisic district. Upon investigating this district, I found that in 18 cholera houses—that is, houses in which cases of cholera had occurred—the closet was in a filthy condition in every instance. These houses had the following combination: Filthy closets, rats, flies, cockroaches, and other insects, and a kitchen immediately adjoining the closet. With this condition, all that is necessary is the presence of the bacilli carrier, who, by using the closet, will furnish the infective material.

Two additional disinfecting squads were put to work immediately for the exclusive duty of disinfecting closets, and on the 13th the cases dropped to 11, and on the 14th to 10. On the 15th sixteen cases occurred, and 105 additional men were employed. This force was increased as rapidly as possible without causing confusion and disorganization, and by September 22 the complete organization of 500 men was working smoothly. This force was increased by the 25th to 600 men.

ORGANIZATION.

The property division of the Bureau of Health purchased all supplies and equipment, with a very slight increase of personnel. The statistical division of the same Bureau took care of the records and statistics. The clerical division handled all financial transactions and current business. The department of sanitation and transportation of the city of Manila furnished ambulances, tank wagons, carretelas, carromatas, and horses.

The boundaries of the health districts already existing were left unchanged, the city being divided as follows:

Station "J", Intramuros, including Malate and Ermita.
Station "L", Paco, including Santa Ana, Pandacan, etc.
Station "A", Meisic, including Binondo, Quiapo, and Santa Cruz.
Station "C", Tondo.
Station "I", Sampaloc.

The office force of each station was not increased, but the field force was enormously augmented.

The organization of the field force in each district was as follows:

STATION "A", MEISIC DISTRICT.

1 medical inspector, in charge of district.
3 municipal physicians, assistants to medical officer in charge.
1 sanitary inspector, in charge of all the men.
1 sanitary inspector, for inspection of disinfecting gangs and quarantines.
12 American foremen, each in charge of a lime squad.
124 Filipino lime throwers.
2 American foremen, each in charge of a disinfecting tank wagon and 6 men.
12 Filipinos, 6 for each disinfecting wagon.
1 chemical fire engine and crew.
1 disinfecting carretela, with crew of 5 men, disinfectants, and hand pumps; for room disinfection of cholera infected houses.

Total personnel of station.

4 medical officers.
2 sanitary inspectors.
14 foremen.
136 Filipino laborers.
5 Filipino disinfectors.
Total, 161.

STATION "C", TONDO DISTRICT.

1 medical inspector, in charge of district.
2 municipal physicians, assistants to medical inspector.
1 sanitary inspector, in charge of all the men.
3 American foremen, in charge of lime squad.
1 American in charge of disinfection of wells and pools.
64 Filipino lime throwers.
3 foremen, each in charge of large disinfecting tank and 6 men.
1 foreman, in charge of small tank wagon and 4 men.
22 Filipinos, on disinfecting wagons.
1 chemical fire engine and crew.
1 disinfecting carretela with 5 men.

Total personnel of station.

3 medical officers.
1 sanitary inspector.
8 foremen.
86 Filipino laborers.
5 disinfectors.
Total, 103.

STATION "J", INTRAMUROS.

1 medical inspector, in charge of district.
1 municipal physician, assistant to medical inspector.
1 sanitary inspector, in direct charge of all the men.
1 sanitary inspector, in charge of disinfecting crews.
1 disinfecting carretela, crew of 5 men. Day duty.
1 disinfecting carretela, crew of 5 men. Night duty.
6 American foremen, in charge of lime squads.
100 Filipino lime throwers.
3 American foremen, each in charge of disinfecting tank wagon.
17 Filipinos, disinfecting tank wagons.
1 chemical fire engine and crew.

Total personnel of station.

2 medical officers.
2 sanitary inspectors.
9 foremen.
117 Filipino laborers.
10 disinfectors.
Total, 140.

STATION "I", SAMPALOC DISTRICT.

1 medical inspector, in charge of district.
1 municipal physician, assistant to medical inspector.
1 sanitary inspector, in charge of all the men.
4 American foremen, in charge of lime squads; 25 men each.
100 Filipino lime throwers.
2 American foremen, each in charge of tank wagon and 6 men.
12 Filipinos, 6 on each tank wagon.
1 chemical fire engine and crew.
1 disinfecting carretela with crew of 5 men.

Total personnel of station.

2 medical officers.
1 sanitary inspector.
6 American foremen.
112 Filipino laborers.
5 disinfectors.
Total, 126.

STATION "L", PACO DISTRICT.

1 medical inspector, in charge of district.
1 sanitary inspector, in charge of all the men.
1 municipal physician, assistant to medical inspector.
1 foreman, in charge of tank wagon and 6 men.
6 Filipinos on tank wagons.
3 foremen, in charge of lime squads.
52 Filipino lime throwers.
1 disinfecting carretela, with crew of 5 men.

Total personnel of station.

2 medical officers.
1 sanitary inspector.
4 foremen.
58 Filipino laborers.
5 disinfectors.
Total, 70.

Total personnel, all stations.[3]

Station.	Medical officers.	Sanitary inspectors.	Foremen.	Laborers.	Disinfectors.	Total.
"A", Meisic	4	2	14	136	5	161
"C", Tondo	3	1	8	86	5	103
"I", Sampaloc	2	1	6	112	5	126
"J", Intramuros	2	2	9	117	10	140
"L", Paco	2	1	4	58	5	70
Total	13	7	41	509	30	600

Lime squads varied in size according to the district. In open, or sparsely settled districts, one foreman could properly supervise from 15 to 25 men. In a district like Meisic, where the houses are crowded together, a foreman could not properly supervise more than 12 men.

One mechanic was assigned to the duty of keeping the disinfection wagons, pumps, and hose in good condition. He traveled from wagon to wagon with tools, thus avoiding sending the wagon in for repairs, which were often trivial and could be made in a few minutes on the spot.

The amount of disinfectants employed was enormous, about 150,000 pounds of lime per day, and about 700 gallons of carbolic acid daily were used, or its equivalent in creoline, tricresol, or formalin. There was some difficulty in securing enough disinfectants to satisfy this enormous demand. The entire stock of carbolic acid, formalin, and tricresol, in the Philippine Islands, was used before the end of September. Four thousand gallons of Jeyes' fluid (a creolin preparation) was secured from Hongkong and Japan in time to prevent the wagons lying idle. Four of the 11 tank wagons might have lost two days because of a lack of disinfectants, but Dr. Raymond F. Bacon, of the Bureau of Science, suggested that salt water be electrolyzed, forming a disinfecting fluid, which, according to laboratory tests, would kill cholera bacilli promptly. The offer of the Bureau of Science to electrolyze the solution was accepted, and for two days, four of the wagons used this fluid.

In a short time all the lime in Manila and the vicinity was exhausted and the entire daily output of the kilns in the Island of Luzon was taken.

[3] This does not include police for house-to-house inspection, nor some 300 men of the city street cleaning force, who have been assisting in draining the worst places in the barrios, nor the Constabulary for quarantine guards.

The lack of lime sometimes caused the cessation of lime disinfection at 3 or 4 o'clock in the afternoon, but lime squads were equipped with shovels, hoes, rakes, brooms, or other instruments, for cleaning houses and grounds, and their spare time was utilized in digging ditches, and cleaning up the yards of premises.

Infected districts were subdivided into subdistricts; maps were made of these subdistricts, and the foreman in charge of a disinfecting wagon or lime squad was furnished with a map of his subdistrict. For example, Meisic was subdivided into 20 subdistricts, and Tondo into 14.

The ordinary chemical fire engine makes an excellent disinfecting apparatus. The 80-gallon tanks are charged by carbon dioxide produced from bicarbonate of soda and sulphuric acid; to make an efficient disinfecting solution it is only necessary to add carbolic acid, creoline, or some other disinfectant to this solution. The ordinary street-sprinkling wagon is convertible into an excellent disinfecting apparatus. All that is necessary is to install an ordinary pressure pump and several hundred feet of hose, put in the disinfectant, and fill the tank from the street hydrant. We used eleven of these wagons and four chemical engines, and they were all effective. The tank wagon possessed the advantage of being cheaper, as the cost of soda and sulphuric acid for charging the chemical engine is not inconsiderable. In Manila the cost was offset by receiving the services of the chemical-engine crew free of charge.

Several kinds of disinfectants were used in the tank wagons. Crystalline carbolic acid does not mix readily with water in excess of the amount dissolved, and requires careful handling in using it on a large scale. Formalin is good, but causes a great deal of complaint from the people because of its irritating properties. Crude carbolic acid, in our experience, did not mix well, and both kinds of carbolic acid, because of irregular distribution of the undissolved portion in the solution, gave rise to minor accidents, such as burning of the hands and feet of the laborers, and the killing of dogs and chickens. The most satisfactory disinfectant was Jeyes' fluid, a creoline preparation which we secured from Hongkong. It is nearly "foolproof" and is very effective. It mixes perfectly with water, forming a milky solution of uniform strength. It does not burn the hands or feet of the laborers or children about the house, and no ill effects upon animals or chickens were noticed.

The simplest and most effective way to use lime is with a bucket and a ladle. The lime gang of from 15 to 25 men was handled by one white foreman and one native *capataz*. Each gang was followed by a cart with lime. Each native lime thrower carried a bucket and scoop or ladle. After a little patient instruction, the natives learned to use the lime to the best advantage, to place it where it was needed, and to avoid the spots where it was unnecessary. Their instructions were definite and included liming all closets and places where fæcal matter existed or was likely to be deposited.

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Each chemical engine was handled by its own crew in charge of a lieutenant of the fire department.

Each tank wagon was in charge of an American foreman, who directed the disinfection and was responsible for the thoroughness of the work and for the conduct of the six natives who manned the pump and hose.

In giving foremen their instructions, great stress was laid upon the necessity of displaying courtesy at all times. They were instructed to take part in no argument with householders or others, and to do their work with consideration for the feelings of the people, but none the less thoroughly. If actual obstructions were encountered, they were to notify the central office at once. The result of these instructions was that during the whole campaign the valid complaints were less than a dozen. All complaints were promptly investigated by the Acting Director of Health, and if found to be valid, the foreman in charge was dismissed. Only one case of actual obstruction was encountered; this man refused to permit the disinfectors to enter; he was arrested, fined fifty pesos Philippine currency, (twenty-five dollars United States currency) and no further trouble occurred.

The organization was mobile, and concentration of disinfecting wagons from Paco, Intramuros, and Sampaloc, as a reënforcement of Meisic and Tondo, was effected when necessary, with good results.

The general plan of campaign was as follows:

House-to-house inspection by police to discover promptly cases of cholera.

Constabulary guard upon house and inmates to prevent ingress or egress until removal of the patient and disinfection of the house.

Examination of the stools of cholera contacts to find bacilli carriers, the bacilli carriers being sent to San Lazaro Hospital for treatment.

Daily disinfection of all insanitary closets with lime, and disinfection of ground surfaces known to be, or suspected of being, soiled with fæcal matter.

An attempt was made to disinfect daily all closets in the strong material districts, which were not flush closets or which were not kept clean. In the light material districts, the effort to disinfect the dejecta of the entire population necessitated the disinfection of entire districts. It was necessary to disinfect practically the whole ground area. When one considers the enormous area to be covered daily in Tondo, Sampaloc, Malate, and Paco, with their outlying barrios, and the fact that there are over 5,000 insanitary closets in the Meisic district alone, the magnitude of this work may be imagined.

Two general methods of disinfecting were employed—(1) the spreading of lime, and (2) disinfection with water wagons, hose and pump, or by chemical engines, containing carbolic acid, creoline, formalin, or other disinfecting material.

Lime was effective in conjunction with drainage in the low-lying, swampy, nipa districts and also for disinfecting the bad closets in the strong material districts. The tank wagons and chemical engines were used for general disinfection of lower floors, out-houses, patios, stables, and closets in both strong and light material districts.

Two factors, more than any others, make difficult the suppression of cholera in Manila—(1) the existence of bacilli carriers and bad closet facilities or none at all; (2) failure to find cases in the early stages of the disease.

The presence of bacilli carriers makes necessary the safe disposal or disinfection of the dejecta of the entire population.

The experience of the writer in the recent epidemic points to the fact that the most important role in the transmission of cholera is played by the bacilli carrier.

If a bacilli carrier is a person of cleanly habits, and if he is in possession and makes use of proper closet facilities, he is practically harmless. But on the other hand, a bacilli carrier of filthy habits, who has no closet facilities, or refuses to avail himself of the public closets furnished him, is the greatest menace to the public health which can possibly exist, so far as cholera is concerned. The demonstration of the fact that over 7 per cent of apparently healthy individuals in the Meisic and Tondo districts were bacilli carriers, coupled with the insanitary closets of Meisic district and the absence of or failure to use public closets in the nipa districts, will go far toward explaining the dissemination of cholera in Manila this year.

Every effort was made to discover promptly light cases of the disease and bacilli carriers. When a case of cholera was found, the house was quarantined until the removal of the patient and until the disinfection had been completed. The stools of the other inmates were taken for the purpose of discovering bacilli carriers. These, if found, were sent to the San Lazaro Hospital and there detained until the vibrios disappeared from their stools. A house-to-house inspection was made of a large area, having the infected house for a center. This was done daily for five days.

The following tables show the number of apparently healthy persons examined by the Biological Laboratory of the Bureau of Science for cholera bacilli, and how many were really carrying the bacilli:

Bilibid Prison.

Number of persons examined	264
Number found positive	17
Percentage found positive	6.44

City of Manila (exclusive of all hospitals and Bilibid Prison).

Number of persons examined	376
Number found positive	27
Number found negative but containing vibrios other than cholera	46
Percentage found positive	7.18
Percentage found negative but containing other vibrios than cholera	12.23

Even with perfect, daily disinfection of closets and places soiled with fæcal matter, all chance of infection from bacilli carriers is not cut off, because a bacilli carrier with his soiled fingers may infect the food or drink of other persons.

The prohibition of certain native foods, fruits, and vegetables was necessary, not only because these substances were often infected or dangerous of themselves, but they were also the substances carelessly handled by dirty people of dirty habits, many of whom were undoubtedly bacilli carriers, and they were the substances which were eaten without sterilization by boiling or cooking, after such handling.

It has been demonstrated this year that the perennial outbreaks of cholera in Bilibid Prison are probably due to bacilli carriers. Upon the appearance of cholera in Bilibid Prison this year, the writer gave orders that stools of those who had anything to do with the preparation or handling of food or drink be taken to be examined for cholera. Two hundred and sixty-four samples were taken and of this number of apparently healthy persons, 17 were found to be carrying the cholera organisms in their intestines. To find out and isolate all the other bacilli carriers would have involved an amount of work in stool examinations alone which would have been impossible for the already overtaxed bacteriologists of the Biological Laboratory.

Results were obtained by an order from the writer to compel washing of the hands in disinfecting solution after stool and before eating. This order was enforced and cases ceased to appear, although there were doubtless many bacilli carriers in the 3,000 prisoners whose stools had not been examined.

THE SPREAD OF THE INFECTION.

The practice of taking stools had to be discontinued when the cases increased to such an extent that it was no longer possible to do so. For the same reason, the house-to-house inspection areas had to be supplanted by general house-to-house inspection of the whole city when the number of infected houses—that is, houses in which cholera had appeared within five days—reached 200.

Failure to find cases of cholera early makes the suppression of the disease difficult. Cases, even with the house-to-house inspection, are sick from two to twenty-four hours before discovery. Upon discovery, a quarantine guard is placed upon the house and inmates, and from this point that particular focus is adequately cared for, but, in the hours before discovery other individuals probably have been infected.

When a Filipino falls ill, all the neighbors will, either through interest or curiosity, crowd into the house. Upon discovery, or upon decision of the householder or doctor, to report the case, these people promptly scatter, go to their meals without washing their infected hands, eat their rice with these same infected hands, and even carry with them from the infected houses, mats, articles of clothing, food, and drink, to save them from the all-destroying disinfectors. Our disinfectors try to trace out these other houses where clothing, etc., has been carried, but this is very difficult and often impossible.

To illustrate the spread of the infection in this way, the course of the disease in the Meisic district may be taken as an example. It will be observed that every four days there is a sudden increase in the number of cases. These are the persons infected from the cases of four days previously. It does not mean an incubation of four days, for these cases when found have already been sick for some time, but it would indicate an incubation of from two to three days.

Counting a house where cholera had been found within five days as a focus, on September 23 there were 241 infected foci in the city of Manila, well scattered, as is shown by the following table:

District.	Number infected foci.
Meisic	66
Tondo	59
Sampaloc	41
Intramuros	54
Paco	21
Total	241

With the organization and the employment of the measures outlined above, in twelve days, the number of cases was reduced from 60, the maximum number in one day (September 20), to 5 cases on October 3. A few cases occurred daily throughout October, and these, in nearly every instance, came from well-known cholera areas, districts in which cholera persists after its eradication from the more cleanly and sanitary portions of the city.

For example, of the last 75 cases in October, 33.3 per cent occurred in the district bounded by Calles Bilibid and Paz on the south, Calle Magdalena and San Lazaro Estero on the west, the railroad on the north, and Calle Felix Huertas on the east. This district has no surface drainage, the interiors are lower than the street gutters of Calle Cervantes, and the majority of the houses, during a great part of the year, stand over collections of filthy water, slime, and muck. This office demonstrated to the city authorities the feasibility of draining this area by ditches and the drainage work is now in progress.

Nine per cent occurred in a triangle formed by Calle Azcarraga on one side, Tondo beach on the second side, and Calle Ylaya and Calle Quesada on the third, one of the best examples of the illegal perpetuation of the nipa hut in the strong material district.

Eight per cent occurred on the upper end of Calle Lemery and its continuation Gagabangin, where drainage problems also remain to be solved.

Nine per cent occurred in a small section of the Meisic district, bounded by Calles Aceiteros, Santo Cristo, San Nicolas, and Madrid. This district contains the filthiest and most insanitary closets in the city of Manila.

Four per cent occurred in the barrio of Balicbalic; other cases occurred in Palomar, in Calle Antonio Rivera, in Bancusay, and in other barrios. The other 20 cases were scattered and widely separated; 3 in Paco, 5 in Meisic, 5 in Sampaloc, 1 in Ermita, 1 off the Malecon Drive, 1 in Malate, and 3 in Tondo; less than 10 per cent were found in the strong material district, and most of these could be traced to one of the above-mentioned plague spots.

Cholera is the same disease, whether encountered in Germany, Russia, Italy, Egypt, India, or the Philippines, but the measures taken to prevent its spread and to suppress the infection depend upon the geographical location of the epidemic. To suppress a cholera epidemic in a country like Germany, for example, is a comparatively simple proposition; while in the Philippines its suppression is complicated by existing conditions peculiar to these Islands.

Four things are of prime importance for the suppression of cholera: (1) A good water supply for all the people; (2) safe disposal of the dejecta of the entire population; (3) prompt discovery of cholera cases, suspects, or bacilli carriers, with immediate isolation and disinfection, and (4) habits of cleanliness.

If the water supply is free from cholera and can be kept so, then the spread of the epidemic depends upon the improperly cared for stools of the persons carrying the spirilla of cholera. Flies, cock-roaches, and other insects or animals having access to such stools carry the infection to food or drink. There is infection from persons who do not wash their hands and whose soiled fingers carry the infection to food or drink. There is also direct infection from actual cases of cholera.

WATER.

Manila city water has been examined daily by the Biological Laboratory of the Bureau of Science and the cholera bacilli have not been found therein. However, with the appearance of cholera in San Mateo and Mariquina, it was deemed prudent to place a military guard to prevent possible pollution of the river.

The new water supply, taken from higher up the gorge, will be practically safe from contamination by human excrement.

The great trouble with the Manila water supply is that it does not reach all the people. Some barrios are at a great distance from the nearest hydrants, and the people must carry, or pay for carrying, a long distance. As a result, they use the water from shallow wells, ponds, esteros, or other questionable sources, for washing clothes, kitchen utensils, and also in many instances for drinking purposes.

It was deemed necessary to close all wells, except a few in the more distant barrios, which were treated with permanganate of potash. Besides closing wells, wherever possible, all stagnant places were drained by digging ditches and certain small, infected esteros were patrolled by the Constabulary to prevent the people using the water.

DISPOSAL OF HUMAN EXCRETA.

The new sewer system is another sanitary improvement anxiously awaited. The existence in the Meisic district of thousands of tight vaults and filthy closets is responsible in a great measure for the spread of cholera in that district and the difficulty experienced in eradicating the disease. These filthy closets and tight vaults can be replaced by modern flush closets connected with the new sewer system. In the newer residence districts, septic vaults and absorbing basins are used as receivers of sewage from modern flush closets. It will be an improvement when all vaults, however satisfactory in construction, are no longer necessary, because of the installation of the new system.

In the nipa districts, the people depend upon the sparsely scattered public closets or have no closet facilities whatever. In the latter instance, the fæcal matter is deposited in the most convenient place; in the long grass, in pools or gutters, or under the house. The family pig takes care of a considerable quantity of human excreta and garbage. There are large barrios within the limits of the city of Manila where the only way of entrance is a path too narrow to permit a wagon to enter. These, of course, have no garbage collection or closet facilities.

Habits of cleanliness are best secured by a campaign of popular education. Excluding the water supply and the disposal of fæces, the other factors in spreading infection can be nullified by the inculcation of cleanly habits. It the bacilli carrier washed his hands often enough and at the proper times he would not transfer infection from his dirty fingers to the food or drink of others. If the kindly, native neighbors who assist those sick with cholera, and who disappear before the arrival of the health officers, can be taught the necessity of washing their hands before eating or handling food, many more cases will be prevented.

The Bureau of Health has printed cholera circulars in Spanish, English, and all the native dialects, telling how to preserve one's self and others against the infection of cholera. This campaign is best conducted in the schoolroom and from the pulpit. The Bureau of Education and the Roman Catholic Church have coöperated in an attempt to spread the knowledge and advice contained in the cholera circulars among the people. Efforts along this line have met with success, but it requires a long time completely to change the habits of a people and it will probably require another generation to complete the work.

MEASURES LOOKING TO THE PREVENTION OF FUTURE EPIDEMICS.

The writer has made, in his report to the honorable the Secretary of the Interior the following recommendation, calculated to prevent the recurrence of cholera in epidemic form in Manila. The difficulties which attend the carrying out of these projects are recognized as well-nigh insuperable, but they are not impossible ideals, and an attempt to realize these ideals should be the policy of the bureau.

The Manila city water supply must be extended to every part of the city and placed within easy reach of everyone.

Tanks and reservoirs must be so constructed as to preclude the possibility of contamination.

Esteros must be controlled and confined to definite beds either by adequate walls or by dredging, so that any overflow land will be drained by tides.

The filling in of low places which can not be drained to the proper height above the curb is essential.

Public closets must be established in all barrios, so that every inhabitant of the city of Manila will have closet facilities at his disposal. It is advisable to have more closets even if of less seating capacity; six closets of six pails each will be of more value than three of twelve pails each, for the reason that the native has a shorter distance to travel. Also, the cutting of alleys through the back yards will facilitate his journey to the closet.

Before permitting land to be used for building purposes within the city limits, the land should be subdivided by streets and alleys upon a definite plan. The indiscriminate building of nipa huts upon the interior of a block without order or regard for necessary intervening spaces, should not be permitted.

Streets and alleys should be cut through already existing collections of nipa huts, and, when necessary, houses removed to permit proper spacing. Streets must be opened into barrios within the city limits which are now isolated and have no wagon road entering them to permit the collection of garbage and refuse.

A sufficient force of sanitary police to enforce the use and sanitary maintenance of closets is necessary.

All wells must be filled in.

More stringent measures to compel the prompt reporting of suspicious cases, with severe penalties for infractions of this ordinance should be adopted.

Stricter enforcement of the building code in the erection of new buildings is necessary.

Nipa huts in the strong material districts must go, and repair to old nipa houses, which perpetuate this problem, must be prevented. These nipa districts exist by sufferance within the strong material districts, dilapidated huts are crowded together in the most insanitary manner, where there are excellent public closets, patronized only by a select few. The majority still find it easier to deposit or throw their dejecta upon the swampy ground. These districts are the natural home of cholera, and from there the people who are trying to live decently are infected by means of *muchachos*, cooks, or *cocheros*, who spend their spare time in these plague spots.

A proper system of surface drainage for every part of the city of Manila is essential, where such drainage is lacking, but especially for (1) the San Lazaro Estate and that portion of the city from the San Lazaro Estate to the railroad crossing on both sides of Calle Cervantes, (2) Santa Monica, (3) Antonio, Rivera, (4) Palomar and Magdalena interior, (5) that portion of Tondo north of Moriones and west of Estero de la Reina, and (6) Malate district, bounded by Herran, Wright, San Andres, and Nueva.

For the "Discussion" of Dr. McLaughlin's article see under "Editorial," p. 59.

ILLUSTRATIONS.

Fig. 1.

Fig 2.

PLATE I.

Fig. 1.

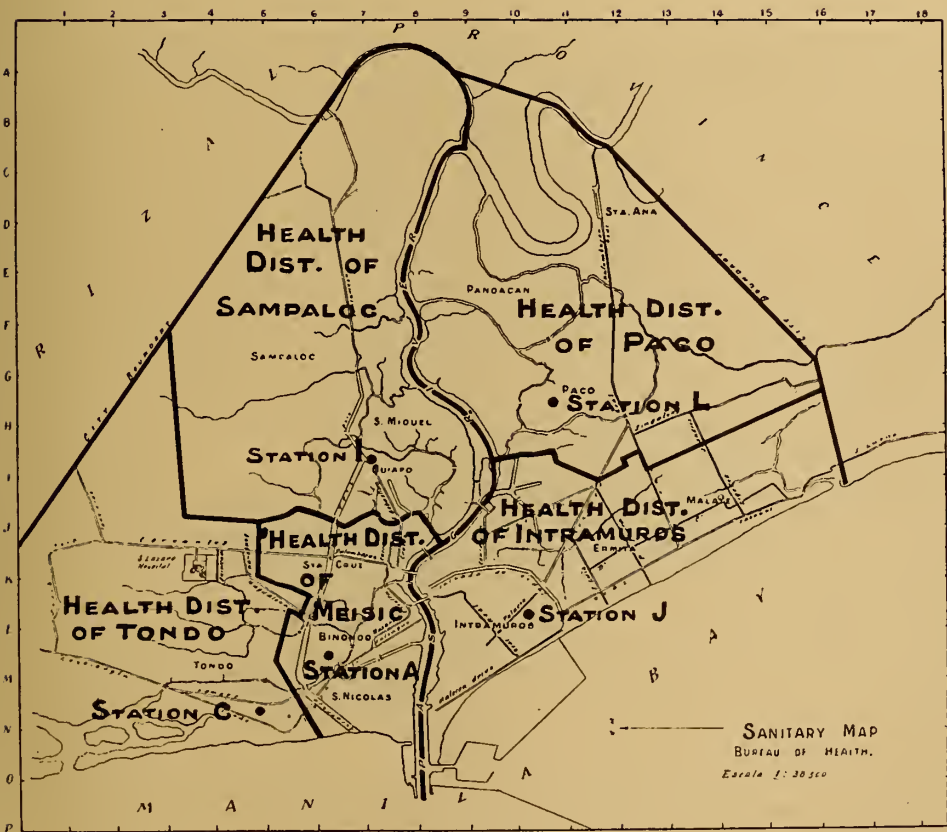
Fig. 2.

PLATE II.

FIG 1.

FIG 2.

PLATE III.



Health Dist. of Sampaloc
Sampaloc
Health Dist. of Paco
Panoacan
Sta. Ana
Paco
Station L
S. Miguel
Station I
Quiapo
Health Dist. of Intramuros
Malate
Ermita
Health Dist. of Meisic
Sta. Cruz
Binondo
Station A
S. Nicolas
Intramuros
Station J
Health Dist. of Tondo
Tondo
Station C
Sanitary Map
Bureau of Health.
M A N I L A
B A Y

Chart 1.

Chart showing infected houses for 5 days ended Sept 23, 1908.

Chart 2.

Chart 3.

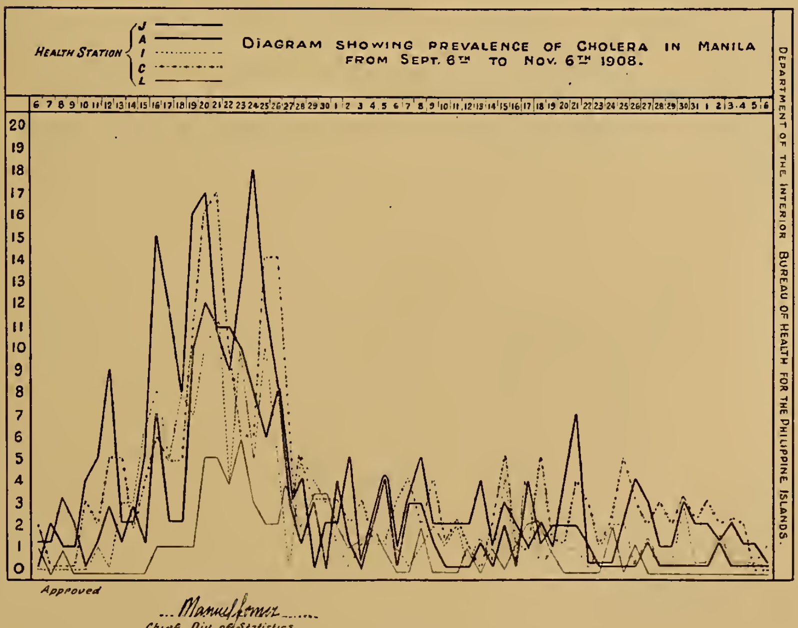
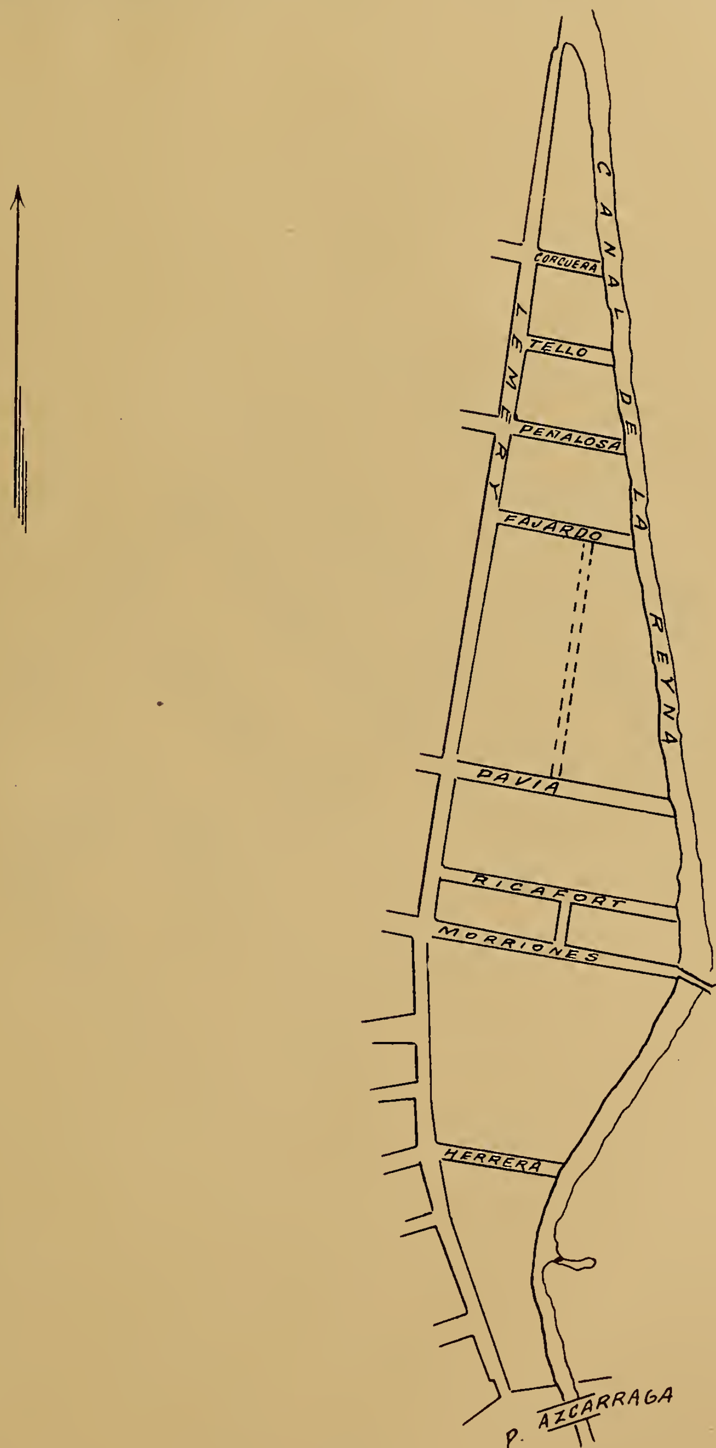
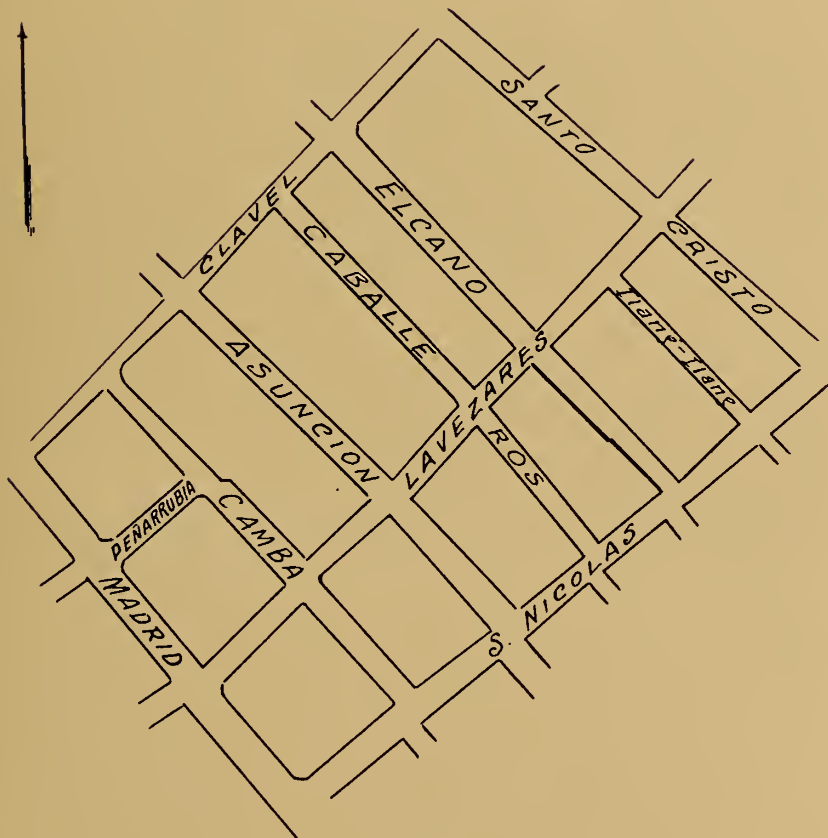


Chart 4.


CANAL DE LA REYNA
LEMERY
CORCUERA
TELLO
PEÑALOSA
FAJARDO
PAVIA
RICAFORT
MORRIONES
HERRERA
P. AZCARRAGA

Map I.


SANTO
CRISTO
ELCANO
CLAVEL
CABALLE
Ilang-Ilang
ASUNCION
LAVEZARES
ROS
PEÑARRUBIA
CAMBA
MADRID
S. NICOLAS

Map 2.

EDITORIAL.

DISCUSSION OF DR. McLAUGHLIN'S PAPER ON "THE SUPPRESSION OF A CHOLERA EPIDEMIC IN MANILA."[1]

Dr. N. M. Saleeby, superintendent of the University Hospital, Manila: I would like to ask Doctor McLaughlin for his opinion as to whether or not at the time of this outbreak cholera was endemic in Manila, or if it was brought from the provinces? Did the first case come from Pangasinan? I believe it to be of the greatest importance to Manila at the present time, for the Manila Medical Society at least to express an opinion. Did this present epidemic of cholera come from the provinces or from endemic cases in Manila? I would like to hear some discussion on this point.

Dr. Allan J. McLaughlin, Acting Director of the Bureau of Health for the Philippine Islands: Doctor Saleeby's question is a very difficult one to answer and it will require a great deal of study. I am not prepared to answer it at the present time. If the suspicious cases during January were connected with the epidemic of September it was not necessary to have it brought down the railroad. There was undoubtedly much reënforcement from neighboring provinces, cases being brought in repeatedly, but whether or not this explains all the cases it is difficult to say. We were unable to trace the first cases in July to the provinces.

In reply to the question as to the condition of the provinces now, Pangasinan, Tarlac, and Pampanga are clean; Bulacan shows from one to four cases per day in the whole province; in Rizal cases occur every few days, and there are very few cases in Cavite. There is not much cholera at the present time excepting around Manila.

Colonel Van R. Hoff, chief surgeon of the Division of the Philippines, United States Army: I would like to ask Doctor McLaughlin how many of the cases, reported as suspicious, turn out actually to be cases of cholera? The reason the question comes to my mind is (in studying as I do the daily reports of the Bureau of Health) that you have reported so many cases of suspected cholera. If any cases are reported as suspected cholera and later prove to be actual cases, how are they included in the report?

Doctor McLaughlin: We have no exact figures on that point, but I remember six cases in one day that were reported as suspicious and all six were later discharged as not cholera. I think the majority turn out not to be cholera, but I have no complete statistics. Cases which are

[1] Held at the meeting of the Manila Medical Society, October 19, 1908.

reported as suspicious and later prove to be cholera are included in the report as cholera cases, and those in which the diagnosis eventually is negative are reported as not cholera.

Dr. Richard P. Strong, chief of the Biological Laboratory, Bureau of Science; professor of tropical medicine, Philippine Medical School: A great deal has been said before the society about the examination of suspected cases of cholera which have occurred before the beginning of the actual epidemics in Manila and in which the bacteriologic examination for cholera has been negative. I think we have lost sight of the fact that we have in Manila an endemic disease known as cholera nostras. I have observed cases of this disease with more or less frequency in the Islands for the past ten years. There have been one or two outbreaks of this malady in the Army and cases are met with from time to time in the natives every year. This disease is well known in other portions of the world, for example in Europe and the United States. It obviously has nothing to do with Asiatic cholera, although its symptoms may sometimes closely resemble those of true cholera. I performed autopsies on a number of cases of cholera nostras in 1900 in Manila, when Doctors Flexner and Barker of the Johns Hopkins University were out here. At that time we searched very carefully for Asiatic cholera, but we never found cases of this disease. Some of the patients died at the old First Reserve Hospital and were carefully examined bacteriologically. From the intestines of some of these proteus bacilli were isolated. I think the cases that the Bureau of Health reports as suspected cholera from time to time, when Asiatic cholera is not present in Manila, are frequently those of cholera nostras or of ptomaine poisoning. Obviously, in these instances we can not find the organism of Asiatic cholera, it is not present, and the disease has an entirely different etiology.

The successful bacteriological diagnosis of Asiatic cholera depends upon the number of cholera organisms in the stool at the time of the examination and the care with which the bacteriological examination is performed. Occasionally, after a patient has been in the hospital for from forty-eight to seventy-two hours it may be impossible to make a bacteriologic diagnosis of cholera from the examination of the dejecta, for the reason that such patients may have been sick for several days before they entered the hospital and the cholera organisms frequently disappear almost entirely from the stool by the fifth or sixth day from the onset of the disease. If the case has succumbed to some late complication of the disease, or the autopsy was not performed until forty-eight hours or a few days after death, it may also be impossible to make a bacteriologic diagnosis of cholera. However, all this has nothing to do with the diagnosis during the acute symptoms of the disease, nor does it depend upon a change of morphology in the organism, or upon a change in its serum reactions, or upon the changes it produces in culture media; it simply depends upon the fact that the cholera organism is either not present or no longer present in sufficient numbers for us to be able to find it. I think it is a reflection upon the bacteriologist to say that he is not able to make a bacteriologic diagnosis of a case of cholera in which the examination is made within a short period of time after the onset of the symptoms. The methods employed in the laboratory are very satisfactory and definite for the bacteriologic diagnosis of cholera. We do not rely alone on the morphology of the organism, for its identification, as one might suppose from some of the remarks that have been made here, but we consider in addition its agglutinative and bacteriolytic reactions and to a certain extent its general biologic properties in culture media and its pathogenic properties. By all these means taken together we are able to make just as definite a bacteriologic diagnosis of Asiatic cholera as we are of typhoid fever or plague. During the past year Dr. Marshall has tried in the laboratory with definite strains of the cholera spirillum to produce a change in the organisms so that they would not agglutinate with a cholera serum, but he has not succeeded in accomplishing this, nor has anyone else done so. The fact that one or two atypical organisms ("El Tor" strains) which resemble the true cholera spirillum in all respects except in the production of hæmatoxins and which give the characteristic serum reactions with cholera serum, have been reported, does not serve to interfere with the bacteriologic diagnosis of cholera from a *practical standpoint.* I feel that we may have great confidence in being able to make bacteriologic diagnoses, providing the cases are seen early enough in the disease and that the examination is performed with sufficient care. A good deal has been said here about the cholera organism changing its morphology, biological properties, and serum reactions so that we were not able to recognize it in the laboratory, but I feel confident that we are still able to diagnose the cholera organism without difficulty for all *practical purposes.*

Dr. Van R. Hoff: I understand that you mean unless you do find the organism it is not cholera?

Dr. R. P. Strong: I do not mean that it is always not cholera if we do not find the organism in a specimen which had not been sent us until say forty-eight or seventy-two hours after the subsidence of all symptoms of the disease, or if the specimen is not delivered to us for several days, or if the autopsy is not performed until several days after death, or if the case has died of some late complication of cholera; but if we get the specimen in time we can find the organism if it is there. The idea has been expressed that before the actual epidemic or toward its close, the organism changes its morphology and its biologic properties to such a degree that we are not able to make a definite, bacteriologic diagnosis. There is no evidence whatever to support this theory, so far it is entirely theoretical.

Dr. Van R. Hoff: I think I heard a gentleman say the other day that the epidemic was losing its virulence as the vibrio was taking atypical forms?

Dr. R. P. Strong: Avirulent strains of the cholera organism sometimes undergo a change in morphology in laboratory artificial media. The spirillum isolated by Pfeiffer in 1894 which has been grown in various laboratories for about 14 years, usually no longer shows the typical comma form, but after frequent passages of this strain through guinea pigs its morphology becomes more typical of cholera. This organism, however, gives the typical serum reactions with cholera serum. By morphology alone, as I have stated, we do not attempt to identify an organism. We would not attempt to identify the plague or the typhoid fever bacillus by its morphology alone. It is by the combination of all the reactions that we identify bacteria and particularly by the serum reactions which are most specific of all.

Dean C. Worcester, Secretary of the Interior of the Philippine Commission, Manila: You have spoken of the disease known as cholera nostras. What is this disease caused by?

Dr. R. P. Strong: Many observers believe that the etiology of the disease is still obscure. Some cases have been thought to be due to meat poisoning, to septicine poisoning, or to intestinal infections with certain of the proteus bacilli or with Bacillus Botulinus. In 1900, when Doctors Flexner and Barker were in Manila, several cases died from this disease and were autopsied in the Army morgue. From these after a careful study a strain of the proteus bacillus was isolated. I also remember one epidemic in which 10 or 15 soldiers were attacked on the same day with symptoms of cholera nostras. The symptoms were supposed to have been caused from eating some spoiled hash served at the mess hall. No cholera spirilla were found in the stools of these cases. These attacks obviously had nothing to do with Asiatic cholera.

Dr. Van R. Hoff: Referring to the distribution of cholera in the city, there seem to be so many foci and it is widespread. Doctor McLaughlin, how do you account for that? You have a simultaneous outbreak in Malate, Intramuros, and Tondo, all separated and in various parts of the city. Could you trace any relationship between any of these different outbreaks?

Dr. Allan J. McLaughlin: No; no connection can be traced. The most plausible explanation is the bacilli carrier. Many of these infections are most puzzling. One case appears in Tondo, and another in Paco, and the case in Paco has no connection whatever which can be traced to Tondo.

Dr. R. P. Strong: I would like to ask Doctor McLaughlin if Doctor Gilman has not reported cases of cholera to the Bureau of Health ever since last January?

Dr. Allan J. McLaughlin: Yes; I think he has. The list I presented here shows practically all the cholera cases, and the only month without cholera was April, and in April we had many of the suspicious cases.

Dr. R. P. Strong: That shows that there was no difficulty in making a bacteriologic diagnosis of the cases as far back as January; that is, at a time before the disease became epidemic.

Dr. Allan J. McLaughlin: There was no cholera present at times, yet the surprising fact is that cases which resemble cholera clinically, but in which we did not find cholera vibrios occurred. Koch says this failure to identify the infecting agent is due to faulty technique, but I do not think so.

Dr. R. P. Strong: I do not think there was any mistake in the diagnosis of the cases: The bacteriologic diagnosis of cholera is a very definite one. A great deal depends, however, on the technique and the care with which the examination is made.

Dr. Van R. Hoff: You were not here, Doctor Strong, but last year (1907) we had a little epidemic of cholera beginning about July and running up to the latter part of December and January, and then it subsided. During the first six months of 1908 we had practically no cholera, excepting occasional, sporadic cases, and then about the same time this year as last, the cases increased in number until they culminated the other day. Why that should be, I do not know, but there may be some relation in it. In studying the history of the Philippines, the epidemics seem always to come about this time, and they cover a period of three or four months in their intensity. Looking back and considering the epidemics for the entire Archipelago and particularly the Island of Luzon, the following appears to be true, when the epidemic last year ceased in Manila it seemed to begin in Dagupan. The first report of any large number of cases I believe came from Dagupan, and the infection worked its way through Pangasinan and appeared in Manila. There were apparently no cases between Manila and Dagupan, at least according to the reports I saw. Cholera jumped from here to Dagupan, and from Dagupan back. All over the Archipelago and in various points in Mindanao we have had cholera, a little here and a little there, but in no great amount, until it developed in Pangasinan. I presume up to the present time, in round numbers, we have twenty-five or twenty-six thousand cases with about fifteen thousand deaths.

Dr. Allan J. McLaughlin: There were something over twenty thousand cases.

Dean C. Worcester: Were Doctor Gilman's diagnoses of cholera all confirmed?

Dr. R. P. Strong: I know some certainly were, after I returned. I came back in April. Doctor Gilman told me he had reported cholera cases in January, before I got back.

Dean C. Worcester: I remember Doctor Heiser complained that Doctor Gilman's diagnoses were not confirmed.

Dr. R. P. Strong: I think Doctor Gilman told me some of the cases which came to the morgue were not cholera. Of the cases of cholera I know that some were identified bacteriologically.

Dr. Paul C. Freer, Director of the Bureau of Science; dean of the Philippine Medical School: All were confirmed after Doctor Heiser mentioned the matter. I have been surprised at the great number of bacilli carriers discovered this year. Over a year ago the Bureau of Science asked the Bureau of Health to send cholera stools of contacts from all stations. We started the work on January 22, 1908 but somehow we failed to get a very large number of stools. We found two Japanese carriers and then we obtained no more material until lately during this epidemic, and these examinations gave us a total of about 7 per cent. This number seems to me usually high. I wish to ask Doctor Strong what the percentage was in the El Tor epidemic.

There is another question that has not been discussed this evening, namely that of vaccination against cholera. What have the other nations that have had to deal with cholera done in this respect? We have done nothing this year, but I think vaccination is being employed in Europe.

I was very much interested in Doctor McLaughlin's statements regarding the nipa houses and the general sanitation of the city. I recall the history of a few years ago, during the early days of the Board of Health, when strenuous efforts were made to clean up various districts of the city. A great many houses had their foundations changed and their ground floors raised above the street levels. Several old and insanitary markets were destroyed, others rebuilt and many insanitary houses burned. An ordinance was passed giving a minimum of 3 meters' distance between nipa houses and insuring a certain height of the ground floor above the street. Public latrines were put in as far as possible. The continuation of these improvements was side-tracked, because of the lack of adequate authority to back up the work of the Board of Health. One example of radical improvement was the remodelling of Calle Carvajal. The discussion leading up to this improvement lasted over four months, but finally the owners of the property were persuaded to do the right thing. Much controversy took place as to the best sanitary code that could be produced, and finally we have a sanitary code combined with the building ordinance, so that in the future the Bureau of Health is in shape to accomplish results by ordinance where the former Board of Health had had to do everything by persuasion, excepting where houses were destroyed by burning. As soon as the pressure of an epidemic disappeared, the capability and power of the old Board of Health to do things was limited by the available ordinances.

Dr. R. P. Strong: In regard to bacilli carriers, that is individuals who carry cholera spirilla in their stools and apparently have no symptoms of disease, it is well recognized that cholera may be spread by such persons, although the organisms do not remain for long periods of time in their intestines. It has been suggested that it was by the means of such carriers that cholera was introduced from St. Petersburg into Berlin. In the epidemic of Hamburg many healthy individuals were found to harbor bacilli. I can not give all the figures, but I remember that the examination of 60 cases, revealed 19 who had cholera organisms in their stools, and none of these had practically any symptoms of cholera. This year, in Japan, 2 per cent of the individuals examined coming into contact with cholera cases were found to carry cholera organisms in their stools. Von Esmarch found that 12 out of 35 healthy cholera contacts examined, contained cholera spirilla in their dejecta. In Manila during the present year we have already found 27 healthy individuals (cholera contacts) from whom cholera spirilla have been isolated.

You ask what is being done in regard to vaccination against cholera in other countries. I can only say that vaccination is pursued extensively in India, where the owners of some large tea plantations no longer employ coolies unless they are vaccinated. At the International Hygienic Congress held last year in Berlin Zabolotoy reported the successful results obtained in Russia. The government of Egypt was also preparing to use protective vaccination against cholera when I was there in January. Inoculations here in the Islands for cholera have not been very extensive. They show that in the vaccinated the percentage that contracted the disease was only one-sixth of that which contracted it in the nonvaccinated.

Dean C. Worcester: I am sorry to disagree with Doctor Freer in one particular. He has overlooked the fact that although we had passed a good sanitary code, the Municipal Board has done some repealing of ordinances. The proper laws were prepared and, with the approval of the Secretary of the Interior, became law. They were enacted in an entirely satisfactory manner, but taking advantage of the fact that its action was not subject to any control by the Bureau of Health or the Governor-General, the Municipal Board has repealed some of the most important sections. It has, furthermore, encouraged constant violations of the provisions of the building ordinance, going on the assumption that it had no proof that the buildings to be erected were going to be used for purposes other than the ones designated by the owners, until they had been so used. In other words, the attitude of the Municipal Board has been that of the policeman who saw a murdered man and another man with a double-barrel shotgun near him, but assumed that he could not arrest the latter because he had not seen him use the gun. We have many houses unfit for human habitation, and as long as the Municipal Board is obliged to accept the statements of the people as to how they will be used, this will continue.

I can state the following as to whether or not cholera is endemic in the Philippine Islands: It is shown very conclusively from the epidemic in 1905 in Manila that the Islands have never since been free from active infection,—we have always had cholera doing serious damage in some parts of the Islands. The investigations I made of the outbreaks during the Spanish days may be of interest.

In 1882, two hundred people died at Maybun on the Island of Sulu in forty days. From here the disease spread to Zamboanga and from Zamboanga to Manila on the *San Francisco Reyes*. We have positive proof that on one day thirteen hundred persons died in the city of Manila. Then came a typhoon and, as the disease had begun to fall off at that time, the Governor-General thought it about time the cholera should terminate and so he proclaimed the cholera at an end, and so ended the outbreak. After this time there were some cases resembling cholera, but the Governor-General gave another name to the infection. Cholera continued during 1882 and 1885. In 1885 they were receiving four, five, and six cases a day in San Juan de Dios Hospital. We can draw some conclusion as to the number of cases when that number presented itself voluntarily at one of the hospitals. In 1884, in accordance with the directions of the Governor-General, these infections were referred to as something else. In the beginning of 1888 cholera became so bad that it could not be concealed, and the condition developed so that it was impossible to cover up the fact of the existence of the disease. The leading physicians of the city met the Governor-General and informed him of the facts. They told the Governor-General what the condition was and that it could not be further disguised. It was necessary for the benefit of the public that the fact be no longer concealed and the Governor-General suggested three names by which it might be called. A short time afterwards, when the Governor-General had a falling-out with the chief health officer, it suited his pleasure to discredit his statements, and so the actual facts became known.

Dr. Van R. Hoff: I ask, how can we hope to get rid of cholera in the future? Of course, that is the essential part of the discussion. Doctor McLaughlin made some admirable suggestions—can they be carried out? What machinery of government is available or can be made available by means of which we can eliminate the disease that has existed from the time that man remembers not to the contrary? The Army is under obligation to do what it can.

Dr. Philip E. Garrison, United States Navy, medical zoölogist, Biological Laboratory, Bureau of Science, and associate professor of medical zoölogy, Philippine Medical School: I think Colonel Hoff's question gives me the opportunity I have been waiting for. Last February at the annual meeting of the Philippine Islands Medical Association a resolution was presented to the government for a commission to investigate the methods for properly disposing of human excreta in the Philippine Islands. Animal parasites at that time seemed to have the center of the stage, and the resolution was made in order to improve the conditions in regard to animal parasites and amœbæ. Animal parasites have given way to cholera and in consultation with Doctor Nichols and others, another resolution has been prepared, which is presented without comment to the society.

Whereas it would appear that the greatest single sanitary need of the Philippine Islands is the proper disposal of human excreta; and

Whereas the proper disposal of human excreta is the one measure preëminently demanded for the control and suppression of certain prevailing diseases, notably cholera, dysentery, typhoid fever, and infections with intestinal worms, without which, provision of other sanitary measures must prove ineffectual; and

Whereas the problem of providing satisfactory, efficient and sanitary means of disposing of human excreta throughout these Islands is so large and complex as to require special and perhaps experimental study by competent men who can give undivided attention to its solution: Therefore be it

Resolved, That the Manila Medical Society does petition the Government of the Philippine Islands, through the honorable the Secretary of the Interior, that a commission of five properly qualified persons be appointed to investigate and decide upon the best method or methods for disposing of human excreta that can be established in these Islands, and that such appropriation be made and such means provided for the establishment of the working system for the disposal of human excreta as from the report of this commission may appear practical and expedient.

It is further recommended that the Director of Science and the Director of Health be *ex officio* members of this commission.

Dr. H. J. Nichols, United States Army, member of the Board for the study of Tropical Diseases as they exist in the Philippines: I second the motion. At the annual meeting of the Philippine Islands Medical Association, there was considerable discussion on this matter, and Sir Allan Perry from Ceylon said that we were trying to do too much, that we ought to be satisfied as other people are and that such investigations are not practicable. Well, we have not tried it for one thing, and for another, the United States sanitary and medical service accomplished results in Panama and Porto Rico which on their face appeared to be impracticable and impossible. I am very strongly in favor at least of this resolution being tried. I believe it is the most important measure to be taken up really to get at the root of all these diseases with which the Filipinos are afflicted. The digging of artesian wells and similar measures are proper, but they do not strike at the bottom of the trouble. If we could dispose of the fæces of the sick it would prevent other people from becoming infected, and until we do this it will require a system of education which is certainly one or two generations ahead. This measure could be put into effect without any consciousness on the part of the Filipinos, that is, without conscious effort. It is practicable to be put in operation and would be a daily routine. I, therefore, second this measure and hope it will be passed.

On being put to the vote the motion was unanimously adopted.

BOOK REVIEWS.

Treatise on Diseases of the Skin. For the use of Advanced Students and Practitioners. By Henry W. Stelwagon, M. D., Ph. D. Fifth Edition. Thoroughly Revised. With 267 illustrations in the text and 34 full-page colored and half-tone plates. Cloth. Pp. 1150. Price $6. Philadelphia and London. W. B. Saunders Company, 1907.

In this last revision, the articles on skin diseases of tropical distribution have been largely rewritten, and several affections of this class, have been introduced for the first time. A new chapter on Dhobie-itch, calling attention to the varied affections grouped together under this name, shows a good understanding of these tropical skin lesions, and their etiology. The article on uncinarial dermatitis, also new, is not so satisfactory and will not be of much value in assisting practitioners to recognize this malady which is said to be very common in tropical countries, but which is certainly not frequently recognized in the Philippines where hookworm disease is rife. The chapter on frambœsia is especially well presented, but could be improved by a description of the methods of finding the *Treponema pertenuis* from the serum of the eruption, a very easy procedure. In discussing the relationship of *Treponema* to yaws and syphilis, and of the Donovan-Leishman body to Oriental sore, the author has, it is thought, been over conservative in view of the large amount of evidence which has been brought forward in support of their causal relationship. Upon the whole, this work, reviewed from the standpoint of the tropical practitioner, is excellent, both as to illustrations and reading matter. The space devoted to treatment is large and the therapeutic agents recommended are, in the opinion of the reviewer, well selected.

A feature of the book, which will appeal to many is the abundant references to the recent literature which accompany each subject.

J. M. P.

Essential of Sanitary Science. By Gilbert E. Brooke. Cloth. Pp. xii+413. Price, 6s net. London: Henry Kimpton, 1909.

This manual is one of Kimpton's Essential Series and is designed for students preparing for the D. P. H. examination, being based on the author's own notes in his reading and laboratory courses for that degree at Edinburgh, and is invaluable to those for whom it is intended and useful to every one who desires to know what is being taught along the lines of sanitary science in the leading universities of the British empire.

The book consists of 413 pages, 387 of which are divided into 20 chapters, treating respectively of Hydrostatics, Pneumatics, Heat, Meteorology, Air, Water, Water Analysis, Food, Food Analysis, Disinfection and Disinfectants, Bacteriology, Parasitology, Personal and School Hygiene, Geology, Sanitary Architecture and Engineering, Disposal of Waste Products, Epidemiology and Endemiology, Vital Statistics, Sanitary Law and Sanitary Administration. The remaining pages are devoted to an appendix of general information of interest to students in the D. P. H. course.

The printing, binding, and arrangement of the volume fully sustain the high reputation of the publishers.

A. J. McL.

PREVIOUS PUBLICATIONS—Continued.

ORDER No.

Bureau of Science—Annual Reports.

201. Fifth Annual Report of the Director of the Bureau of Science for the Year Ending August 1, 1906.
202. Sixth Annual Report of the Director of the Bureau of Science for the Year Ending August 1, 1907.
203. Seventh Annual Report of the Director of the Bureau of Science for the Year Ending August 1, 1908.

Philippine Museum.

(Now Section of Ornithology.)

* *No. 1, 1903.*—On Birds from Luzon, Mindoro, Masbate, Ticao, Cuyo, Culion, Cagayan Sulu and Palawan. By Richard C. McGregor.
* *No. 2, 1903.*—List of Bird Skins Offered in Exchange.
43. *No. 3, 1904.*—Birds from Benguet Province, Luzon, and from the Islands of Lubang, Mindoro, Cuyo, and Cagayancillo. By Richard C. McGregor.
* *No. 4, 1904.*—The Birds of Calayan and Fuga, Babuyan Group. By Richard C. McGregor.

Mining Bureau.

(Now Division of Mines.)

45. *1890.*—Descripción física, geológica y minera en bosquejo de la Isla de Panay por D. Enrique Abella y Casariego, Inspector General de Minas del Archipiélago.
* *1890.*—Memoria descriptiva de los manantiales minero-medicinales de la Isla de Luzón, estudiados por la comisión compuesta de los Señores D. José Centeno, Ingeniero de Minas y Vocal Presidente, D. Anacleto del Rosario y Sales, Vocal Farmacéutico, y D. José de Vera y Gómez, Vocal Médico.
47. *1893.*—Estudio descriptivo de algunos manantiales minerales de Filipinas ejecutado por la comisión formada por D. Enrique Abella y Casariego, Inspector General de Minas, D. José de Vera y Gómez, Médico, y D. Anacleto del Rosario y Sales, Farmacéutico; precedido de un prólogo escrito por el Excmo. Sr. D. Angel de Avilés, Director General de Administración Civil.
48. *1893.*—Terremotos experimentados en la Isla de Luzón durante los meses de Marzo y Abril de 1892, especialmente desastrosos en Pangasinán, Unión y Benguet. Estudio ejecutado por D. Enrique Abella y Casariego, Inspector General de Minas del Archipiélago.
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THE PHILIPPINE

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B. MEDICAL SCIENCES

VOL. IV APRIL, 1909 No. 2

ADDRESS AT THE COMMENCEMENT EXERCISES OF THE PHILIPPINE MEDICAL SCHOOL.[1]

By PAUL C. FREER.

The physicians of the Occident are at present in a position far different from that of their colleagues in the Far East. There we have institutions of learning whose history extends over centuries, institutions in which the great advances of science have been made, institutions that have developed Faraday, Berzelius, Gay-Lussac, Liebig, Wöhler, Virchow, Pettenkofer, Nernst, Ostwald, Fischer, Pasteur, Koch, Ehrlich, and a host of others. There, those beginning their academic careers are brought in contact with a well-trained army of assistants and even with the masters themselves. They have at their disposal the great state laboratories and hospitals, are in the centers giving facilities for the international exchange of the results of research, and the comity between seats of learning gives to them not only the exactness necessary for the development of scientific investigation, but also the tolerance of the views of others which is essential to the thorough discussion of any subject. The great majority of the scientific journals are published in Europe and America, and in those continents the workers in science can digest the current literature of their subjects almost as soon as it is issued from the press. Great scientific congresses meet at frequent intervals, where discussion of recent advances spurs on the new endeavor; in short, in the Occident we have a scientific atmosphere which in every way favors the growth of medical knowledge.

In the Far East, on the other hand, until very recent years, the various

[1] Address of the Dean of the Philippine Medical School: Read at the commencement exercises of the School, February 27, 1909, Manila, P. I.

countries and colonies have been in a state of greater or less isolation the one from the other; only with the development of steamship and rail communication have more comprehensive medical associations and a freer exchange of the results of investigation become feasible. Scientific work in the Far East has also suffered in the past most seriously from the lack of well-organized and extensive libraries, so that the profession at large, even if it had been animated by the most potent spirit of development could not have done the fundamental work necessary for any comprehensive piece of research.

Isolation produces stagnation, and more than that, gives rise to the growth of an insular conceit which not only is fatal to advance, but which even rapidly leads to retrogression. The isolated individual and community have no standards for comparison with others nor stimulus to the best endeavor, and inevitably a habit of thought becomes implanted, which accepts what was the best practice in the past as being equally advantageous to-day. This condition, with all due deference to what was accomplished in former times, has existed in the Philippine Islands. The Archipelago, isolated and with infrequent communication with other countries, was compelled to live within itself. The members of the medical profession, if they have no means of comparing themselves with the leaders of other countries and if they lack the stimulus of great libraries, are almost certain to develop into leagües on the one hand for mutual admiration and on the other for recrimination, with the result that development is checked and old and standard practices retained. Ever and anon fresh blood may be brought in from abroad, causing a momentary awakening which leaves a certain amount of permanent advance, but in the main, owing to the conditions which of necessity exist, its best effort is eventually lost.

However, in recent years a rapid improvement, not only in the Philippines, but throughout the Orient has been manifest. In Manila we now have a scientific library which gives access to all the recent literature, laboratories which subject the existing diseases to the search light of exact investigation and which give certain means of diagnosis and accurate statistics, hospitals where careful studies can be carried on, medical associations which bring us in contact with the members of the profession in contiguous countries, and a journal by means of which the results of the work accomplished can be placed in the hands of our colleagues throughout the world. Ambitious and well-trained investigators have now been coming to the Islands for a number of years, each bringing with him the latest experience and technique of the great laboratories of Europe and America, and each doing his part toward advancing our knowledge of tropical and other diseases.

The time finally arrived when, realizing that the means and men were at hand successfully to begin instruction in medicine by the same methods and on as high a plane as had so long been done abroad, the Government established a Medical School for the purpose of bringing up young physicians who would be capable of using exact methods of laboratory technique and diagnosis and who would themselves be able to carry on the work of investigation so well begun. The period of stagnation has passed, the time for development has come, and the Far East, with its tremendous mass of heart-breaking problems and enormous wealth of new material, is finally coming into its own. The center for the study of tropical medicine will eventually be moved to this part of the world and Manila with the start already gained, will finally become one of the great centers of medical learning.

Although the time for stagnation is past and new conditions, which inevitably must continue to prevail and which must lead to further development are here, there are not wanting those who regard with a sceptical mind that which has been done and who deprecate the expense, effort, and sacrifice. Insular prejudice is difficult to overcome and to eliminate it altogether must take years of patient endeavor amidst circumstances of the most discouraging nature. However, conscious that we have followed the right path, conscious that our development has been real and not imaginary, and conscious that our work will eventually result in the greatest good to the greatest number, we can continue to ignore unjust criticism. Let us not forget that the true followers of the art of Esculapius in other countries have their trials as well, let us not forget that in other parts of the world true scientific work is often regarded as impractical and visionary, and that despite this, medical science has grown and developed marvelously.

The great mass of humanity, to say the most, are but slightly familiar with the achievements of modern medicine, and having but a superficial insight into the exact methods of scientific investigation are prone to regard the great modifications in practice which we encounter to-day, as compared with the principles followed even a few years ago, as the result of the controversies between various schools of medicine or as being due to the influence of different empiric doctrines upon the methods of thought of physicians. In so doing, they completely overlook, or ignore, the fact that since the latter half of the eighteenth century the development of science in all of its branches has proceeded with startling rapidity. In the few years preceding and following the French Revolution the methods of exact investigation became firmly rooted in the scientific world; and these methods, which before that time were confined to a few of the greater minds, were universally adopted. Quantitative study was developed in chemistry, and the bitter controversies in support of opposite views carried on by the devotees of that science, finally resulted in the present development of structural formulæ. This development gave to us the many dyes and stains without which modern biology would be far behind its present status. We obtained a clearer insight into the nature of the great group of carbohydrates, and the hitherto nebulous field of proteins began to assume shape and form. Physiological chemistry was now placed upon a firm, scientific basis and the rapid application of its results to the general problems of the medical science was made possible. Physics, with its equally great development, has contributed as much as chemistry to the general advance. The study of electricity has given us resources which daily find application in physiology, biology, and in the practical branches of surgery and medicine. The work in optics produced the modern microscope with all its accessories and together with photo-chemistry the investigations on light have given us photography. The science of mathematics has grown equally with its sister subjects and joined with chemistry and physics has laid the foundation of what is practically a new branch of learning, physical chemistry. The latter to-day is called upon to explain phenomena and point the way to new research in almost all branches of medicine. Modern biology, with the aid of the microscope, has made us familiar with new classes of flora and fauna, and hence with bacteriology, protozoölogy, helminthology, and mycology. Histology and pathology have gone hand in hand, giving us new developments and new points of view each day. Physiology now makes use of all the resources of physics, chemistry, mathematics, and biology, and, together with anatomy and pharmacology, has become a branch of science to which specialists devote all of their attention.

As you all know, the development of this topic could be continued *ad infinitum*. Almost every branch of science has done its part in advancing medicine and bringing it to its present eminence. Medicine itself has produced the modern hospital where disease in all its forms can be studied and treated with the entire instrumentarium to-day available to us, and where the knowledge gained from experimental work in the laboratory can be applied.

What wonder then that the standpoint of modern medicine has altered. It is not the influence of this or that dogma or superstition, it is not the inner consciousness that this or that practice, previously held, is now untenable, nor is it the belief that to be progressive we must constantly change, that has brought us to our present standpoint. No, it is the great advance of scientific work and the methods of thought in general which have placed medicine where it is and made it, perhaps, the hardest taskmaster in the world. The human body, in health or disease, is subject to the exact laws of physical science and in striving to fathom the relation of these laws to life, medicine will continue to develop in the future as it has in the past. Beliefs and views we hold to-day must give way to others founded on still more extended scientific research, in the continual endeavor to reach that perfect knowledge we will never attain. There can be no differing schools of true medicine: there can be but one medicine, founded upon the laborious achievements of experimental, scientific investigation.

What if controversies, sometimes fierce and acrimonious, exist? They are solely brought about by different interpretations of actual results which are not yet sufficiently great in number or variety to throw the final decision one way or the other. It is one of the great characteristics of the scientific world that it is fundamentally sceptical and that it only gives unanimous acquiescence to an interpretation of facts which have been proved over and over again, until no doubt exists. Modern medicine is not tolerant of fiction or hypothesis: it demands exact observation, and woe be to him who comes before his colleagues with any statement which, with methods at command of the world at the time, he can not prove or for the confirmation of which he calls upon his imagination. Sooner or later someone will plow over the same ground and discover that what he was led to believe was soil of unusual fertility, is only barren rock and sand.

As medicine is founded on the exact sciences, and as the latter are constantly and restlessly advancing, accumulating new results and developing new theories, the physician can not mentally remain stationary. He too must hold the pace, must follow the work of his colleagues, must know the latest point of view and be able to use the latest apparatus. It is this very necessity for increasing the breadth of the physician's knowledge that was one of the prime factors in bringing about the almost universal formation of medical societies where discussion is free and where new results can be gauged at their true value; which has caused the publication of the mass of journals devoted to one or the other branches of the subject; which has founded the modern clinical laboratory, and which has given the services of so many of the profession to the hospitals and dispensaries. Especially the young physician, fresh from his institutional studies, must beware of the danger of lethargy, of believing that if he attends to such patients as he has, with such knowledge as he possesses, he has done his duty. The great procession will sweep by him and leave him, not only unprepared for his great task, but even a menace to the community.

To the graduating class I wish to say the following: The time to do your most energetic work is when you are young, and therefore do not neglect your opportunities. You have completed your academic course, the hospitals are your next school; in these institutions, with no fixed course of study laid out for you by a faculty, you will have opportunity to gain experience and knowledge in much greater degree than in the past, to contract habits of independent thought and to learn how to investigate. It is only by an earnest endeavor to continue your development, it is only by hard work, and above all by endeavoring to advance our knowledge of disease as it exists in the Philippine Islands that you can do your whole duty by the Filipino people who, by their sacrifices, have founded the school which has in part at least, given you your education.

SOME EXPERIMENTS ON THE CULTIVATION OF BACILLUS LEPRÆ.[1]

By Moses T. Clegg.
(*From the Biological Laboratory, Bureau of Science, Manila, P. I.*)

The following experiments on the cultivation of the leprosy bacillus were confined entirely to an attempt to grow the organism in symbiosis. Believing that the leprosy bacillus derives its nutrition from the products of the tissue cells in the lesions in which it is encountered, and from the fact that it occurs so frequently within the protoplasm of these cells, an organism was selected which could be cultivated and which corresponded in a degree to the living tissue cells; that is, an organism containing a nucleus and protoplasm, the amœba. It was first necessary to procure a suitable growth of amœbæ and in this step the technique employed was the same as that recommended previously by Dr. Musgrave and myself in the cultivation of these protozoa. The culture media was composed of agar 20 grams, sodium chloride 0.3, extract of beef 0.3; it was otherwise prepared in the same manner as ordinary agar media for bacteria, the finished product giving a reaction of 1 per cent alkaline to phenolpthaleïn. The media was then placed in tubes and sterilized. The culture media when it is to be used is melted and poured into sterile Petri dishes and allowed to harden before being inoculated. The material containing the amœbæ is then spread in a thin layer over the surface of the media. If the proper symbiotic bacteria are present, the amœbæ will develop within two to ten days, depending upon the source of the amœbæ and the number and character of the bacteria present.

As intimated this media, an amœba, and its symbiotic bacteria were used in an attempt to cultivate the leprosy bacillus. A culture of amœbæ was obtained from a dysentery stool and after a sufficient growth of the amœbæ had occurred to overbalance the original symbiotic bacteria growing with the amœbæ, that is to say, when it would have been necessary to add a fresh supply of the symbiotic bacteria to the culture in order to obtain a further development of the amœbæ, leprosy bacilli were added instead. The inoculation of the plates with leprosy bacilli was accomplished by smearing the surface of the media containing the amœbæ with a portion of the pulp of a leper's spleen. The first series of plates was

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

made from a case autopsied by Dr. Teague of this Laboratory. The spleen was removed aseptically and was found to contain enormous numbers of leprosy bacilli. The plates were smeared with portions of the spleen as described above and incubated for six days at a temperature of 37° C. Microscopical preparations were then made from the cultures, and stained with hot carbol fuchsin solution, decolorized and counterstained by Gabett's method. A great number of leprosy bacilli were found to be present together with short, plump, acid-fast bacilli occurring mostly among the clumps of the leprosy bacilli and associated closely with the amœbæ. Those organisms which from their morphology were evidently leprosy bacilli were undoubtedly carried over from the original source, that is from the spleen. Transplants from these plates were immediately made on fresh plates containing amœbæ and their symbiotic organisms, and incubated for two days at the same temperature. Slides were then prepared from this series of cultures and stained in the same manner. Microscopical examination showed that the short, plump acid-fast bacilli had increased in number, showing conclusively that the organism was multiplying. Control plates made at the same time, with the same amœbæ and in the same manner, except without the material from the leper's spleen showed no acid-fast organisms.

An attempt was made to cultivate the leprosy bacillus from a second fatal case of leprosy upon which the autopsy was performed by myself. The lungs contained tubercular cavities though there was no evidence of tuberculosis elsewhere. The spleen was removed aseptically and smears from it showed a fair number of leprosy bacilli. Inoculations were made from this spleen in the same manner as in the first case, the same strain of amœbæ being employed with similar controls. Microscopical preparations made four days after incubation of the culture showed a short, plump acid-fast bacillus identical in morphology to the organism found in the first case, together with clumps of the original leprosy bacilli inoculated from the spleen. The controls were all negative for acid-fast organisms and remained free from them.

CONCLUSIONS.

In the cultures from both of these cases an acid-fast bacillus is growing and multiplying which although it differs from the leprosy bacillus in morphology nevertheless may be that organism as we know nothing regarding the morphology of *Bacillus lepræ* on artificial media.

Obviously it is advisable to consider in detail the sources of error in these experiments: First, that of air contamination; this is hardly probable and I think can be excluded. Second, that of an acid-fast bacillus growing originally with the amœbæ. If such were the case the control plates should also show the presence of such an organism, whereas this has not been the case and there is no reason to suppose that such an organism may have been overlooked in the control plates when it was so plentiful in the plates inoculated from the leper's spleen. Third, the presence of another acid-fast bacillus occurring in the spleen of leprous subjects. The fact that the acid-fast bacillus isolated from the two different cases is of similar morphology and is evidently the same organism in both instances would render it extremely improbable that it was a contamination from either the spleen or from the air during the inoculation of the plates.

This paper represents a brief résumé of my work on this subject up to the present time and is preliminary to a more extensive research already outlined. One of the first problems to be confronted is the cultivation of the acid-fast organism in pure culture with some well-known species of bacteria for the symbiotic organism and the amœba. It is now well known that amœbæ can not be cultivated without the presence of symbiotic bacteria. In the experiments described above the organisms growing in symbiosis with the amœbæ were unidentified. In as much as we know nothing regarding the morphology or biological properties of the leprosy bacillus on artificial media I shall first investigate the properties of the acid-fast organism growing in symbiosis with the amœbæ and a well-known species of bacteria such for example as the cholera spirillum or the typhoid bacillus. In this manner if the leprosy bacillus colonizes, I will probably be able to differentiate its colonies from those of the cholera or typhoid organisms (constituting the symbiotic bacteria), whose characters are so well known.

SUPPLEMENTARY NOTE.

Since presenting this paper I have succeded in obtaining a growth of an acid-fast organism similar to that obtained in the first two cases described, from leprous nodules in the ear of three living subjects. I have also modified the media by using plain agar alone without the beef extract but the same amount of sodium chloride as was employed in the first experiments. The finished product should have a reaction of 1 per cent alkaline to phenolphthalein. The technique of the method of cultivation has not been changed. At the present time the acid-fast organisms grown from the first two cases are developing well on the tenth subculture and those cultivated from the ear are being grown on the fifth. All efforts have failed to grow the bacillus on any media without the association of amœbæ.

Repeated inoculations of the leprous material on the media containing amœbæ seems to be necessary in most cases in order to produce a primary growth of the acid fast bacillus. This may be due to the change in environment of the amœbæ caused by the addition of the blood and tissue cells from the spleen. Repeated inoculations of the plates probably allow the amœbæ to become gradually accustomed to this change in the media and in this way perhaps a satisfactory relationship for growth, between both the amœbæ and the acid-fast bacillus is obtained.

(For the discussion of this paper before the Philippine Islands Medical Association see p. 141.)

THE TREATMENT OF ASIATIC CHOLERA DURING THE RECENT EPIDEMIC.[1]

By Henry J. Nichols and Vernon L. Andrews.[2]

I. Incidence of the Disease.
II. General Mortality.
III. The Treatment and Mortality of Collapse.
IV. The Treatment and Mortality of Uræmia.
V. Special Problems.
VI. Hospital Management.
VII. Conclusions.

I. INCIDENCE OF THE DISEASE.

An epidemic of 885 cases of cholera occurred in the city of Manila during August, September, and October, 1908. As the population numbers about 223,000, the percentage affected was a little less than 0.4 per cent. Fifty-nine and four-tenths per cent of the cases were males and 40.6 per cent females. As males make up 58 and females 42 per cent of the inhabitants, the incidence of the disease in regard to sex corresponded closely to the general population. The same is true, in a general way, of the incidence in regard to age as is shown in Charts 1 and 2.

While these charts show that, in a general way, cholera affected persons of both sexes and all ages in proportion to the number present, several exceptions should be noted. Proportionately more children of each sex under 10 became infected; the habits of small children may explain this increase. Proportionately less children of both sexes between 10 and 19 took cholera; no explanation of this fact suggests itself except

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, Manila, P. I., February 11, 1909.

This paper gives the results obtained in the treatment of cholera during the recent epidemic in Manila at San Lazaro, the regular isolation hospital, and at the Mary Johnston Emergency Hospital. A great majority of the cases were treated at San Lazaro, but the same general problems presented themselves and the same general conclusions were reached at both hospitals. Dr. R. P. Strong was consultant when the epidemic became severe and besides the writers the following took part in the treatment: Dr. Newberne, Dr. Teague, Dr. Bowman, Mr. Clegg, Dr. Sison, Dr. Guasson, and Dr. Laygo.

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that the instruction and warnings in regard to cholera infection which were given in the schools may have been effective. For some reason proportionately more females of ages from 20 to 29 were infected, and as a number of these women were pregnant, this accounts in part for the increased mortality among females from uræmia. This will be referred to later. In relation to treatment, it may be said that, if this epidemic is a typical one, preparations should be made to receive, during epidemics in the future, cases of both sexes and of all ages in proportion to the population and especial preparations should be made for receiving an excess of children under 10 years of age.

II. GENERAL MORTALITY.

Of the 885 cases 579 or 65.4 per cent died. Two hundred and ninety-eight or 33.6 per cent of the cases were found dead. Of the 587 discovered while alive 466 or 79.3 per cent were treated in the two hospitals. The general hospital mortality was 50 per cent. The hospital mortality for males was 48.7 per cent; for females 51.8 per cent.

Collapse and uræmia are of course the two essential conditions to be met in the treatment of cholera; if untreated, a great majority of the cases die in the first forty-eight hours of collapse; those who survive or are tided over the stage of collapse by treatment may die later of uræmia.

Everyone connected with the patients was strongly impressed with the value of intravenous injections of salt solution in the stage of collapse. Some criticism of this method, however, has been heard on the ground that the large amounts of solution which were frequently given might in some way increase the death rate from subsequent uræmia. Accordingly it will be well to give here the total mortality for each method of treatment from collapse and from uræmia and later to consider each separately.

In the first part of the epidemic only stimulants, such as strychnine and digitalin, were used for collapse, later subcutaneous injections of salt solution were introduced and still later intravenous injections came to be the routine treatment. The following table gives the total results. (In these tables 450 cases among Filipinos only are considered, a small number of whites and foreigners being excluded.)

TABLE I.—*Giving results of different methods of treatment.*

Method of treatment.	Number of—		Mortality.
	Cases.	Deaths.	
			Per cent.
Stimulation	145	47	32.4
Subcutaneous injection	175	117	68.8
Subcutaneaous and intravenous injections	36	19	52.7
Intravenous injection	94	41	43.6

Under the head of treatment by stimulation all the mild cases are included so that the mortality appears small. As a method of treatment of severe collapse this method is generally recognized to be of the least value.

As may be seen, the number of recoveries in the cases treated by the intravenous method is 25.2 per cent greater than in those treated by the subcutaneous method and 9.1 per cent. greater than in the cases treated by the combined method.

It may be argued that as the method of intravenous injection was employed toward the end of the epidemic, the apparent superiority of this method was in reality due to a diminished virulence of the disease. The facts, however, are as follows: The epidemic was at its height from September 19 to 26. The method of intravenous injection as a routine measure was begun about September 26. The general mortality in the city from August 1 to September 25 was 67.3 per cent; from September 26 to October 31 it was 62.3 per cent. Hence the mortality in the last part of the epidemic was only 5 per cent less than that of the first part. This decrease may be much more reasonably attributed to the increased facilities for finding and treating cases than to a reduced virulence, but in either case there remains a substantial gain in the recovery of the cases treated by the intravenous method.

Chart 3 illustrates the curves of total mortality in the patients treated with the two methods and for the different ages of the patients and shows that the intravenous method was more advantageous for all ages; its superiority was shown to be least for cases from 20 to 29 and from 60 to 69 years. In making the curves relating to age, a total of 409 cases was used, 162 being treated by the subcutaneous method and 87 by the intravenous; the charts of the remaining individuals were incomplete or unavailable.

III. THE TREATMENT AND MORTALITY OF COLLAPSE.

TABLE II.—*Showing the results of the different methods of treatment in collapse.*

Collapse.	Cases.	Deaths.	Mortality.
			Per cent.
Stimulation	145	27	18.6
Subcutaneous injection	175	96	54.8
Subcutaneous and intravenous injections	36	9	25.0
Intravenous injection	94	19	20.2

The above table gives the results of treatment from which it may be seen that during the stage of collapse the mortality in the cases treated by the intravenous method is 34.6 per cent less than in those treated by the subcutaneous method.

Chart 4 gives the curves of mortality of the patients of different ages treated by the subcutaneous and intravenous methods and shows that the latter method gave better results regardless of the age of the patient, but that this was least apparent in the cases under 10 and over 60 years of age.

The average number of intravenous injections of salt solution given to those who recovered was 1.8, the average number given to those who died was 2.6. The highest number of injections given to those who recovered was 5; to those who died 6. The average number of injections given by the subcutaneous method was 1.4 for both those who died and for those who recovered. The highest number of subcutaneous injections given among those who recovered was 3, among those who died 5. Undoubtedly if the method of subcutaneous injection had been employed more frequently, more cases would have been saved, but the maximum activity of physicians and nurses was reached as it was.

The apparatus used in administering the injections intravenously is illustrated in fig. 5; it is believed to be of the greatest value in the treatment of cases of cholera. The salt solution employed (0.85 per cent) was prepared in the Biological Laboratory of the Bureau of Science and was sterilized and sealed in 1- and 2-liter bottles. It was brought to the hospital as needed. When a bottle was to be used the cork was loosened and the bottle heated in the hotwater bath to about 43° C. A two-way rubber cork with one long glass tube for the admission of air and a short one to which a piece of rubber tubing was attached, was kept in a weak carbolic solution and when required for use, was firmly inserted into the neck of the bottle, immediately after the withdrawal of the original cork; the bottle was next inverted in the rack and the solution allowed to run from the tube until warm. For insertion into the vein only a few instruments are necessary: a sharp scalpel, a thumb forcep, a grooved director or other similar instrument for introduction under the vein, ligatures preferably of silk, and a medium-sized hypodermic needle, or canula. After the bottle of salt solution had been prepared as stated above, the method of procedure was as follows:

FIG. 5.

A clean towel was placed under the foot or arm of the patient to protect it from the bed clothing, the skin over the site of the operation was cleansed by a cotton or gauze sponge wet with alcohol. Usually the long saphenus vein just above the internal malleolus, or sometimes one of the veins of the arm was selected for the injection. If a needle was used it was either thrust directly into the vein, or more commonly a small incision was made, the vein exposed and then the needle inserted. If a canula was used the vein was dissected from the surrounding tissue, the grooved director inserted beneath it, and the vein ligatured at its distal end. A small, longitudinal incision was then made in the vein above the ligature, the canula inserted, and the salt solution allowed to flow. At the close of the operation the vein was tied above the incision, a dry gauze dressing applied and the part bandaged. In some cases iodoform powder was dusted on the wound before bandaging. On the average about 1,500 cubic centimeters of saline solution were injected at a time, although the amount employed was controlled entirely by the condition of the patient. If the introduction of 500 cubic centimeters of saline solution was sufficient to give rise to a good strong pulse the injection was discontinued; on the other hand, 2,000, 2,500, or 3,000 cubic centimeters were sometimes employed to produce this result. Sometimes it was very difficult to get the solution to enter the veins, owing to their extremely collapsed condition, but by rubbing the limb toward the trunk this difficulty was eventually overcome. If the same patient was given several injections the same vein was frequently used twice. In this case the second operation was conducted in a similar manner to the first except that it was performed from an inch to an inch and a half higher up on the vein. After the vein was opened it was pressed upon to expel any clot that might have formed from the previous operation.

This method of intravenous injection of saline solution is considered to be the most advantageous yet adopted; the advantages derived from its use in overcoming collapse as compared with those from the employment of the subcutaneous injections are its directness, simplicity, and minimum of discomfort for the patient and minimum of time and attention for the physician. As most of the patients came to the hospital in collapse, the injection was usually given at once and repeated as often as the pulse seemed to be failing.

The administration of saline solution in cholera is often called symptomatic treatment, but if the symptoms are in part due, as they seem to be, to a loss of the body fluids, the treatment is to this extent specific. Whether or not the loss of the fluid is due to the mechanical irritation of the cholera vibrio in the intestines or to the toxins of the organism, or to both acting together, the restoration of the fluid in the vascular system is indicated. Attempts to stimulate the heart with strong stimulants, such as strychnine, digitalin, spartein, camphor, etc., do no good, because the heart has nothing to act on. There must be sufficient fluid in order that the heart may carry on its functions. We became so convinced of this in the treatment of cholera that whenever a failing pulse was noticed or a case was admitted into the hospital in collapse we hastened to give an intravenous injection of saline solution rather than a hypodermic injection of strychnine. The results were often dramatic. The respirations which formerly were rapid and difficult became easier, the pulse good, and the general comfort and condition of the patient greatly improved. The almost lifeless individual became again able to speak and to observe what was going on about him. In some instances this transformation was very striking. The only untoward effects noticed after the injections were occasional chills, but these passed off without any apparent ill effects. We do not wish to convey the idea that stimulation in addition to the liberal use of salt solution is never necessary, for it is essential sometimes and must be used. Cramps in the extremities result from lack of fluid in the tissues and were treated by an intravenous injection of saline solution and *not* by a hypodermic injection of morphine.

In giving the intravenous injections the pulse and respirations were watched carefully and at the least untoward symptoms the injection was stopped. Sometimes after the solution had been flowing for a few minutes the patient would take a few shallow breaths, gasp, swallow and act as though choking. The introduction of the solution was stopped immediately, the patient allowed some time to rest, and if necessary treated again later.

In the intravenous introduction of saline solution there seems to be a point up to which the solution can be given and good results obtained, if this is gone beyond, the fluid passes out through the intestines almost as fast as it is injected. It is not always easy to determine when the injection should be discontinued. In collapse, the fluid part of the blood is withdrawn and its organic constituents concentrated. Now, if we could recognize when we had injected just sufficient fluid to restore the normal ratio between the solid and fluid parts of the blood this might be the signal for stopping the injection; going beyond this point might increase the fluidity beyond normal and set the current the other way.

Besides the introduction of saline solution either subcutaneously or intravenously, hot saline enemata, consisting of two liters of fluid, were given every six to eight hours. In this manner the lower part of the intestines was kept washed out and a good effect on the kidneys produced. For a while for excessive diarrhœa chlorodyne was given in 1 to 2 cubic centimeter doses every three to four hours, but it seemed to do little good and was not used much in the latter part of the epidemic. Hot tannic acid enemata (1 per cent,) were frequently given for diarrhœa and seemed to check the condition better than any other treatment. The warmth of the patient was sustained by hot water bottles.

The patients were encouraged to drink copiously of water so long as it did not induce vomiting, but at the first sign of nausea the liquid was restricted and given only in very small quantities or small pieces of ice were administered by the mouth. A solution of cocaine (0.016 gram to 4 cubic centimeters of water) was given to control vomiting and usually proved efficacious. Hiccough was often quite troublesome and obstinate to overcome. Aromatic spirits of ammonia (4 cubic centimeters), ether (1.2 to 1.7 cubic centimeters), or cocaine (0.016 gram to 4 cubic centimeters of water) were employed in the treatment of this symptom.

As to diet, for the first twenty-four to thirty-six hours no nourishment was given; after this time rice water or soups and broths and coffee were administered. The amount was limited, however, a cup of soup with a little coffee was usually more than a patient would care to take at one meal. As the patient began to convalesce a larger amount was given or a soft diet allowed. This usually consisted of soft toast and rice water with some rice. A liberal diet was gradually substituted.

IV. THE TREATMENT AND MORTALITY OF URÆMIA.

TABLE III.—*Showing the results obtained by the different methods in uræmia.*

Method of treatment.	Cases surviving collapse.	Deaths from uræmia.	Per cent.
Stimulation	118	20	16.9
Subcutaneous injection	79	21	26.5
Subcutaneous and intravenous injections	27	10	37.4
Intravenous injection	75	22	29.3

It will be seen that among the cases in which no saline solution was injected the mortality from uraemia was 16.9 per cent. The worst cases of collapse are apt to develop the most severe uræmia. These cases are largely saved from death in collapse by intravenous injections, but are more likely to develop uræmia than the less severe cases which pass through collapse without having received heroic methods of treatment. Hence the increase of uræmia by 12.4 per cent in the cases treated by intravenous saline injections is to be expected; moreover the small difference of 2.8 per cent in the mortality between the cases treated by the subcutaneous and intravenous methods also argues against the production of uræmia by the intravenous method and gives no ground for fear in the liberal injection of saline solution into the veins as compared with that into the subcutaneous tissue.

Therefore, from the results of treatment in these cases, there is no doubt that the method of intravenous injection of saline solution in cholera is much superior to any other form of treatment as it reduced the mortality from collapse and did not increase in itself the mortality from uræmia.

Of the cases treated intravenously who survived collapse, 45.4 per cent developed uræmic symptoms more or less marked; of these cases 64.3 per cent died and 35.7 per cent recovered. Figure VI shows the ages of those who developed uræmia and the percentage of those who died of it. Treatment was most effective between 20 to 29 and 40 to 49 years.

In dividing the treatment of Asiatic cholera into that of collapse and of uræmia, the writers wish to emphasize the importance of the latter condition as a sequela, which the text-books speak of as the "reaction stage" or state of "cholera typhoid." In the recent epidemic, at any rate, the symptoms of this stage were those of uræmia and consisted of a bounding pulse, labored breathing, flushed face, and coma. The treatment of uræmia should begin, if possible, before the clinical signs appear. As stated above, the severe cases of collapse may be expected to develop some uræmia and as soon as reaction had occurred mild diuretics were administered to these cases; large rectal injections of hot saline solution were also given, and in addition cupping over the kidneys was employed. The patient was encouraged to drink large amounts of water and of lemonade. A little later, as the pulse began to bound, hot packs were given in some cases, but because the patients sometimes became frightened by this procedure, and because of the mental disturbance produced causing the patient to struggle violently against it, the pack was discontinued. As the native people become more used to hospital methods, the pack can probably be used to greater advantage in the treatment of cholera.

In the early part of the epidemic, sweet spirits of nitre was given as a matter of routine from the time of the entrance of the patient into the hospital until convalescence had been established. Toward the close of the epidemic an effervescing solution of potassium bicarbonate and citric acid was given *after* the kidneys had begun to secrete urine. No benefit could be noticed from the use of any medicinal diuretic. Of all the measures used to induce the kidneys to secrete, that one of giving large rectal injections of hot saline solution was the most successful and gave the best results. Many times enemata of 4 to 6 liters were given five or six times in the twenty-four hours, instead of three or four times as in the case of the ordinary enemata. The patient was given as much as he could hold comfortably of these large injections and then allowed to pass it, then more was given.

In the most severe cases all measures, such as venesection with intravenous injection of salt solution and constant stimulation by hypodermic injections, were of no avail; and to us the most "grievous picture of the disease" did not constitute the thready pulse, sighing respiration, shrunken features, and clammy skin of collapse, but instead the bounding pulse, the labored breathing, swollen face, and wandering mind of uræmia.

Among the less severe cases of collapse it was impossible to tell which would develop uræmic symptoms, although careful attention was paid to the urine. A systematic examination of the urine was started in the hope of finding some indication of the approaching uræmia, but the epidemic terminated before enough cases were studied. The results as far as they were determined are as follows:

TABLE IV.—*Showing the results of urinary examinations.*

Day.	23 recoveries.				6 deaths, uræmia.			
	Quantity of urine.	Albumin.	Urea.	Total solids.	Quantity of urine.	Albumin.	Urea.	Total solids.
	cc.				cc.			
First	18	1.5	0.8	3	17	1.0	0.05	0.5
Second	188	1.6	2.0	5	10	3.0	0.06	0.4
Third	745	1.0	12.0	17	50	1.7	0.22	1.1
Fourth	1023	0.9	17.0	23	60	1.6	0.2	1.3
Fifth	1337	0.7	20.0	27	153	2.0	0.4	4.0
Sixth	1764	0.5	24.0	30	125	2.0	1.0	4.0
Seventh	1810	0.5	30.0	34	160	2.0	2.0	4.0

The albumin was simply estimated by the eye with the nitric acid test as of degree 1, 2, or 3. The urea was estimated by the Doremus apparatus and the total solids by the specific gravity. The average amount of urine per day per case was as follows:

TABLE V.—*Showing the average urinary results.*

	Quantity of urine.	Albumin.	Urea.	Total solids.
	cc.			
Recoveries	900	0.3	13.0	18.0
Deaths	72	2.0	0.7	2.0

The average time of convalescence was five days, the average fatal case lived six days. The number of cases is too small for the figures to be conclusive, but some such method of examination as illustrated by this table might be of value in order early to direct proper treatment to the uræmic cases.

Intestinal paralysis occurred in a few cases, and as a rule was very intractable. This condition sometimes was relieved by hot turpentine stupes applied to the abdomen over a long period of time in connection with hot saline enemata, with the rectal tube left in for a variable period to draw off the water and gas. Later, small doses of calomel followed by magnesium sulphate were given, but owing to the denuded condition of the intestine and the lowered vitality of the patient these drugs sometimes produced a bad effect.

As a result of the subcutaneous injection of saline solution, abscesses occurred in only two cases, once under the breast and once in the groin. When one considers the large number of injections that were given and the confusion that attended the giving of many of them, one is surprised to find that more abscesses did not develop.

In a few cases a general urticarial-like rash appeared. This was in patients in which the uræmic symptoms were well marked and in which the convalescence extended over a longer period than usual. None of these cases proved fatal and the rash, although it caused a slight itching sensation, which was relieved for the time being by sponging with a solution of sodium bicarbonate, seemed of little importance.

V. SPECIAL PROBLEMS.

Among the many puzzling and worrying incidents that the physician in a cholera epidemic has to contend with, none perhaps will cause him more anxiety than the treatment of the children and pregnant women. To stand by the bedside of the little ones and witness their intense suffering without being able to bring relief is very distressing. Their veins are so small that in their collapsed condition it is in many cases impossible to give an intravenous injection of saline solution. In such cases subcutaneous injection of the solution is the only alternative but on many occasions it seems to do little good. In addition to the attack of cholera the native children here, are almost invariably infected with round worms which for some reason seem to manifest an increased activity at this time. Possibly the presence of the cholera toxin and the increased intestinal peristalsis are accountable for this action, for certain it is that they are frequently passed by the mouth as well as by the rectum. As many as fifteen large worms were pulled from the throat of a child at one time during an attack of cholera. At first small doses of calomel and santonin were given for this condition, but owing to the great depression produced by this treatment it was soon stopped and nothing was done during the attack to expel the worms. Their annoyance to the patient occasionally is great, sometimes almost choking him. Convulsions are not uncommon in children, and all of the cerebral symptoms seem to be more prominent than in adults.

With pregnant women, inasmuch as they almost always abort, one asks one's self the question: Should abortion be produced as soon as the patient enters the hospital or should the physician let nature take its course? We preferred not to interfere for the following reasons: First, these patients, like the others, usually entered the hospital in collapse; and, second, were never thought to be strong enough to withstand the shock of artificially produced abortion. While pregnancy lessens the chances of the patient's recovery such cases do not necessarily prove fatal. In our experience at San Lazaro we had several women who recovered after abortion. The term of pregnancy ranged from three to eight months. Other things being equal, the earlier the case is treated the better the patient's chances are for recovery.

A bacteriological diagnosis was made in nearly all cases within twenty-four hours by Mr. Clegg of the Biological Laboratory of the Bureau of Science. This was of much assistance in handling suspects. Two consecutive negative reports of the stools or contents of the rectum were required before the patient was discharged from the hospital.

VI. HOSPITAL MANAGEMENT.

As is the case in most cholera epidemics, this one was unexpected and it was some time before the accommodations, the number of physicians and nurses, and the supply of apparatus and medicines were such as would have been provided could the epidemic have been foreseen. In an ideal cholera hospital the following conditions should exist: There should be three classes of medium-sized and accessible wards for handling the worst cases among men, women, and children either at the time of their admission or as they develop. In each ward for every six patients there should be one nurse, one helper, one physician (or medical student under the direction of a physician) and all the necessary apparatus. There should be larger wards for mild and convalescent cases and a separate ward for cholera suspects. A definite system for disinfecting and storing patients' effects: sterilization of linen and good laundry facilities should be in force. Large sized toilet rooms which are easily disinfected and kept clean and readily accessible are absolutely necessary, as is also sufficient help to scrub thoroughly the floors of the wards with some strong disinfectant at least twice a day. A small laboratory for bacteriologic diagnosis and urinary analysis should be at hand.

VII. CONCLUSIONS.

1. With regard to sex and age cholera occurred in proportion to the population with an excess of cases in children under 10 years.

2. Intravenous injection saved about 80 per cent of the cases from collapse.

3. Nearly half of those who survived the stage of collapse showed some symptoms of uræmia and nearly one-third died of this complication.

4. In general, the intravenous injection of saline solution greatly reduces the mortality from collapse; the more often the patients survive collapse, the more important becomes the treatment of the subsequent uræmia; with the present methods of treating uræmia only about one-third of the cases recover.

(For the discussion of this paper before the Philippine Islands Medical Association see p. 141.)

ILLUSTRATIONS.

Fig. I.

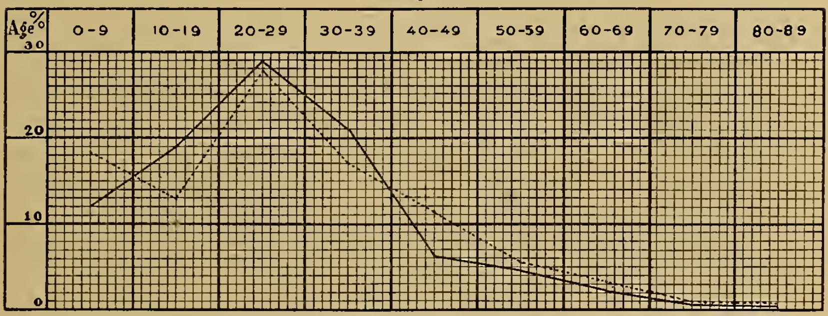


Chart 1. ——— % Population, Manila, Males.
------ % Cases of Cholera, Males.

Fig. II.

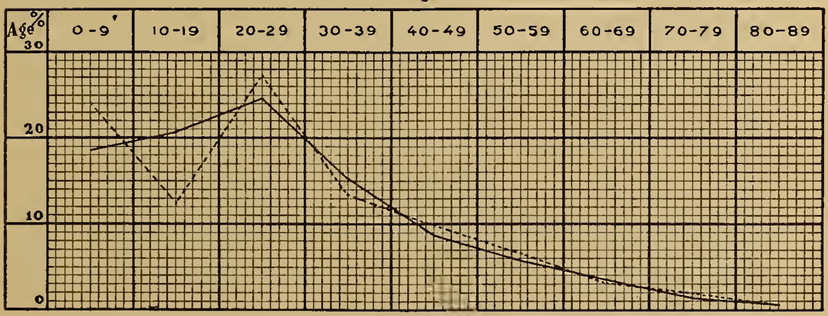


Chart 2. ——— % Population Manila, Females.
------ % Cases of Cholera, Females.

Fig. III.

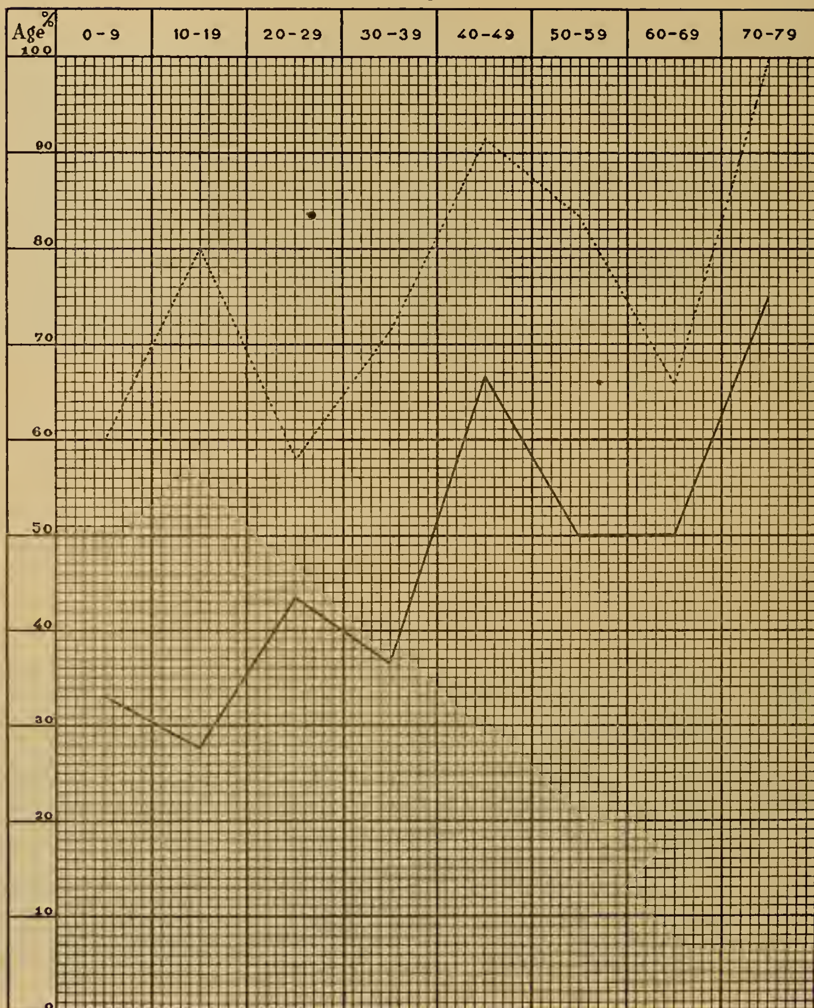


Chart 3. .... %Mortality, Subcutaneous Injection.
______ %Mortality, Intravenous Injection.

Fig. IV.

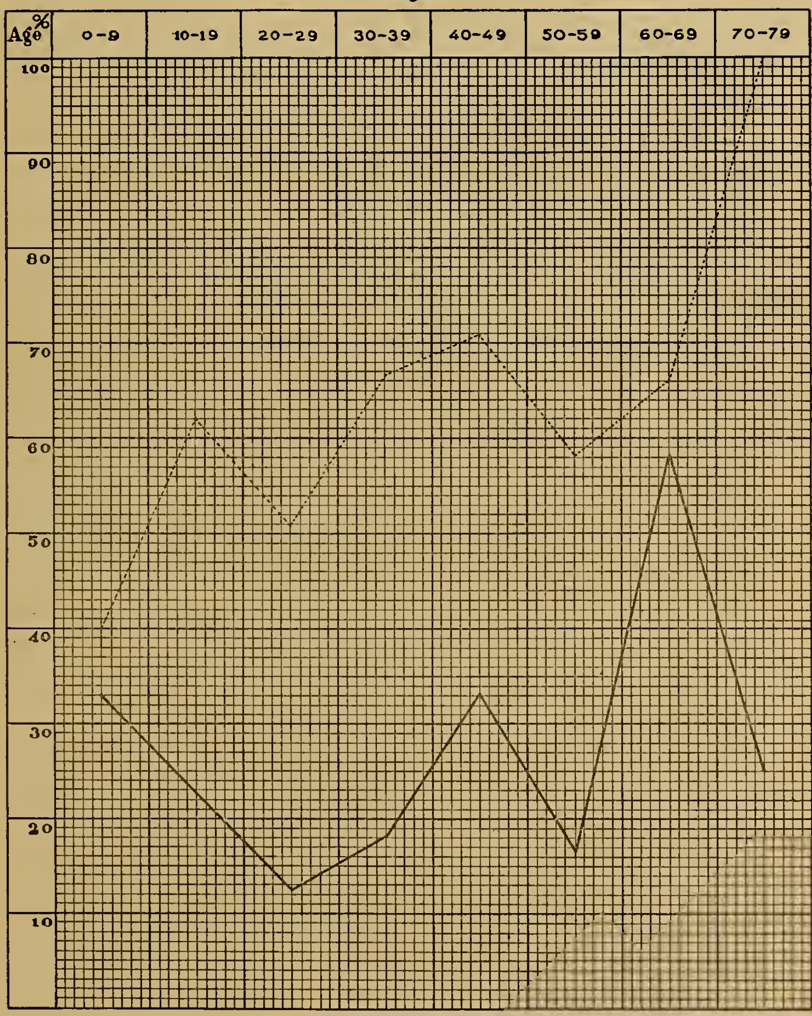


Chart 4 ——— % Age Mortality, Collapse, Intravenous Injection.
-------- % „ „ „ Subcutaneous „

Fig. VI.

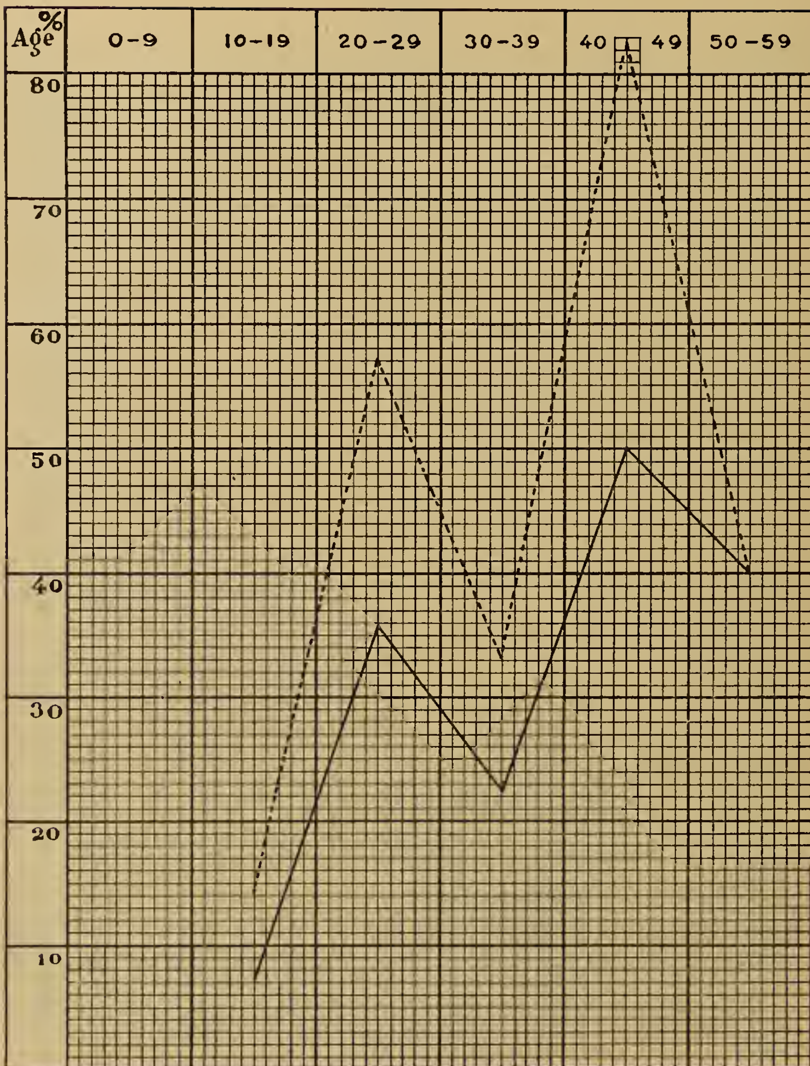


Chart 5 —— Age % Mortality, uræmia, Intravenous Injection.
-------- " " Cases of " " "

THE TREATMENT OF CHOLERA BY INJECTIONS OF HYPERTONIC SALINE SOLUTIONS WITH A SIMPLE AND RAPID METHOD OF INTRAABDOMINAL ADMINISTRATION.[1]

By Leonard Rogers.[2]

The abrupt onset and rapidity of the course of cholera make it an exceptionally difficult disease to treat efficiently. Indian statistics show that the recorded mortality has certainly not decreased with the advance of our knowledge of its causation through the discovery of the comma bacillus by Koch twenty-five years ago. Although Haffkine's preventative inoculation doubtless has a protective influence, it has not been found practicable to use it as a routine measure and it is now very little employed in India. No serum treatment has come into use, while a study of the writings of physicians from the time of the first great modern Indian outbreak in 1817, shows extremely little advance in the treatment by drugs or by other therapeutical agents during the last century.

RELATIONSHIP OF LOSS OF FLUID FROM THE BLOOD TO THE SEVERITY OF CHOLERA.

I have been studying the blood changes in cholera for some years past in the hope of obtaining thereby indications for a more definite line of treatment directed toward combating the actual pathological changes produced by the disease. It is well known that the blood becomes greatly concentrated, owing to the extensive drain of fluid from the body, yet as late as 1866 (and even in a book on nursing in the tropics, published last year), the evacuant treatment of cholera was advocated, in order to remove the toxins of the disease. Moreover it was strenuously denied that there is any relationship between the loss of fluid and the death rate. As Wall and others have pointed out, the effect of a given loss of fluid from the blood will depend as much on the rapidity as on the actual quantity of the loss. In order to estimate the actual degree of concentration of the blood in cholera, I have rapidly defribrinated and centrifuged it in a hæmocrite, the percentage of corpuscles and serum respectively being thus ascertained. As the corpuscles are not lost (except to a very small extent, in the rare hæmorrhagic cases), as

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

[2] Professor of pathology, Medical College of Bengal, Calcutta, India.

many as 8,000,000 per cubic centimeter repeatedly having been found by me, the amount of serum which has been drained from the blood can be estimated by a simple calculation. Working in this way I obtained the following results in a successive series of cases treated by the method described below. The average loss of serum in the most severe class of cases, which comprised those which proved fatal in spite of intravenous transfusion, amounted to no less than 64 per cent of the total. In the cases requiring transfusion, but who recovered, the loss was 52 per cent. In the mildest cases, who recovered without transfusion, it averaged only 35 per cent. There was thus a most definite relationship between the loss of serum from the blood, with its corresponding concentration, and the severity of the disease. If we take the blood as one-thirteenth of the body weight, and the volume of serum of these Bengali patients as 55 per cent, then in the fatal cases no less than 42 of the total 66 ounces of serum were on the average lost from the circulating blood alone, in addition to the great drain from all the tissues of the body. Further, in the second class of recoveries after transfusion, the loss averaged 34 ounces. Such great losses of fluid, accompanied by a corresponding degree of concentration of the blood, must necessarily greatly embarrass the circulation, evidence of which is so clearly seen in the cold and blue extremities. In the severer cases the blood is so thick that it will not run into the capillary tube of a hæmocrite without the aid of suction, so that its passage through the minute vessels of the pulmonary and systemic circulations must be very difficult. Moreover, as long as this condition of the blood remains, and the exceedingly low blood pressure of 50 millimeters and less exists in severe cholera, there is no possibility of renal secretion, and on this the system is mainly dependent for the removal of the toxins. All these observations point to the replacement of the lost fluid as the primary consideration in the treatment of the collapse stage of cholera.

THE PROPORTION OF SALTS IN THE BLOOD IN CHOLERA.

At first sight it might be expected that the loss of such large quantities of fluid would be associated with an increase in the percentage of salts in the circulating blood, and that this condition might act as a conservative process by producing osmotic currents carrying fluid into the blood rather than from it. In this manner it would check the further escape of the fluid through the bowel wall, a process which manifests itself in the form of a watery diarrhœa and one which becomes much less marked in the collapse stage. Further, intravenous transfusion of normal saline fluids, such as have been used in the treatment of the disease for the last eighty years, would reduce the excess of salines in the blood, and again restore the draining of fluid through the intestines. It is just this recurrence of the diarrhœa, commonly within a very few hours, or even immediately after such injections, which has led to the generally acknowledged failure of this promising plan of treatment in materially reducing the death rate from cholera, in spite of the miraculous, but very temporary, improvement resulting from it.

I have also tried large and repeated intravenous injections of normal saline solution (1 drachm to the pint or 0.65 per cent NaCl) controlling the amounts injected by their effect in raising the blood pressure to about the normal, but with the same want of success which has baffled all previous workers on the same lines. It then occurred to me that the desideratum to be aimed at was to raise or maintain a high salt content in the circulating blood which might be effected by using hypertonic saline solution. On rapidly increasing the strength to double that formerly used (2 drachms of sodium chloride to the pint, or 1.35 per cent, to which 3 grains of calcium chloride may be added) a most gratifying degree of success was obtained. At the end of a year, in spite of epidemic prevalence, such as is usually accompanied by an exceptionally high mortality, the death rate at the Calcutta Medical College Hospital during 1908 has been reduced from an average of 61 per cent during the four previous years before transfusion was commonly employed to 32.5 per cent in 186 recent cases, or to barely one-half of the average death rate before hypertonic transfusion was used. In the course of the outbreak I have made a number of estimations of the total percentage of chlorides in the blood, with very instructive results. The patients were almost all Bengalis, in whom Captain D. McCay, Indian Medical Service, has shown that chlorides are higher than in Europeans, namely, nearly 1.0 per cent. This fact must be borne in mind in considering the results, which showed that in the worst cases of cholera, the chlorides of the blood are nearly always actually below the normal, having averaged only 0.79 in the fatal ones, and 0.9 in the recovering ones including those treated with hypertonic solutions. Further, if the chlorides are raised to 1.0 per cent or over, recovery from the collapse stage almost always ensues. In several cases less than 0.7 per cent was found, and in some of these the blood was actually commencing to hæmolise, the serum after centrifuging being stained with dissolved hæmoglobin. In one instance hæmorrhages were also found in the mucous membrane of the cæcum at the post-mortem examination. On examining the blood immediately after raising the salt content by hypertonic transfusion, the serum was found to be quite clear. In the cases which proved fatal from collapse, in spite of transfusion, the chlorides after the injection were still below 1.0 per cent and this was true in all cases except one, an old man who apparently died of heart failure.

The great reduction of chlorides in the blood in the worst cases of cholera, is doubtless associated with the presence of these salts in considerable quantities in the rice water stools, as pointed out long ago by Edmund Parkes. I also have found them commonly to contain as much as 0.5 per cent of chlorides and sometimes even more.

The above observations show the imperative necessity of replacing the lost salts as well as the fluid, for in the severest cases of cholera over two-thirds of the chlorides have been lost from the blood, and presumably nearly a similar amount from the tissues. This can most rapidly be done by the use of hypertonic intravenous saline injections, although in mild cases, with still a fair pulse and infrequent stools, the solution may be administered by the bowel. The transfusions were carried out by Captain Maxwell Mackelvie, Indian Medical Service, to whom I am extremely indebted for trying my plan.[3]

QUANTITY OF FLUID REQUIRED.

By estimating the percentages of serum and corpuscles with the hæmocrite and taking the specific gravity of the blood, both before and after intravenous transfusion, the effect of the introduction of different quantities of saline solution, to replace the fluid already lost, can be ascertained. The object to be aimed at is to dilute the blood to at least its normal condition, or preferably a little below this, in order to allow for any later concentration caused by further diarrhœa, and to replace the fluid and salts lost from the tissues. In cases requiring transfusion my observations show that from three to four pints are required for this purpose; usually the larger amount is necessary. Occasionally the injection of still further quantities is indicated, but rarely at one time. The amounts above mentioned have occasionally to be repeated on the following day if diarrhœa has persisted, but this is not very often the case when hypertonic solutions have been employed. Rigors and a rise of temperature not infrequently follow the injections, but do not appear to be harmful. Such large amounts as three or four pints can not be given very conveniently subcutaneously in cholera, and if no pulse at all can be felt at the wrist, they are sometimes not absorbed. Moreover, with the utmost care abscesses too often follow, owing to the great lowering of the vital resistance of the tissues in this disease. The intravenous injections require a fair amount of skill owing to the collapsed state of the vessels, while great watchfulness is necessary to avoid such dangers as the entry of air. Therefore under Indian conditions their use is frequently not feasible. Again, when the epidemic has appeared unexpectedly and has become widely prevalent it is generally impossible to find time to administer large intravenous injections to all the patients who require them since at least half an hour is necessary for each treatment. Under such circumstances a more simple and rapidly performed method of replacing the loss of fluid would render the use of hypertonic solutions a much more practicable and generally available life saving treatment in cholera.

[3] *Indian Med. Gaz.*, (1908), 43, 165.

A SIMPLE METHOD OF TRANSFUSING SOLUTIONS INTO THE ABDOMINAL CAVITY.

The peritoneal sac affords a rapidly absorbing surface of wide dimensions, and one which would appear to be an ideal location for the introduction of the saline injections if the technical difficulties could be overcome, and the shock incidental to opening the cavity with a knife avoided. I have devised a simple form of canula which has been used in some thirty or forty cases at one of the Calcutta hospitals, with very satisfactory results. It consists of a steel tube about the size ordinarily used in paracentesis of the abdomen, and possesses a flat circular flange to prevent its introduction for more than 1½ inches. The end is sharpened like a cork borer and is inserted into a narrow incision made through the skin and fascia. The instrument is bored through the remaining portion of the abdominal wall with fairly firm pressure, a finger preventing a sudden slipping in of the instrument to any great depth. The incision is made about half an inch below the navel where the peritoneum is adherent, and will not strip before it. It has been found impossible to perforate or otherwise injure the bowel with this instrument, while by attaching a sterile bulb and rubber tube to the external end, saline solution to the amount of 3 or 4 pints can be run into the cavity within ten minutes or less. If the pulse of the patient can be detected at all the fluid is rapidly absorbed, while an immediate further material rise of blood pressure is obtained by applying an abdominal binder after the transfusion has been completed, care being taken not to embarrass the respiration. For example, 3½ pints of hypertonic saline solution were run into the abdomen of a cholera patient with a blood pressure of only 15 millimeters. After the operation the pressure was found to have risen to 65 millimeters, while an abdominal binder further raised it to 73 millimeters. Three hours later the fluid was mostly absorbed, and the pressure was 88 millimeters, while on the following morning it had reached the normal (for a Bengali), of 100 millimeters. The specific gravity and proportion of serum in the blood had both returned to normal, and the patient was passing urine freely and doing well. He subsequently made an uninterrupted recovery, except for a rise of temperature, which was found to be due to malaria, and which rapidly fell under quinine treatment. This plan requires further testing, but it promises to be a valuable addition to the methods of introducing saline solutions into the circulation, while it should also prove valuable in shock produced from other cause than cholera. In both there is a good deal of vaso-motor paralysis, and consequent accumulation of blood in the portal system, which may be materially relieved by the pressure exerted by an elastic abdominal bandage after intraperitoneal transfusion. The same aseptic precautions are necessary as for intravenous or subcutaneous injections, but boiled tap water has been safely used for preparing the salt solutions used in Calcutta in the cholera cases.

DEFICIENT BLOOD PRESSURE AS THE PRINCIPAL CAUSE OF POST CHOLERAIC URÆMIA.

Now that the use of hypertonic saline injections enables the great majority of cholera cases to be tided over the very dangerous collapse stage of the disease, that common and deadly late complication, uræmia, has become relatively more important than ever. A comparative analysis of all the cases treated at the Calcutta Medical College Hospital in 1907, when transfusions were rarely given, and normal saline solution only used, with those during the year 1908 when hypertonic injections were employed, showed a slightly lower death rate from uræmia in the latter than in the former series, namely, 12.8 per cent against 13.2 per cent. Therefore it is clear that the strong saline solutions in no way predispose to a deficient action of the kidneys. A study of the microscopical changes in the kidneys of patients who had died of post-choleraic uræmia, led me to suspect an actual mechanical obstruction to the circulation through the organs, produced by the great effusion of blood into and around the tubules. In order to test this hypothesis I measured the height required to perfuse normal saline solution through the vessels, of the kidney removed at the post mortem examination. These experiments were carried on with healthy kidneys and with those removed from patients who had died of choleraic uræmia. The results were very striking, for whereas in normal organs a pressure of from 20 to 30 millimeters of mercury sufficed to run a good stream of saline solution through the organs, in the choleraic kidneys after death from uræmia one of 90 to 100 millimeters were necessary. In one case of death from pneumonia following cholera, the patient having succumbed about a week after the renal secretion had been reestablished, 30 millimeters pressure only was needed to pass the solution through the kidney, showing that it was only in the uræmic cases that the obstruction was present. I have therefore watched the blood pressure day by day after recovery from the collapse state of cholera with the following results: Out of ten cases of fatal uræmia subsequent to intravenous transfusion in five the pressure toward the end was not over 80 millimeters, in three not above 90 millimeters, while in only two did it reach only 100 millimeters and that was just after intravenous injections, two and five days, respectively, before death. Moreover fatal uræmia was commoner in cases which had not been transfused than in those which had been; although the former were much milder cases in whom the measure did not appear to be necessary, but in which the blood pressure usually rose only very slowly from the invariable low point during the acute stage of the disease. Again a remarkable recovery from apparently hopeless choleraic uræmia, with rapid stertorous breathing, followed the forcing up of the blood pressure to over 100 millimeters by hypodermic injections of adrenalin and digitalin.

There is, then, a very definite relationship between a continued low blood pressure and the supervention of uræmia after recovery from the acute stage of cholera, which affords most valuable indications for treatment of this justly dreaded complication. Uræmia is most frequent in two classes of cases, first in very acute ones admitted early in the disease, and second, in mild ones admitted more than 48 hours after its onset, whose treatment has been consequently neglected, and in which a low blood pressure has persisted for a long period of time.

CONCLUSIONS.

1. The severity of the cholera attack is in proportion to the loss of fluid and salts from the blood, which, in all but mild cases of the disease, it is desirable to replace.

2. This can best be done by the intravenous injection of about four pints of hypertonic salt solution, two drachms of sodium chloride to the pint, (1.35 per cent) being a suitable strength. The use of this solution has reduced the mortality during 1908 in the Calcutta Medical College Hospital by nearly one-half.

3. When time does not suffice and the staff of assistants is not sufficiently large for the regular administration of intravenous injections, the salt solution may be given intraperitoneally with great advantage by the simple method described above.

4. Post-choleraic uræmia is associated with deficient blood pressure, and should be treated by methods which raise the tension in the arterial system.

(For the discussion of this paper before the Philippine Islands Medical Association see p. 141.)

THE SUPPRESSION OF A CHOLERA OUTBREAK IN THE PROVINCES OF THE PHILIPPINE ISLANDS.[1]

By ALLAN J. McLAUGHLIN.[2]

The measures necessary for the suppression of an outbreak of cholera in the provinces are simply the measures applicable for the suppression of cholera anywhere, with such modifications as may be necessary because of local conditions.

These measures naturally group themselves into general and local. Under the head of general measures, or measures calculated to prevent widespread dissemination from unknown sources of infection, must be placed:

1. The securing of a good water supply; or general measures to render the water supply safe.
2. Safe disposal of fæces of the entire population.
3. House-to-house inspection.
4. General disinfection of large areas where the foci can not be located definitely.
5. Campaign of education.
6. Prohibition of certain food stuffs.
7. Enactment of necessary ordinances.

Under local measures, or measures directed toward preventing spread and eradicating infection from known foci of infection, are placed:

1. Early quarantine of house and inmates.
2. Disinfection of house and inmates.
3. Observation of contacts for five days.
4. Examination of stools of contacts.

GENERAL MEASURES.

1. WATER SUPPLY.

The best water supply for the small provincial towns and *barrios* is undoubtedly furnished by the artesian well. The sum of ₱150,000 was appropriated last year by the Insular Government of the Philippine

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 12, 1909.

[2] Passed assistant surgeon, U. S. P. H. and M. H. Service, assistant director of Health.

Islands and is now being expended in drilling artesian wells in the provinces which have suffered most from cholera.

The itineraries of the well-drilling outfits are made out according to the recommendations of the Bureau of Health. The object lesson given by the Insular Government in drilling artesian wells successfully has had its effect on some of the more progressive provinces and several provincial boards have bought or propose to buy well-drilling outfits for furnishing artesian well water wherever feasible within their provinces.

The water supply in the majority of the provincial towns and *barrios* is still derived from sources easily infected, such as rivers, streams, ponds, pools, and shallow wells. The best of these wells should be selected and the others closed. If the water of the wells selected is of doubtful quality, it may be treated with permanganate of potash or boiled, and then issued under guard, with an absolute prohibition of the use of water from any other source. If the water is taken from a river every effort should be made to prevent pollution of the stream. There should be absolute prohibition of bathing or washing of clothes in the stream, and the people should be advised to boil all water before using it.

2. DISPOSAL OF FÆCES.

The demonstration of the presence of bacilli carriers shows us that the defecations of the apparently healthy may be dangerous, so that we must not only dispose of in a sanitary manner the stools of those actually sick with cholera, but also make safe disposal of the stools of the entire population.

In large cities, with sewer systems and flush closets, this part of the problem is easy of solution, but in Manila, and to a greater extent in the provinces, it presents great difficulties because of the habits of the people and certain peculiarities of climate and topography.

The Philippine village and town are usually poor, and expensive systems of disposal of waste is out of the question. The simple pit, used as a closet, where the stools are covered by lime or fresh earth, is effective during the dry season, or, when situated on high ground, is satisfactory in the wet one. In low, marshy districts, during the rainy season, the pit is unsatisfactory, and a pail system, or some simple modification thereof, is probably most satisfactory. A disinfecting solution should be furnished householders and all persons required to deposit their dejections into this solution.

3. HOUSE-TO-HOUSE INSPECTION.

House-to-house inspection is very important and if carefully done the cases are discovered early and the house may be quarantined before contacts have had a chance to scatter. To be effective it should be done at least once daily.

4. GENERAL DISINFECTION OF LARGE AREAS.

General disinfection of large areas is necessary at times when scattered cases occur over a large area and the source of infection can not be definitely located. Such disinfection should include that of all closets or any substitute therefor, or any place suspected of being soiled or infected by fæcal matter. It may include also disinfection of the hands of the people in the suspected area, and an effort should be made to induce them to wash their hands before eating.

5. CAMPAIGN OF EDUCATION.

The inculcation of cleanly habits among the people, and instruction as to how they should protect themselves from infection are very valuable general measures in the prophylaxis of cholera. The campaign is most effectively carried on in the schoolroom and from the pulpit. The medical officer who is able to secure in this work the coöperation of the local *padre* and school-teacher will be indeed fortunate. The Director of Education and the Archbishop of Manila have done everything in their power to secure the coöperation of their representatives in the provinces with the Bureau of Health. The cholera circular of the Bureau of Health is concise and explicit and contains all the necessary rules for protection against infection. The circular is printed in Spanish, English, and the principal native dialects.

6. THE PROHIBITION OF CERTAIN FOOD STUFFS.

The prohibition of certain native foods, fruits, and vegetables seems to be a useful measure, although there is some doubt as to the reason why such prohibition is beneficial. Some of these foods are very irritating and indigestible and may be only predisposing factors. All these prohibited foods may cause infection, as they are either eaten raw or long after cooking, and are handled by a people many of whom in epidemic times may be bacilli carriers and whose habits of personal hygiene are those of a semi-savage people who have not yet arrived at the refinement of using a knife, fork, or spoon at their meals, or the washing of their hands before eating.

7. ENACTMENT OF SANITARY ORDINANCES.

It will be necessary to induce the municipal board to pass necessary ordinances in order to place these general measures in force, if such ordinances do not already exist, and the accomplishment of this is an art in itself. I think the past grand master in the art of inducing municipal councils to pass and enforce sanitary ordinances in the Philippines is Medical Inspector Paul Clements of the Bureau of Health. An efficient and fearless justice of the peace is essential to see that the enforcement of the ordinances is real and to apply substantial fines to the offenders.

LOCAL MEASURES.

1. QUARANTINE OF THE INFECTED HOUSES.

A quarantine of an infected house to be effective must be placed early and maintained rigidly. The local police are usually worthless, and the best results are obtained by employing outsiders, preferably the Constabulary, who have no interests, "*parientes*" or "*amigos*" in the *barrio* and who will obey instructions implicitly.

2. DISINFECTION.

As the cases must remain and be cared for in the houses in which they are found, one room is first disinfected, and the patient placed therein with a person acting as nurse. Disinfecting solution is furnished for the treatment of excreta, and instruction in the care of the sick and in self-protection is given to those in attendance on the patient. The rest of the house and its contents are then disinfected by washing or by immersion of the articles in a disinfecting solution. The contacts are disinfected and isolated; they are held under observation for five days, and whenever possible their stools are examined for cholera vibrios.

When, through the apathy or incompetence of local officials, it becomes necessary for Insular officers to take charge of a cholera situation in a provincial town, they usually find that little, if any, effort has been made to carry out these two very important factors which are so successful in combating cholera.

The first two cases of cholera in the Mariquina Valley, during the present fiscal year, occurred in the municipality of Mariquina on the 30th of August, one of them dying on the same day of the attack and the other living until the next day. During the month of September, from the 11th to the 31st, a total of 61 cases and 48 deaths were reported from this town.

In Pasig, the disease broke out on the 2d of September, there being during the month 60 cases and 50 deaths.

In San Mateo, the disease appeared on the 7th of September, the total for the month being 46 cases and 40 deaths.

The outbreak was coincidental with the Manila epidemic, but nevertheless men were sent from Manila to organize the available force and to direct operations. Sanitary Inspector Percy was detailed for duty in the Mariquina Valley from September 19 to October 20; medical inspector Vicente de Jesus from September 20 to October 24; and Sanitary Inspector Palmer from October 18 to October 30.

Troops were sent to Mariquina to protect the water supply of the city of Manila and remained on duty until the water from the new water system was turned into the mains.

Permission was granted for the withdrawal of the troops guarding the river and the removal of the pail system installed by the city of Manila, when the inauguration of the new water system rendered these precautions unnecessary for the protection of the Manila water supply. The provincial and municipal authorities were urged to provide an efficient substitute for the pail system removed from Mariquina. This they failed to do.

When left to themselves, there is no doubt that the local authorities, with one or two remarkable exceptions, relapsed into their habitual apathy. The president of the sanitary department of Mariquina, Vicente Mallori, and the justice of peace of the same town, did probably all that two individuals could do without support from the other municipal officials.

As a result of the work of organization done by Dr. Jesus and Sanitary Inspectors Percy and Palmer, and the campaign carried on under their direction, cholera disappeared from the valley by November 16. The entire district was free from cholera from November 16 to December 12, when one case occurred in San Mateo. This was followed by a reappearance of the disease on the 14th in Mariquina, and in Pasig on the 21st, the total for the valley for the month of December being 87 cases with 77 deaths.

Medical Inspector Laughlin, late in December, made an inspection of Pasig and other towns and attempted to stir the local officials into activity. On December 29 and 30, Medical Inspector Clements made an inspection of the entire valley and did some strenuous work exhorting the municipal councils to action. On December 31 the writer, after a careful inspection of Pasig, Mariquina, San Mateo, and Montalban, decided that the local authorities were unable to cope with the situation quickly and placed the following organization at work on January 1, 1909. All of the men employed belonged to the regular Manila force:

Pasig: Sanitary Inspector Hogle in charge; 10 assistant sanitary inspectors; 1 disinfector.

Mariquina: Sanitary Inspector Pauly in charge; Sanitary Inspector Jacobsen; 10 assistant sanitary inspectors; 1 disinfector.

San Mateo and Montalban: Sanitary Inspector Percy in charge; 10 assistant sanitary inspectors; 1 disinfector.

Daily inspection of the entire valley was made by Medical Inspector Paul Clements, and inspection three times per week by the writer.

On the 3d of January, upon request of the writer, the Governor-General ordered two companies of Constabulary to assist in this work. They were available for duty on January 5. The campaign was directed along the lines of our work in Manila in the recent epidemic, recognizing that the cardinal principle in fighting cholera is the proper disposition of the fæces of the entire population. Every householder in Pasig, Mariquina, and San Mateo was compelled to keep his premises clean, to dig a pit for the reception of fæcal matter and to cover such fæcal matter with lime or fresh earth. House-to-house inspection was made by the assistant sanitary inspectors in order that the cases might be found in the early stage of the disease, the cholera cases were immediately quarantined under Constabulary guard, and careful and thorough disinfection carried out. The Bureau of Health in this fifteen-day campaign not only furnished all personnel, but also furnished 15 tons of lime and several barrels of Jeye's fluid and carbolic acid for disinfection.

The rapid decrease in the number of cases a day is shown by the following table:

Town.	January.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Mariquina	3	2	3	3	4	2	1	0	1	1	1	0
San Mateo and Montalban	3	5	1	2	2	2	1	1	0	0	0	1
Pasig	1	0	2	1	1	0	1	1	0	0	1	0

These towns having been five days without a case of cholera the Manila force was withdrawn on January 16 and 17, 1909.

Totals for 3 towns for 15 days preceding advent of Insular officials, with municipal and provincial health officers in charge, December 17 to 31, 1908.		Totals for the same 3 towns for 15 days during which Insular officers had charge, January 1 to 15, 1909.	
Date.	Number of cases.	Date.	Number of cases.
December 17	1	January 1	7
December 18	0	January 2	7
December 19	4	January 3	6
December 20	6	January 4	6
December 21	4	January 5	7
December 22	2	January 6	4
December 23	10	January 7	3
December 24	6	January 8	2
December 25	5	January 9	1
December 26	7	January 10	1
December 27	9	January 11	2
December 28	12	January 12	1
December 29	7	January 13	0
December 30	4	January 14	0
December 31	4	January 15	0

The sudden reduction in cases after the Constabulary became available on January 5 will be noted, showing the effect of efficient quarantine of the infected houses.

In fifteen days the valley was practically cleared of cholera. The measures employed were of kindergarten simplicity. The local authorities and the district health officer were continually urged to take note of these measures, and it is hoped that their continuance will follow.

In view of the rapid reduction in the number of cases, there is sufficient local force, including sanitary inspectors, police, and other employees of the municipalities to carry on the work provided the municipal president, the other municipal officials, and the police do their duty.

The chief difficulty arises from the reluctance of municipal officials to prosecute *"parientes"* or *"amigos."* There is also no doubt that the average native policeman for the same reason makes a very inefficient quarantine guard or sanitary inspector; he hesitates or neglects to report infractions of health ordinances if the infractors are friends or relatives, and he usually permits friends or relatives to enter or leave infected houses when he is left alone in charge.

It was deemed advisable to remove the president of the municipal board of health of Pasig from office. This individual complied with instructions inasmuch as he disinfected the house and placed it under quarantine guard, but it was his practice to permit infected clothing, bedding, dishes, food and drink to be removed and he then disinfected the empty house. He permitted the contacts to escape and then placed his quarantine guard on the empty house, which he had just disinfected. This was not ignorance, but rather an exaggerated desire to please his friends or to avoid making enemies.

The success achieved in the towns of Mariquina, Pasig, and San Mateo was repeated later in January in Taytay and Binangonan, which towns are also in Rizal Province.

The course of the outbreak is best shown on the charts appended.

ILLUSTRATIONS.

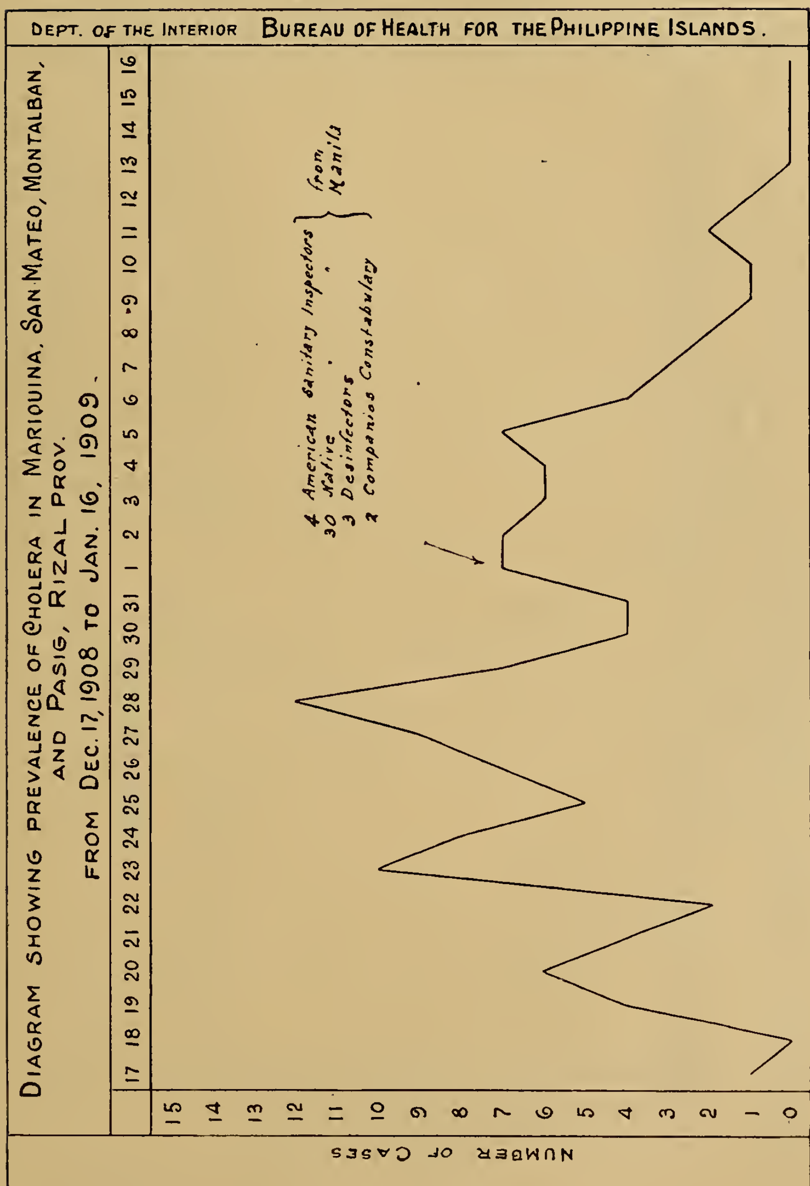

DEPT. OF THE INTERIOR BUREAU OF HEALTH FOR THE PHILIPPINE ISLANDS.
DIAGRAM SHOWING PREVALENCE OF CHOLERA IN MARIQUINA, SAN MATEO, MONTALBAN, AND PASIG, RIZAL PROV.
FROM DEC. 17, 1908 TO JAN. 16, 1909.
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
4 American Sanitary Inspectors
30 Native "
3 Desinfectors
2 Companies Constabulary
from Manila
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
NUMBER OF CASES

CHART 1.

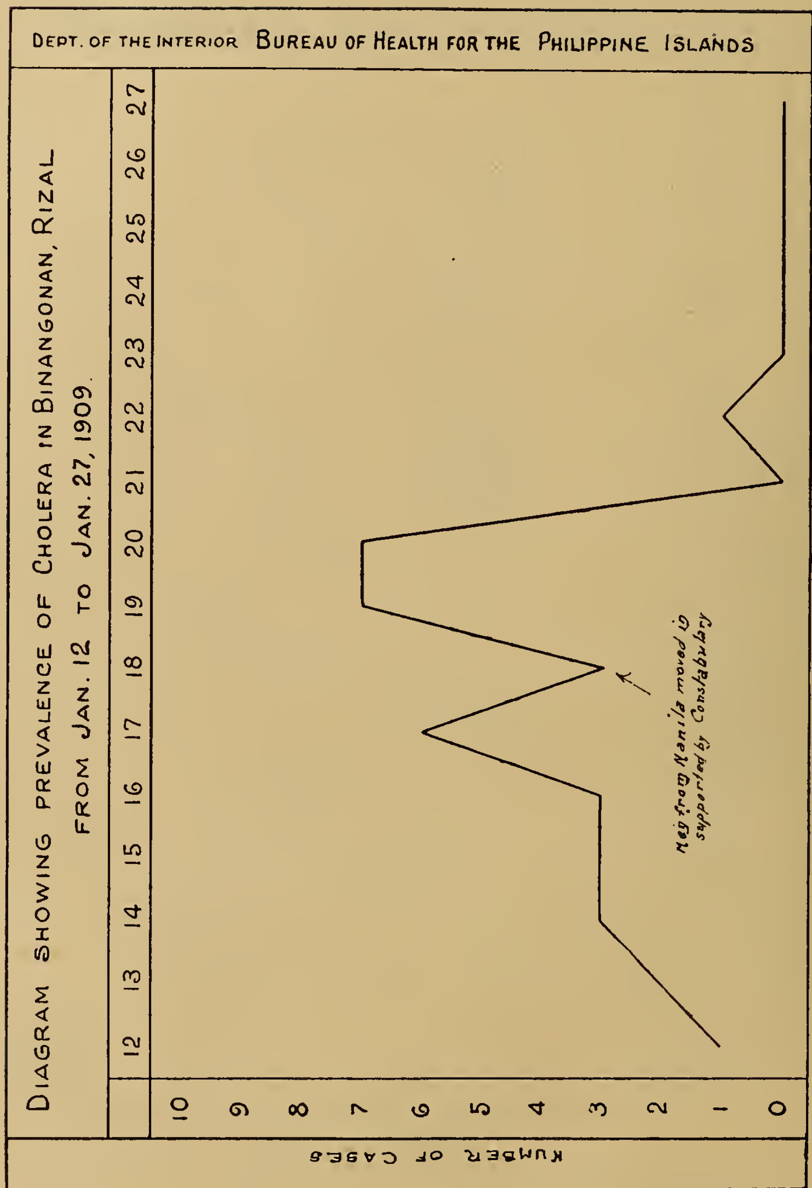

Dept. of the Interior Bureau of Health for the Philippine Islands
Diagram showing prevalence of Cholera in Binangonan, Rizal
from Jan. 12 to Jan. 27, 1909.
12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
10 9 8 7 6 5 4 3 2 1 0
Number of Cases

Chart 2.

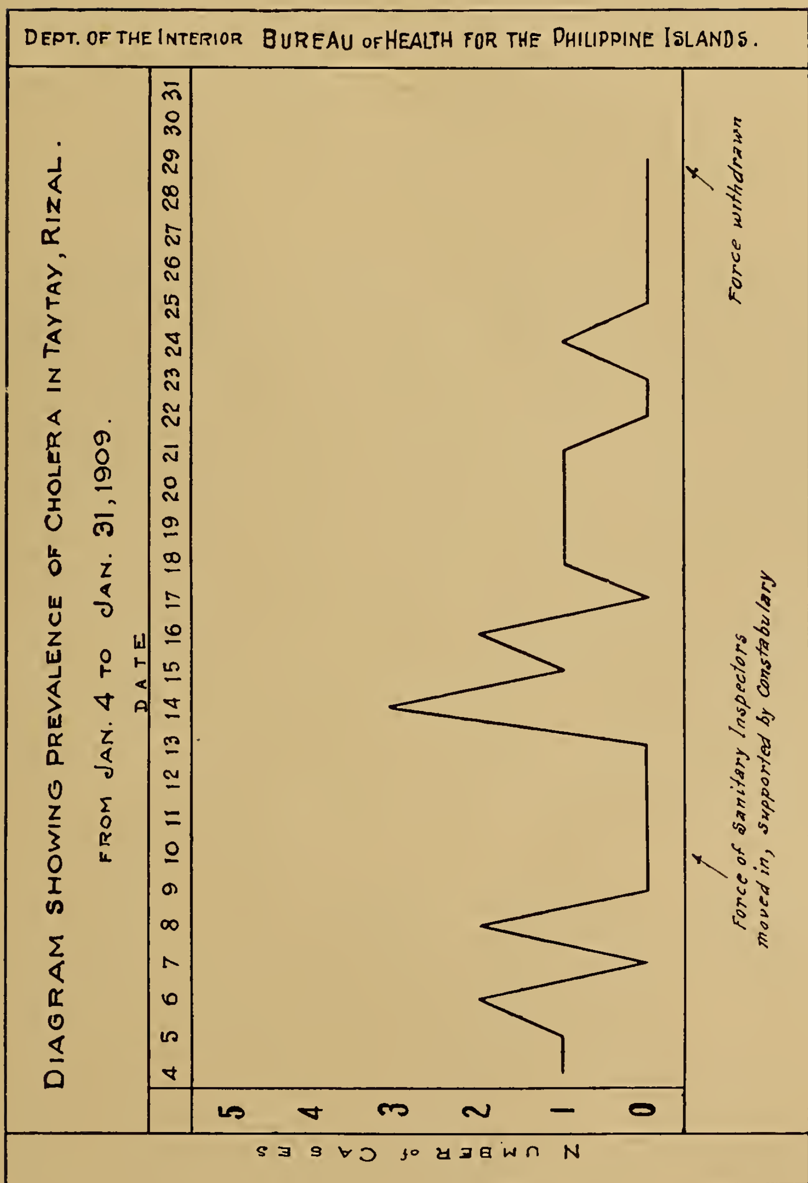

DEPT. OF THE INTERIOR BUREAU OF HEALTH FOR THE PHILIPPINE ISLANDS.
DIAGRAM SHOWING PREVALENCE OF CHOLERA IN TAYTAY, RIZAL.
FROM JAN. 4 TO JAN. 31, 1909.
DATE
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
5 4 3 2 1 0
NUMBER of CASES
Force of Sanitary Inspectors moved in, supported by Constabulary
Force withdrawn

CHART 3.

REMARKS ON PIROPLASMOSIS.[1]

By E. Martini.[2]

Theobald Smith was the first to recognize the real nature of *Piroplasmata.* He discovered the germ of Texas fever in the red blood cells of cattle in 1893 and called it *Pirosoma bigeminum* on account of its pearlike shape. Babes, a Roumanian, in 1888, had already observed similar organisms in the red blood cells of cattle, but he held them to be diplococci. Although these organisms are in no way related to bacteria, nevertheless, to Babes is given the priority of their discovery, especially by zoölogists, and the whole group is called after him *Babesia;* other observers, especially Laveran and Mesnil, inclining more to Theobald Smith's nomenclature, have adopted the name of *Piroplasma.*

The *Piroplasma bigeminum* which I shall describe fully as a type of the group is illustrated in Plate I, fig. 1. The organism is pear-shaped in outline and the body is double; the cytoplasm stains blue, and the chromatin-mass red. The whole parasite lies within a red blood cell. This parasite is transferred from animal to animal by means of ticks, and it weakens or even kills the host which it attacks through the destruction of enormous numbers of red blood cells, or in other words, by the severe anæmia which it produces.

It would take too long to give a full description of all the symptoms of the diseases to which *Piroplasmata* give rise, and in regard to the transmission of the diseases, I shall merely remark that only adult ticks, which have sucked the infected blood, or their young, are capable of transferring the disease from a sick to a healthy animal.

Since the discovery of *Piroplasma bigeminum* similar organisms have been sought for in all species of animals, not excepting man and in almost every part of the world. The *Piroplasma* of the horse and of the dog and the *Piroplasma* of Rhodesia fever in cattle, and others, all of similar morphology, have now been discovered. The last, name *Piroplasma parvum,* is extremely destructive to cattle, and was discovered by Koch in Rhodesia.

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 13, 1909.

[2] Surgeon major, Royal German Navy; detailed medical biologist to the Biological Laboratory, Bureau of Science, Manila, P. I.

In the case of infection with all of these parasites, ticks were demonstrated as the means of transmission of the disease from one animal to another. A recital of the names of the various species of ticks concerned in the transmission of the disease would be of little importance in the present discussion.

At least one, and perhaps more varieties of *Piroplasmata* exist in East Asia and I have been able to discover recently a *Piroplasma* in calves in Manila. The parasites lie within the red blood cells like other species of *Piroplasma,* generally they are rod-shaped or have the form of an arrow. It is seldom that they assume a ring shape. The chromatin-mass is quite distinct and sometimes two chromatin-masses can be seen; rarely four are visible. (Plate I, figs. 2 to 4.)

Such is the appearance of the *Piroplasmata* as they occur in the animal body. I am convinced that other important species of these parasites will be discovered in the near future.

The discovery of a *Trypanosoma* in human beings, which had been at first observed only in animals inspired a careful search for species of *Piroplasma* in man. And these attempts have also been successful. The cause of both typhus fever and of Rocky Mountain fever was first attributed to *Piroplasmata;* in both instances, unfortunately, a confirmation of these claims is wanting. Finally in 1903 a somewhat similar organism to the *Piroplasmata* was found in man. Leishman and Donovan, working entirely independently of each other, found the *Piroplasma* of *Kala-azar,* the one in smears made from a spleen at autopsy the other in material obtained by splenic puncture. Later, Homer Wright discovered the *Piroplasma* of tropical ulcer, which resembles that of *Kala-azar.* The *Piroplasma* of *Kala-azar* has received through Laveran the name of *Leishmani donovani,* which indicates that in his opinion this parasite belongs to a new group. Homer Wright has given the name of *Helcosoma tropicum* to the parasite which he discovered.

While the first mentioned *Piroplasma,* namely, *Pirosoma bigeminum* and *Piroplasma parvum* occur within the red blood cells, the human parasites just referred to are found in the leucocytes and macrophages. This is very evident in specimens made from the spleen of a case of *Kala-azar.*

Whereas ordinarily the leucocytes and macrophages act as phagocytes and destroy the microörganisms, in these instances the reverse is sometimes true and the parasites destroy the leucocytes and macrophages. Therefore, the name *Piroplasma leucocytophagum* might be an appropriate one for the group.

The suggestion to place these parasites, which are so different morphologically, in the same group with the *Pirosoma bigeminum* and *Piroplasma parvum* (the erythrocytophages), may seem at first surprising: however, some support for such an idea may be received from the fact that intracellular parasites, such as the *Malaria plasmodia,* possess the biological faculty of changing the blood pigment into visible, amorphous particles, which faculty is entirely wanting in the *Piroplasma* group. I will not enter here upon a discussion of the relationship between these leucocytophages and the trypanosomes, an idea which has been suggested in a recent work, because this relationship at the present time is not quite clear.

For the present, the following species of parasites may be referred to one group:

(1) *Pirosoma bigeminum* aptly named by Theobald Smith on account of its pear-shaped, double body. The parasite is free from pigment, is situated in the red blood cells, and may be taken as a representative of the whole group.

(2) *Piroplasma parvum.*—This organism sometimes possesses a double body, but is not pear-shaped in outline; it likewise is free from pigment and is situated in the red blood cells.

(3) *Leishmani donovani* and *Helcosoma tropicum,* both of these parasites are also free from pigment and therefore are classified with the other two.

ILLUSTRATIONS.

PLATE I.

FIG. 1. *Piroplasma bigeminum.*
2, 3, 4. *Piroplasma parvum.*

FIG. 1.

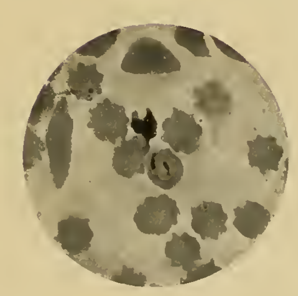


FIG. 2.

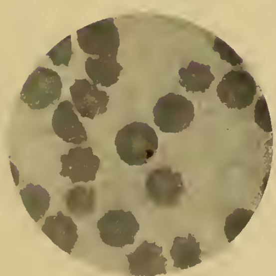


FIG. 3.

FIG. 4.

PLATE I.

THE DISTRIBUTION OF FILARIA IN THE PHILIPPINE ISLANDS.[1]

By James M. Phalen and Henry J. Nichols.[2]

I. INTRODUCTION.

In a brief article published the previous year,[3] the writers reported the result of a little over one thousand blood examinations for filaria, these examinations being made in various localities in Mindanao, Cebu, and Manila.

The investigations indicated that a small amount of filariasis was present throughout the Archipelago, and to form some adequate idea of its prevalence and distribution, the examinations thus commenced have been since continued.

The present paper is based upon nearly 6,400 examinations of as many subjects, with positive findings in 127 cases, showing nearly 2 per cent of infection for the Islands. The localities covered by these investigations include nearly the whole of Luzon, the principal islands of the Visayan group, the northern end of Mindoro, and scattered sections near the coast of Mindanao.

II. MATERIAL.

The enlisted personnel of the Philippine Scouts furnished 4,883 subjects for examination, the remaining number being made up of house servants and quartermaster employees at different military stations, inmates of provincial jails, and others from whom blood specimens could

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, Manila, P. I., February 13, 1909.

[2] Captain, Medical Corps, United States Army, and first lieutenant, Medical Corps, United States Army, constituting the United States Army Board for the Study of Tropical Diseases, as They Occur in the Philippine Islands.

[3] *This Journal, Sec. B.* (1908), 3, 305.

be obtained. It will thus be seen that the great majority of the subjects were adult males, and thus the results obtained from the examinations are not entirely representative of the entire population.

So far as sex is concerned, the error thus introduced is probably of little moment, as the occupations and habits, and therefore the opportunities for infection are much the same for the women of the Philippines, especially for the classes here considered, as for the men. Of the number examined by us 93 were women, of whom 3 were infected, indicating a percentage of infection among females of about the same as for the entire number of examinations. Of 35 subjects afflicted with elephantoid disease observed in the Provinces of Albay and Sorsogon, 14 were women.

With regard to age also the subjects were not entirely representative of the whole population. A very large majority of the persons examined were between 20 and 30 years. The filarial infection, once introduced, persists indefinitely, probably aided by frequent auto-inoculation in the presence of suitable mosquitoes. It is therefore reasonable to suppose that the number of such infections would be in nearly direct ratio to the age. In the subjects affected with elephantiasis, before mentioned, the average age at the incidence of the disease was about 35 years. Allowing then for a smaller number of infections in the young and a larger number in those of middle age and in older individuals, our subjects should represent a fair average of the general population.

The subjects examined are representative of the mass of the Filipino people, although the highest class is not represented and the lowest laboring class by but a very small number. Besides the Filipinos, several hundred Moros were included in the examinations and a few Chinese and Japanese residents.

The examinations have been made either by the writers or by medical officers of the Army at the several stations occupied by native troops, known as Philippine Scouts. Including American negro soldiers, a total of 6,804 cases have been examined for filaria; 3,447 by the Tropical Board, and 3,357 by medical officers as shown in the accompanying table (Table II). The findings given in each case have been confirmed by us.

III. METHODS.

The chief surgeon of the division issued a circular requesting either that an examination be made of the men of each command by the local medical officer or that suitable specimens be taken and forwarded to the Army Tropical Board for examination. The circular of instruction requested the examination of fresh specimens of blood taken after 9 o'clock at night, or preferably the examination of dried specimens by the following method. Four large drops are placed close together near the center of the slide and they are then run together with a needle to form a thick smear of the size of a small, square cover-glass. The smear is allowed to dry in the air and may be examined at any time thereafter. When the smear is looked over, it is first placed face downward in a shallow dish of water, the ends of the slide supported upon glass rods. Within a few minutes, depending upon how long the smear has been kept, the hæmoglobin will have become dissolved out of the smear, leaving a whitish film upon the slide. This is best examined with a low-power lens while still wet and without staining. The advantages of this method are that a much larger amount of blood is examined than if the fresh specimen is employed and that the examination may be made at any subsequent time. This is very important where a large number of persons are to be examined and when the specimens are taken at night. Then too, the smear can be run over very rapidly and with very little strain on the vision, the filarial embryo catching the eye as soon as it comes into the field. To one not familiar with the appearance of the embryo in such preparations, there are many objects, chiefly plant fibers, which may at a glance resemble filaria, but by observing them with a higher power lens, all doubt as to their nature will be removed. After having seen the filarial embryo once, the examiner will have no difficulty thereafter in recognizing it immediately with a low-power lens. Such preparations are of no value in determining the species of the parasite, the presence or absence of a sheath being about the only important point that can be determined from dried specimens. Having found the parasite by this method, the further study of it must be carried out with fresh specimens.

In our investigations only one examination of one blood specimen from each subject was made. On this account some slight infections with filaria may have been overlooked, but it is not thought that the number so missed could be very great. Among the large number of filarial cases that we have seen in the last year, there were not more than a half dozen in whose blood embryos could not be found in every specimen taken at night. In a large proportion 20 to 40 embryos per drop could be found, while in several instances the number reached well above a hundred.

IV. DISTRIBUTION.

The following table shows the geographical distribution of the parasite in the Islands. The Provinces of Luzon and Mindanao have been arranged in groups either on account of their proximity or on account of tribal affiliation of the inhabitants. For the rest of the Archipelago, the distribution is shown by islands.

TABLE I.—*Distribution of Filaria nocturna in the Philippine Islands.*

Source.	Number examined.	Infected.	
		Number.	Per cent.
Ilocanos (Ilocos Norte, Ilocos Sur, and Union)	1,019	6	0.58
Cagayanes (Cagayan, Isabela, Infanta, and Nueva Vizcaya)	394	1	0.26
Pangasinans (Pangasinan, Tarlac, Nueva Ecija, and Zambales)	374	0	0.0
Pampangans (including Macabebes)	1,140	1	0.088
Tagalogs (Bulacan, Rizal, Cavite, Laguna, Batangas, Tayabas, and Mindoro)	399	2	0.53
Tagalogs in Manila	292	13	4.4
Bicols (Ambos Camarines, Albay, and Sorsogon)	365	37	10.1
Inhabitants of—			
Bohol	27	2	7.4
Cebu	519	3	0.57
Leyte	253	20	7.8
Negros	131	2	1.5
Panay	536	4	0.74
Samar	141	4	2.8
Cotabato	390	4	1.3
Lanao and Misamis	191	9	4.7
Zamboanga	172	2	1.25
Davao		15	
Miscellaneous	41	0	0.0
Total	6,384	125	2

The percentage for the various localities can be seen more readily by reference to the accompanying map. The examinations classified as "miscellaneous" were mainly from the Province of Bataan and from the smaller islands, from which localities there were not enough examinations to warrant making an estimate of the percentage of infection. The district of Davao has been given tentatively a percentage of between 2 and 5. Three infections have been found among a small number of examinations and Captain Ames of the Constabulary service reported that he had found 12 cases in the course of his ordinary medical practice in three years.

As will be seen from the map, the greater part of Luzon and the populous Islands of Panay, Negros, and Cebu show an infection of less than 1 per cent; in most instances it is much less than this. Among over 50 cases of elephantoid disease of which we have definite records, only three lived within these regions. Filarial disease, therefore, is not an important one in this large area.

However, in southeastern Luzon, and the Islands of Samar, Leyte, and Bohol over 5 per cent of the population is infected, and in some localities fully 10 per cent. Forty of the cases of elephantiasis encountered live in these regions. Therefore, filarial disease must be considered of great importance in these portions of the Islands. The description of the character of southeastern Luzon, given in a previous paper, as a country of rugged outline, high rainfall and rank vegetation applies to Leyte and Samar, and these islands are in marked contrast to the comparatively bare and dry Island of Cebu lying near by.

Certain areas in Mindanao would seem to show a percentage of infection intermediate between these two extremes, but further work will be necessary to establish this definitely.

TABLE II.—*Examination of Philippine Scouts for filaria.*

No. of company.	Station.	Specimen taken by—	Examined by—	Number examined.	Number infected.	Tribe.
1	Los Baños	Capt. Boyer, M. C	Tropical Board	101	0	Macabebe.
2	do	Capt. Persons, M. C	do	108	0	Do.
3	do	Lieut. Reed, M. C	do	109	0	Do.
4	do	do	do	103	2	Do.
5	Calapan, Mindoro	Lieut. Bierbower, M. R. C.	Lieut. Bierbower, M. R. C.	105	0	Do.
6	Macabebe, Pampanga.	Lieut. Clayton, M. R. C.	Lieut. Clayton, M. R. C.	100	0	Do.
7	Camp Avery, Corregidor.	Capt. Woodall, M. C.	Capt. Woodall, M. C.	82	0	Do.
8	Cotabato, Mindanao	Tropical Board	Tropical Board	85	0	Do.
9	do	Maj. Fuller, M. C	Maj. Fuller, M. C	110	0	Do.
10	Fort Pikit, Mindanao.	Lieut. Delacroix, M. R. C.	Lieut. Delacroix, M. R. C.	46	0	Do.
11	Cotabato, Mindanao	Maj. Fuller, M. C	Maj. Fuller, M. C	110	0	Do.
12	Camp Avery, Corregidor.	Capt. Woodall, M. C.	Capt. Woodall, M. C.	105	0	Ilocano.
13	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brenchemin, M. C.	95	0	Do.
14	Camp Wilhelm, Tayabas.	Capt. Powell, M. C	Capt. Powel, M. C	87	1	Do.
15	Camp Overton, Mindanao.	Maj. Shimer, M. C	Maj. Shimer, M. C	114	0	Do.
16	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	91	0	Do.
17	Gandara, Samar	Lieut. Kellogg, M. R. C.	Lieut. Kellog, M. R. C.	104	0	Do.
18	Calapan, Mindoro	Lieut. Bierbower, M. R. C.	Lieut. Bierbower, M. R. C.	87	1	Do.
19	Camp Wilhelm, Tayabas.	Capt. Powell, M. C	Capt. Powell, M. C	87	0	Do.
20	Camp Connell, Samar.	Lieut. McLeod, M. R. C.	Lieut. McLeod, M. R. C.	113	1	Do.
21	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	95	0	Do.

TABLE II.—*Examination of Philippine Scouts for filaria*—Continued.

No. of company.	Station.	Specimen taken by—	Examined by—	Number examined.	Number infected.	Tribe.
22	Camp Connell, Samar.	Capt. Ekwurzel, M. C.	Capt. Ekwurzel, M. C.	100	0	Ilocano.
23	do	do	do	100	2	Do.
24	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	99	0	Do.
25	Camp Avery, Corregidor.	Capt. Woodall, M. C.	Tropical Board	97	1	Cagayano.
26	do	do	Capt. Woodall, M. C.	96	1	Do.
27	Atimonan, Tayabas	Lieut. Hall, M. R. C.	Lieut. Hall, M. R. C.	102	0	Do.
28	Camp Avery, Corregidor.	Tropical Board	Tropical Board	105	2	Do.
29	Imus	Capt. Metcalfe, M. C.	do	88	1	Tagalog.
30	do	do	do	73	1	Do.
31	do	do	do	87	1	Do.
32	Infanta, Tayabas	Lieut. Warriner, M. R. C.	do	93	9	Bicol.
33	Nasugbu, Batangas	Lieut. Patterson, M. R. C.	Lieut. Patterson, M. R. C.	107	6	Do.
34	Imus	Capt. Metcalfe, M. C.	Tropical Board	70	1	Tagalog.
35	Abuyog, Leyte	Lieut. Stallman, M. R. C.	Lieut. Stallman, M. R. C.	108	8	Visayan.
36	Tagabiran, Samar	Lieut. Hadra, M. R. C.	Lieut. Hadra, M. R. C.	75	0	Do.
37	Camp Hayt, Samar	Lieut. Eliot, M. R. C.	Lieut. Eliot, M. R. C.	90	1	Do.
38	Naga, Cebu	Tropical Board	Tropical Board	108	4	Do.
39	Tanuan, Leyte	Lieut. Dougherty, M. R. C.	do	100	5	Do.
40	Palawan	Lieut. Bowman, M. R. C.	Lieut. Bowman, M. R. C.	114	0	Do.
41	Tolosa, Leyte	Lieut. Sabin, M. R. C.	Tropical Board	107	2	Do.
42	Cotabato, Mindanao	Lieut. Love, M. C.	Lieut. Love, M. C.	73	2	Do.
43	Borongan, Samar	Lieut. Tetrault, M. R. C.	Lieut. Tetrault, M. R. C.	107	4	Do.
44	Tagabiran, Samar	Lieut. Hadra, M. R. C.	Lieut. Hadra, M. R. C.	109	0	Do.
45	Cudarangan, Mindanao.	Tropical Board	Tropical Board	92	4	Do.
46	Margosatubig, Mindanao.	Lieut. Jordan, M. R. C.	Lieut. Jordan, M. R. C.	100	0	Do.
47	Danao, Cebu	Lieut. Davis, M. R. C.	Lieut. Davis, M. R. C.	102	0	Do.
48	Borongan, Samar	Lieut. Tetrault, M. R. C.	Lieut. Tetrault, M. R. C.	107	0	Do.
49	Camp Hayt, Samar	Lieut. Eliot, M. R. C.	Lieut. Eliot, M. R. C.	95	3	Do.
50	Balamban, Cebu	Lieut. Phillips, M. C.	Lieut. Phillips, M. C.	102	1	Do.
([a])	Fort McKinley	Maj. Rand, M. C.	Maj. Rand, M. C.	40	0	
	Total			4,883	64	

[a] Band men.

Grouped according to races the number of examinations and infections are shown in the following table:

TABLE III.—*Racial infection with filaria.*

Race.	Examinations.	Cases.	Per cent.
Filipino	6,035	118	1.9
Moro	384	5	1.7
Japanese	39	1	
Chinese	26	1	
American negro	420	2	
Total	6,804	127	

The negros examined were soldiers, and are not included in the first table. They had all been serving in the Cotobato district of Mindanao for a little over a year before the examinations were made. One of the two found infected was from Charleston, South Carolina, where cases of filariasis are occasionally seen, and the other from Porto Rico where the disease is rife. Therefore, the question as to where these two men were residing when they became infected must be considered doubtful. However, the Porto Rican had been in the Philippine Islands only 5 months when the parasite was found, and the two men had been in the same company for two years; it is possible, therefore, that the Porto Rican was infected in his own country and later was the source of infection of the other case.

V. THE FILARIAL PARASITES OF MAN AND ANIMALS.

Only a small number of the cases seen or reported have been studied with a view to the identification of the parasite. Such as we have studied, however, have shown embryos fulfilling the requirements of the microfilaria Bancrofti, perhaps more widely known as the *Filaria nocturna.* No specimen of the adult worm has been seen, so that identification has been made wholly by means of the embryo. No example of the *Filaria philippinensis* of Ashburn and Craig has been observed. From the southern islands medical officers of the Army have reported a microfilaria without a sheath and with apparently diurnal periodicity, but these observations have not been verified.

Of the filaria of the lower animals, the *Filaria immitis* of the dog and a filaria analogous to the *Filaria loa* of man, but parasitic in the horse, are known to occur here. Dr. Bishop, of the Manila city stables, reported having seen the *Filaria immitis* in two wolves dying at the zoölogical garden, and Dr. Love of the Army saw a case in a house dog at Jolo.

The writers recently made post-mortem examinations of twenty-two dogs at the city pound and found one dog with his right heart filled with adult worms, while the lungs contained very numerous embryos. The filaria of the horse, probably *Filaria papillosa*, has been reported from several places in the Provinces of La Laguna and Batangas. It may be observed swimming around in the fluid of the anterior chamber of the eye, and can usually be easily extracted. Dr. Thompson of the Alabang stock farm has recently observed two such cases. A trip was made to the farm for the purpose of securing a specimen, but the parasite had retired into the posterior chamber of the eye, and could not be discovered.

VI. PRACTICAL CONSIDERATIONS.

Since filariasis possesses such disastrous potentialities, it should be incumbent upon us to take precautions against it, especially in sections where it is known to be most prevalent. These precautions are not difficult, and as the protection from mosquitoes is one of the prime requisites, and is a matter quite as much of comfort as of safety, this measure is usually fairly well carried out. The other measure, also very easy, is the examination at night of the blood of the house-servants for the parasite, and the prompt discharge of any that are found infected. No consideration should suffice to keep a subject harboring filariæ about the house of an American or European. Any measure of protection for the mass of the Filipino people must be hopeless, unless possibly a mosquito crusade covering the whole Islands were undertaken, but the energy of such crusades is usually too quickly dissipated to avail much against such a persistent disease.

The investigation of the Philippine Scouts will probably result in the discharge of the infected individuals, and the examination of the blood for filaria, of applicants from areas which have shown a high percentage of infection, required as a part of the examination for enlistment in that branch of the Army.

VII. CONCLUSIONS.

Many writers have spoken of the irregular, often erratic, distribution of filariasis. Scheube[4] speaks of the small, narrowly circumscribed centers to which the disease is frequently confined even in tropical countries, and this despite the fact that the surrounding regions present to all appearances exactly similar conditions.

The valley of the Kinali River in Albay seems to present some such endemic center, although the whole surrounding country appears to be infected to a lesser extent. There are probably other small centers in Samar, Leyte, and Mindanao. A local distribution of the filaria-carrying

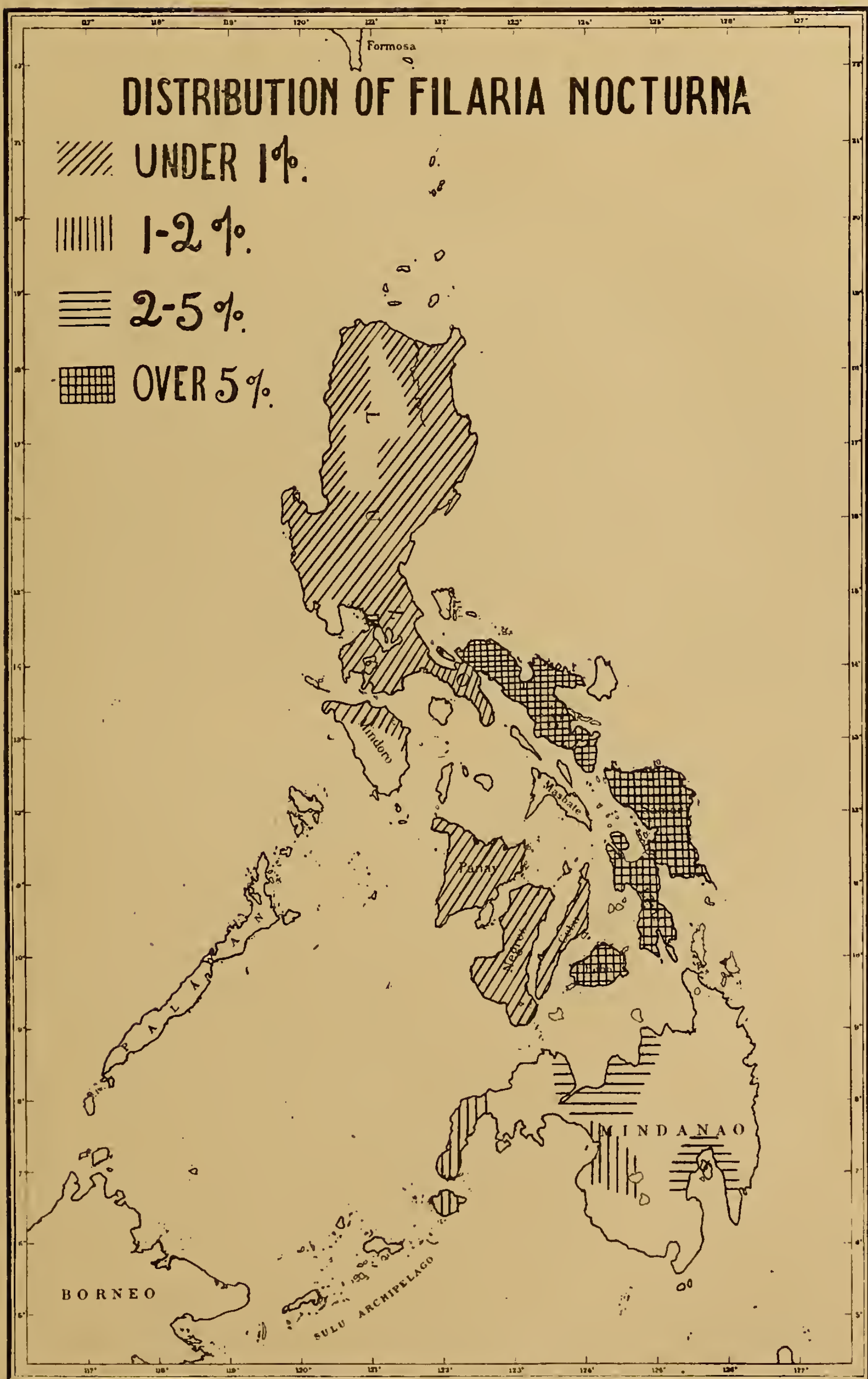
[4] Diseases of warm countries (1892), 389.

mosquito would be the first explanation of this phenomenon that would suggest itself, but the demonstration of the ability of the omnipresent *Culex fatigans* Wied. to transmit the disease renders this theory improbable. An explanation of this erratic distribution is furnished by Wanhill [5] from Jamaica, which island is said to be free from filariasis. He says that while Jamaica has no filariasis it is highly malarious, while the neighboring Island of Barbados which has no malaria shows a high percentage of filarial infections. From these facts and observations upon a subject of filariasis, who later developed malaria, he evolved a theory of an antagonism between the malarial and the filarial parasite. The hypothesis is interesting at least, and as no better explanation is at hand, it might be well to look into the frequency of malaria in the filarial centers of these Islands, and if the observations of Wanhill were confirmed, experimental work might possibly give us a biological remedy in filariasis where drugs have proved entirely unavailing.

SUPPLEMENTARY NOTE.—Since the presentation of this paper, examinations have been made of the blood of 250 American soldiers of the Twenty-sixth Infantry, who have been stationed for eighteen months at Camp Darago, Albay, in the most highly infected filarial district of the Islands. Contrary to expectation, no case of infection was found. This result would seen to indicate that, with ordinary precautions, protection of white people from filariasis is not a difficult matter.

[5] Journ. Roy. Army Med. Corps (1906), 6, 561.

ILLUSTRATION.



Philippine Islands Base Map 1905 *Mercator projection 1/5000000 in lat 13°N.*

EDITORIAL.

DISCUSSIONS OF THE PAPERS OF MR. CLEGG AND OF DRS. ROGERS, AND NICHOLS AND ANDREWS.[1]

Dr. Oscar Teague, assistant, Biological Laboratory, Bureau of Science: I have had the pleasure of following Mr. Clegg's work from day to day and feel convinced that the acid-fast bacillus which he has placed under the microscopes for demonstration is really undergoing multiplication on his amœba-plates. The fact that acid-fast bacilli are rare in the intestine renders it unlikely that the bacillus in question is a contamination which wandered from the intestine by way of the blood into the spleen. As mentioned by Mr. Clegg the cultivation of an acid-fast organism of similar morphology from the spleen of a second case, and the failure to find this organism in control plates furnish additional evidence against contamination.

Dr. R. P. Strong, chief Biological Laboratory, Bureau of Science, Manila, P. I., and professor of tropical medicine: I have had, of course, an opportunity to observe carefully Mr. Clegg's work. As most of you are aware, we have no definite means of identifying the leprosy bacillus outside of the human body. The morphology and the staining reactions of this organism are the most definite features in its recognition. Its failure to multiply on artificial media has also been regarded as an important means of differentiating it from *Bacillus tuberculosis*.

Although very numerous attempts have been made to cultivate the *Bacillus lepræ* on artificial media, and a number of successful reports of such cultivations have been made, I think we are justified in saying that up to the present time no satisfactory means of its cultivation has been discovered. However, no one before has reported any attempt to cultivate the leprosy bacillus in symbiosis with amœbæ. This is a new idea, and while it is still too early to speak with absolute certainty, yet it would appear that Mr. Clegg has been successful in cultivating this organism.

It is true that after a few transplants of his cultures the morphology of the acid-fast organism does not resemble closely in morphology the leprosy bacillus as we see it in the human lesions. But as Mr. Clegg

[1] Held before the Sixth Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

has pointed out, we know nothing as yet of the morphology of the leprosy bacillus on artificial media. However, it must be admitted that the changes in morphology between the organism he has cultivated and the leprosy bacillus as seen in the lesions are greater than those seen between the tubercle bacillus as it occurs in the tissues and in sputum, and in cultures.

In order for us definitely to be sure that the acid-fast organism which he has cultivated is *Bacillus lepræ,* these experiments must be repeated many times with different strains of amœbæ and with numerous cases of leprosy.

Inoculations of animals with the organism will probably throw little light on the subject, for while it has been occasionally possible upon subcutaneous inoculation of the leprosy bacillus into monkeys, to cause it to multiply slightly, a fact recently called attention to by Nicolle and confirmed by Mr. Clegg in some of his early experiments, the results of such inoculations are too uncertain and the lesions produced too indefinite for them to be of much value in the identification of the organism.

It would appear that Mr. Clegg has actually cultivated the leprosy bacillus, but even if it should be shown in his further experiments that this is not the case, his discovery will nevertheless be of importance, since, if the organism is not really *Bacillus lepræ,* it is evidently a hitherto undiscovered one.

Mr. Lindquist of Manila, P. I.: During the past week I have isolated from the stools of a child an acid-fast bacillus which can be cultivated on agar. I have just obtained a pure culture of this organism and I will be glad to send the culture to Dr. Strong.

Dr. Victor G. Heiser, Director of the Bureau of Health, professor of hygiene, and passed assistant surgeon, Public Health and Marine-Hospital Service: I was particularly interested in the treatment discussed by Dr. Rogers, and will give his method a trial at the San Lazaro Cholera Hospital as soon as the opportunity offers. The figures were very striking, but further confirmation seems highly desirable.

A representative from the Pasteur Institute came here a few years ago who had treated with a cholera serum about 30 cases of cholera in Saigon without a single death, but here the use of the serum at the San Lazaro Hospital administered by himself, proved to be no more efficacious than the routine treatment.

Dr. Strong: I was also very much interested in Major Rogers's paper, and I thoroughly agree with him that the replacement of the lost fluid must be the primary consideration in the treatment of the collapse stage of Asiatic cholera. Gärtner and Beck in 1893 after experiments upon dogs and rabbits, suggested the employment of a hypertonic solution of sodium chloride by intravenous injection, for the treatment of Asiatic cholera in order to prevent exudation from the blood into the intestinal canal and the further concentration of the blood. They thought perhaps that a reabsorption of fluid might even take place from the intestine and they were able to show in their animal experiments that such a reabsorption did take place. Rumpf tried this method of treatment in cholera, but did not obtain any more favorable results with it than with that in which normal salt solution was employed.

There is no doubt that the specific gravity of the blood is higher than normal in the severe cases of Asiatic cholera, as has been shown by numerous careful examinations. This concentration of the blood is due to the loss of water; the organic constituents are thereby increased.

Biernacki showed that both the leucocytes and red blood corpuscles were increased in number, owing to the loss of fluid from the blood; the latter numbering from 6 to 8 million in severe cases. The salts of the blood pass into the intestines together with the water. A number of chemical analyses of the blood in cholera made by Schmidt showed a moderate decrease in the sodium chloride and an increase in the potassium salts in the concentrated blood. Schmidt's analyses were made in 1850 and no careful chemical study of the blood in cholera appears to have been made since. Dr. Aron of our laboratory has recently begun some chemical analyses of this nature. I believe that the increase in the specific gravity of the blood in cholera is due largely to the increase in the organic constituents and is not affected much by the decrease in the amount of salts. If it is advantageous to increase the amount of sodium chloride in the blood in cholera cases beyond the normal, it would seem that theoretically we have a basis for using the injections of hypertonic saline solution as recommended by Major Rogers, however from the experiments of Gärtner and Beck we must bear in mind that possibly the toxic substances in the intestine, the products of the cholera spirillum, may be more rapidly absorbed at the same time the reabsorption of any water that may be present takes place.

During the recent epidemic in Manila, both hyper- and hypotonic injections of saline solution were employed in a small number of cases, but we were unable to decide definitely in regard to their value. For the routine method of treatment, saline solution of a specific gravity .085 was employed.

We have also used the intraperitoneal injections, but could not convince ourselves that they were as advantageous as the intravenous ones. Such a canula as Major Rogers has suggested would certainly minimize the danger of giving the intraperitoneal injections, and as he has remarked, the intraperitoneal injections may be performed in a shorter time than the intravenous ones. Therefore, the former would be of advantage in a large epidemic where the force of doctors and nurses was inadequate to administer the intravenous injections.

Dr. Paul Clements, medical inspector, Bureau of Health, secretary Philippine Islands Medical Association: I wish to say a word on the mortality of cholera and on the factors which influence that mortality in the provinces, where there are no hospital facilities, where the people are not yet educated to the point of valuing the services of a physician, and where the cholera patient is usually left to the care of his immediate family and the mercies of the *arbolario* (herb doctor).

The mortality during the first two-thirds of an epidemic outbreak frequently approaches 100 per cent. Probably 75 per cent die in from six to ten hours, or a little longer, in the stage of collapse; the remaining 25 per cent die from three to seven days later, of uræmia or from overfeeding. Those who die in collapse are frequently not seen before death, by the health officer. The other cases are usually examined by him. On account of the unwillingness of the family to accept medical advice, even when offered gratis, it is rarely possible to do anything, even for the remaining 25 per cent. Owing to the fact that many provincial towns do not possess a drug store, and that the health officer as a cholera campaigner can not carry very much with him, attempts at medication are seldom practicable even in the few cases which request advice.

The advice which I have usually given in cases where a request has been made is, to administer coffee, strong and hot, in as liberal a quantity as the patient is able to take, to give the juice of native fruits of the citrus family, and to insist upon complete abstinence from food for at least three days. I have seen on many occasions a cholera patient, who had survived the stage of collapse, whose kidneys had begun again to secrete satisfactorily and who was apparently convalescent, die within a few hours after taking nourishment. It may be possible, in a hospital with a well-appointed diet kitchen and a well-trained nurse, to supervise the administration of nourishment for such patients and to begin allowing food twenty-four or thirty-six hours after the subsidence of the severe symptoms. However, in the absence in the barrios of all such luxuries greater precautions are necessary. The clamor of the patient himself for food, when his appetite returns (as it frequently does within forty-eight hours after the subsidence of the severe symptoms) the disposition of the family to humor and encourage the desires of the patient and their belief that if not fed he would soon starve, must all be guarded against, otherwise a quickly fatal result may follow from indulgence in food. In a few cases in which the patient or the members of his family possessed sufficient knowledge to appreciate and follow the advice given, encouraging results have followed. In fact, stating it broadly, I have come to the conclusion that there should be no mortality in cholera except from collapse or from uræmia. In the latter third of an outbreak, a greater proportion of those affected survive the collapse stage, and the disasters of overfeeding become even more apparent. Dr. Andrews mentioned in his paper that abortion of pregnant women attacked by cholera is almost certain, but I have seen one or two cases in which it did not occur. In the provinces, in the midst of an outbreak any diarrhœa is considered suspicious of cholera, and if that diarrhœa is followed by cramps, we are apt to regard the case as one of cholera.

Dr. V. L. Andrews, assistant, Biological Laboratory, Bureau of Science, Asst. professor of pathology and bacteriology: I am interested in Dr. Roger's remarks with reference to blood pressure. In the work at San Lazaro Hospital I could distinguish, by the reaction of the patients to the intravenous treatment with saline solution, two classes of cases. First, those who would rally and not return to a condition of collapse; second, those who would rally for a short time after each intravenous injection of saline solution, but would in a little while sink into collapse again. In the patients, comprising the second class of cases, there was no abatement of the diarrhœa, and the water seemed to pass out through the intestines as fast as it was injected into the veins; these patients did not always manifest the severest symptoms at the beginning of the disease nor were they always those to whom medical attendance came late in its course.

There seemed to be a point up to which the intravenous solution might be given and the patient rally and remain in this condition, but if one went beyond this point it would not be but a short time before the diarrhœa would apparently be worse and the patient again sink into collapse.

In collapse, the organic constituents of the blood are concentrated, and as the restoration of the normal ratio between the organic and fluid parts of the blood is the thing to be desired, possibly the estimation of the blood pressure by an instrument of precision instead of attempting to estimate it by the sense of touch while feeling the pulse would greatly aid one in determining the stopping point of the injection.

With reference to Dr. Heiser's remarks that the virulence of an epidemic always decreases toward its close I will state that the figures of the present epidemic show a decrease of only 5 per cent between the mortality of the first half and that of the last half of the epidemic. I think that this difference can be attributed to improved facilities in the discovery of the cases in the early stages of the malady, and their prompt removal to the hospital rather than to a decrease in virulence of the disease.

Dr. Strong: In Dr. Andrews's paper I believe that all of the more important points in reference to the treatment of the disease were referred to. I might add a word in regard to the treatment of severe dyspnœa. Dyspnœa occurs commonly in cholera as a symptom of collapse, and is an evidence of failing circulation and disturbed cardiac action. Sudden and severe dyspnœa may also occur apparently either from the development of coagula in the right heart or to a spasm of the smaller pulmonary arteries, in which case the vessels of the lungs are unable to transmit the thickened blood. If the dyspnœa is due to the latter cause, life may sometimes be saved, provided immediate measures are instituted. Nitrate of amyl should be administered at once with the object of overcoming the spasm of the arteries and intravenous injection of saline solution rapidly given at the same time, with a view of increasing the pressure and of diluting the thickened blood. During the recent epidemic, two cases of sudden dyspnœa and marked cyanosis were treated in this way, in both of which the symptoms quickly disappeared and the cases eventually recovered.

Dr. Paul C. Freer, Director of the Bureau of Science; professor of chemistry and dean of the Philippine Medical School: The statements of Dr. Rogers which are so well in conformity with those of many others, that the severe symptoms of cholera are caused by losses of fluid from the blood, brings us to the question as to how the action of the soluble toxin is produced. We have discussed that question considerably in the laboratory and I would like to hear from some of the biologists of what they think about the subject.

Dr. Oscar Teague, assistant, Biological Laboratory, Bureau of Science: What I might say with regard to the cause of the diarrhœa in cholera has only a theoretical interest and the experiments of Dr. Strong and myself have developed as yet no new facts in this direction.

It might be thought that since the cholera vibrio is one of the most motile organisms with which we are acquainted and since it penetrates the superficial layers of the inner lining of the intestine, the mechanical stimulation of the nerve endings thus produced might set up an increased peristalsis and resultant diarrhœa. But the consensus of opinion is that the diarrhœa in cholera is due to a toxin, and in certain animals a diarrhœa is produced when killed cultures of the cholera vibrios are injected intravenously. Whether the toxic substance concerned is a true soluble toxin or an endotoxin, which is set free only after the death and disintegration of the vibrios, is still undecided. It seems to me that probably both the mechanical irritation of the motile vibrios and the cholera toxin are factors in the causation of the diarrhœa.

ORDER No.

Bureau of Science—Annual Reports.

201. Fifth Annual Report of the Director of the Bureau of Science for the Year Ending August 1, 1906.
202. Sixth Annual Report of the Director of the Bureau of Science for the Year Ending August 1, 1907.
203. Seventh Annual Report of the Director of the Bureau of Science for the Year Ending August 1, 1908.

Philippine Museum.

(Now Section of Ornithology.)

* *No. 1, 1903.*—On Birds from Luzon, Mindoro, Masbate, Ticao, Cuyo, Culion, Cagayan Sulu and Palawan. By Richard C. McGregor.
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43. *No. 3, 1904.*—Birds from Benguet Province, Luzon, and from the Islands of Lubang, Mindoro, Cuyo, and Cagayancillo. By Richard C. McGregor.
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Mining Bureau.

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* *1890.*—Memoria descriptiva de los manantiales minero-medicinales de la Isla de Luzón, estudiados por la comisión compuesta de los Señores D. José Centeno, Ingeniero de Minas y Vocal Presidente, D. Anacleto del Rosario y Sales, Vocal Farmacéutico, y D. José de Vera y Gómez, Vocal Médico.
47. *1893.*—Estudio descriptivo de algunos manantiales minerales de Filipinas ejecutado por la comisión formada por D. Enrique Abella y Casariego, Inspector General de Minas, D. José de Vera y Gómez, Médico, y D. Anacleto del Rosario y Sales, Farmacéutico; precedido de un prólogo escrito por el Excmo. Sr. D. Angel de Avilés, Director General de Administración Civil.
48. *1893.*—Terremotos experimentados en la Isla de Luzón durante los meses de Marzo y Abril de 1892, especialmente desastrosos en Pangasinán, Unión y Benguet. Estudio ejecutado por D. Enrique Abella y Casariego, Inspector General de Minas del Archipiélago.
49. *1901.*—The Coal Measures of the Philippines. Charles H. Burritt.
50. *1902.*—Abstract of the Mining Laws (in force in the Philippines, 1902). Charles H. Burritt.
51. *1902., Bulletin No. 1.*—Platinum and Associated Rare Metals in Placer Formations, H. D. McCaskey, B. S.
52. *1903.*—Report of the Chief of the Mining Bureau of the Philippine Islands. Charles H. Burritt.
53. *1903, Bulletin No. 2.*—Complete List of Spanish Mining Claims Recorded in the Mining Bureau. Charles H. Burritt.
54. *1903, Bulletin No. 3.*—Report on a Geological Reconnoissance of the Iron Region of Angat, Bulacan. H. D. McCaskey, B. S.
55. *1904.*—Fifth Annual Report of the Mining Bureau. H. D. McCaskey.
56. *1905.*—Sixth Annual Report of the Chief of the Mining Bureau. H. D. McCaskey.
57. *1905, Bulletin No. 4.*—A Preliminary Reconnoissance of the Mancayan-Suyoc Mineral Region, Lepanto, P. I. A. J. Eveland, Geologist.
58. *1905, Bulletin No. 5.*—The Coal Deposits of Batan Island. Warren D. Smith, B. S., M. A., Geologist.

Division of Mines.

301. *1908.*—The Mineral Resources of the Philippine Islands, with a Statement of the Production of Commercial Mineral Products during the year 1907, issued by Warren D. Smith, Chief of the Division of Mines.

Ethnological Survey.

(Now Division of Ethnology.)

401. *Vol. I, 1905.*—The Bontoc Igorot, by Albert Ernest Jenks. Paper, ₱2; half morocco, ₱3.
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Division of Ethnology.

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409. Directions for Ethnographic Observations and Collections, 1908. *For free distribution.*

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B. MEDICAL SCIENCES

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* *No. 23, 1904, Biological Laboratory.*—Plague: Bacteriology, Morbid Anatomy, and Histopathology (Including a Consideration of Insects as Plague Carriers). By Maximilian Herzog, M. D.

24. *No. 24, 1904, Biological Laboratory.*—Glanders: Its Diagnosis and Prevention (Together with a Report on Two Cases of Human Glanders Occurring in Manila and Some Notes on the Bacteriology and Polymorphism of Bacterium Mallei). By William B. Wherry, M. D.

25. *No. 25, 1904.*—Birds from the Islands of Romblon, Sibuyan, and Cresta de Gallo. By Richard C. McGregor. (*For first four bulletins of the ornithological series, see Philippine Museum below.*)

26. *No. 26, 1904, Biological Laboratory.*—The Clinical and Pathological Significance of Balantidium Coli. By Richard P. Strong, M. D.

27. *No. 27, 1904.*—A Review of the Identification of the Species Described in Blanco's Flora de Filipinas. By Elmer D. Merrill, Botanist.

28. *No. 28, 1904.*—I. The Polypodiaceæ of the Philippine Islands. II. Edible Philippine Fungi. By Edwin B. Copeland, Ph. D.

29. *No. 29, 1904.*—I. New or Noteworthy Philippine Plants, III. II. The Source of Manila Elemi. By Elmer D. Merrill, Botanist.

30. *No. 30, 1905, Chemical Laboratory.*—I. Autocatalytic Decomposition of Silver Oxide. II. Hydration in Solution. By Gilbert N. Lewis, Ph. D.

31. *No. 31, 1905, Biological Laboratory.*—I. Notes on a Case of Hæmatochyluria (Together with Some Observations on the Morphology of the Embryo Nematode, Filaria Nocturna). By William B. Wherry, M. D., and John R. McDill, M. D., Manila, P. I. II. A Search into the Nitrate and Nitrite Content of Witte's "Peptone," with Special Reference to Its Influence on the Demonstration of the Indol and Cholera-Red Reactions. By William B. Wherry M. D.

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* *No. 34, 1905.*—I. Birds from Mindoro and Small Adjacent Islands. II. Notes on Three Rare Luzon Birds. By Richard C. McGregor.

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36. *No. 36, 1905.*—A Hand-List of the Birds of the Philippine Islands. By Richard C. McGregor and Dean C. Worcester.

* Report of the Superintendent of Government Laboratories for the Year Ending August 31, 1902. (Appendix M of Third Annual Report of the Philippine Commission.)

* Report of the Superintendent of Government Laboratories in the Philippine Islands for the Year Ending September 1, 1903. (Appendix G of the Fourth Annual Report of the Philippine Commission.)

39. Third Annual Report of the Superintendent of the Bureau of Government Laboratories for the Year Ending August 31, 1904.

40. Fourth Annual Report of the Superintendent of the Bureau of Government Laboratories for the Year Ending August 31, 1905.

Bureau of Science—Publications.

101. Price and Exchange List of Philippine Bird Skins in the Collection of the Bureau of Science, Manila, P. I. (Effective January 1, 1908.)

102. *No. 1, 1909.*—A Check-List of Philippine Fishes. By David Starr Jordan and Robert Earl Richardson. *In press.*

103. *No. 2, 1909.*—A Manual of Philippine Birds. By Richard C. McGregor, Parts I and II. A systematic index to the orders, families, and genera. Paper, ₱8 for the two parts.

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(Concluded on third page of cover.)

THE PHILIPPINE

JOURNAL OF SCIENCE

B. MEDICAL SCIENCES

VOL. IV JUNE, 1909 No. 3

THE DEVELOPMENT OF A PIROPLASMA AND TRYPANOSOMA OF CATTLE IN ARTIFICIAL CULTURE MEDIA.

By ERICH MARTINI.[1]

(*From the Biological Laboratory, Bureau of Science.*)

Since January, 1909, I have been on leave of absence in Manila. During this time I have been employed in the Biological Laboratory where I have had the opportunity of making blood examinations in cattle. Among the dozen apparently quite healthy calves placed at my disposal, I found in one the parasite of surra, which disease is not uncommon in the Philippines; in another calf I discovered a species of piroplasma. This latter parasite reminded me both of the piroplasma of coast fever—discovered by Robert Koch(1) in Rhodesia—and of the piroplasma of cattle discovered by Dschunkowsky and Luhs(2) in Caucasas; it also resembles somewhat the piroplasma described by Miyajima and Shibayama(3) in Japan, and the one which I (4) found in Shantung and in Petschili, China. Hunter(5) in Hongkong has also given a description of a piroplasma of similar morphology; unfortunately he has published no illustrations of this parasite. Recently Schein(6) has made an observation similar to that of Hunter, in Indo-China, his article containing numerous drawings. In many points there are variations between the piroplasma I have found in Manila and the other piroplasmata mentioned; however, these variations are probably only of secondary importance. The different forms of the Manila piroplasma are illustrated

[1] Surgeon major, of the Imperial German Navy; director of the government hospital and hygienic laboratory at Tsingtau, China; at present a member of the staff of the Biological Laboratory, Bureau of Science, Manila.

in the half-schematic drawings (Plates I and II) which were made from fresh blood smears stained with Romanowsky-Giemsa solution. In the drawings, the thick, dark places are intended to represent the chromatin staining red, and the fine lines the boundaries of the parasites. Plate I, fig. 1, shows the young forms resembling those described by Koch; they are found sometimes singly and sometimes in pairs. In fig. 2 one also sees a resemblance to his ring forms. In fig. 3 there are forms with double nuclei, which frequently are found in the blood of animals infected with the other species of piroplasmata mentioned above. The cross forms described by Robert Koch as characteristic for the Coast fever group were also found in the blood of the calf infected with the Manila parasite; these are very probably composed simply of a pair of parasites with double nuclei placed side by side. (See Plate I, fig. 3, *c*, and Plate III, figs. 1 to 5.) In Plate I, fig. 4, a form is illustrated which I have not seen in the blood in infections with any other piroplasmata; it is somewhat arrow-shaped; sometimes the head of the arrow constitutes a solid chromatin mass, or forms a hollow triangle at whose apex the nucleolus lies and at whose base a larger mass of chromatin is situated. A similar form pictured in Plate I, fig. 4, *c*, at first glance might give the impression that the parasite is a small intracellular trypanosoma, an impression which would be strengthened by the appearance of an intracellular, binuclear form shown in Plate I, fig. 5, *b*, and also in Plate III, figs. 6 and 7. Finally I encountered once in the centrifugated blood a form (see Plate I, fig. 5, *c*) lying free in the blood plasma which it is advisable to describe here, on account of its relationship to the forms seen later in other calves. It was of about the size of a red blood corpuscle; its form was somewhat round and on one side the protoplasm was drawn out in a wedge shape. This irregularity of form perhaps resulted by pressure when the blood smear was made, in which case, obviously, no special weight should be laid upon the shape. The plasma of the parasite stained a bright blue; at the base of the wedge-shaped portion there are round chromatin masses stained a bright red, and on the opposite side at each of the angles is a dark brown chromatin granule. It is not clear what stage this form represents in the life cycle of the parasite; it is illustrated in Plate I, fig. 5, *c*, and in Plate III, fig. 8. It is not improbable that with special study, forms analogous to the peculiar ones described above and illustrated in Plate I, figs. 4 and 5, will be discovered in the life cycle of the other piroplasmata. These forms and the very interesting results which Mijayama obtained; namely, a growth of trypanosoma-like organisms in cultures made from the blood of cattle suffering with piroplasmosis, led me also to make blood cultures after the manner of this Japanese investigator.

For purposes of description, I shall refer in this article to the calf, in which I first saw the piroplasma, as the "original calf," in order to distinguish it from the calves used in the subsequent experiments; the animal was a female, one year of age at the time the experiments were begun and was kept protected from ticks, flies and mosquitoes in a screened stall.

PRELIMINARY EXPERIMENTS.

On the 18th of January, 1909, 50 cubic centimeters of its blood were drawn from the jugular vein and then defibrinated, care being taken to avoid bacterial contamination of the blood. Two cubic centimeters were placed into each of several tubes containing 10 cubic centimeters of bouillon. Five of the tubes contained 1 per cent alkaline bouillon and five 1 per cent acid bouillon, phenolphthalein being used as an indicator. The tubes were placed in the incubator kept at a temperature of 26° to 27° C.

Thirty-three hours after making the cultures a trypanosoma (a division form) with a distinct flagellum was found in one of the tubes. Trypanosomata appeared later in many of the tubes, but only after a period of from forty-four to forty-eight hours. In general the parasites were about the size of the rat trypanosoma (*Trypanosoma lewisi*) and, like it, showed very considerable variation in size. There were some which measured longitudinally, together with the flagellum, one and one-half to three times the diameter of a red blood cell of the calf, and others about six to seven times this length. Occasionally, and then generally in the later days of the culture—that is, from the fifth to the sixth day—I found forms which measured from twenty to twenty-five times the diameter of the red blood cells of the calf. The smallest form was just as distinct and well developed as the largest one. The principal characteristic was a club-like swelling at the anterior (2) extremity of the flagellum, as is seen from the drawings and especially from the photographs. (Plate I, fig. 6, *b, c,* and *d,* and Plate III, figs. 10 to 13, and Plate IV, figs. 14 to 17.) The blepharoplast lies with its long axis perpendicular to the axis of the trypanosoma, and the nucleus parallel to this axis; the blepharoplast is usually anterior to the nucleus and is posterior to it only in exceptional cases. This trypanosoma reminds one of that found in the bison and described by Wrublewski (8) in Russia. Wrublewski's article was called to my attention after I had found the trypanosoma in my cultures.

In the cultures on acid media numerous chromatin granules appeared in the body of the trypanosomata. Both acid and alkali media seemed equally good for the cultivation of the parasites. However, for the further experiments only the acid medium was used. The motility of the parasites was similar to that of other trypanosomata which bear the flagellum at the anterior end. Only in the case of obstruction did the parasite move posteriorly.

Among the well-developed forms observed there were a few very small

[2] In this article the end of the trypanosoma upon which the flagellum is situated is considered to be the anterior one. (Co-Editor.)

ones in which the flagellum was very short and the undulating membrane poorly developed. These small forms (see Plate I, fig. 6, *a,* and Plate III, fig. 9) might suggest, on superficial examination, that they were transition forms between the trypanosoma-like organism (already described as lying in the red blood cells) and the fully developed trypanosoma. However, these rudimentary forms were always found at the same time as the well-developed ones. A chronological transition could not be observed, in spite of critical observations made every hour.

A careful study of stained preparations from the cultures showed a remarkable fact. The parasites lying within the red blood cells, that is, the piroplasmata already described, remained in the cultures until the fifth day, apparently without having increased or decreased in number: at the same time the trypanosomata showed an abundant multiplication forming large rosettes. The latter were photographed, while living, in a hanging drop preparation (see Plate V, fig. 19), in smear preparations the large masses of the parasites were torn to pieces. While the multiplication of the trypanosomata occurred as mentioned above, no development was noticed in the piroplasmata, although hourly observations were made both during the day and for a portion of the night. One noticed only a gradual swelling of the parasites and that the chromatin and protoplasm stained badly, a phenomenon which went hand in hand with the swelling of the erythrocytes. Finally on the fifth day nothing more of the piroplasmata was to be seen. Transition forms between the piroplasmata and trypanosomata were not observed either in the beginning or in the later stages of the cultures.

On about the third day of cultivation the trypanosomata were inclined to assume involution forms; that is, to become somewhat thicker and shorter and to lose their flagella. The chromatin became disintegrated and stained badly; the blepharoplast small and like a point; yet the outlines of the parasites were fairly distinct. Occasionally one had the impression that a sexual increase had set in (see Plate V, fig. 26), forms resembling spermatozoa apparently appearing in the cultures. However, a careful study with the microscope immediately dispelled such an idea, since these forms were seen to be merely involution forms of two trypanosomata and their degenerated flagella. It is important to emphasize that a development of piroplasmata into trypanosomata was, therefore, in spite of the most careful study, not observed. At the same time a careful examination of the fresh blood of the "original calf" for the presence of trypanosomata was made. Smears of the blood were made every day and on about ten occasions blood from the jugular vein was centrifugated and smears from the surface examined. The result was always the same; the piroplasmata were always present, trypanosomata never. At the same time the question of the pathological properties of the trypanosoma for monkeys was studied. Three monkeys, *Cynomolgus philippinensis* Geoffr., were given subcutaneous injections of 30 cubic centimeters of blood from the "original calf" and afterwards showed no signs of an infection. On the other hand, two monkeys of the same species, to which Mr. Clegg of this laboratory gave, on the 19th of January, 1909, 1 cubic centimeter and 50 cubic centimeters, respectively, of blood from the calf infected with surra, showed an enormous number of parasites in the peripheral blood, and both died, one on the 2d of February, the other on the 5th of February, 1909; the first having lived fourteen the other seventeen days after the inoculation. The subcutaneous injection of one of our cultures containing numerous trypanosomata into each of three monkeys of the same species gave likewise a negative result. In other experiments inoculations in this same species of monkey were made for the purpose of excluding the surra parasite, because it is well known in the Philippines that these monkeys are extremely susceptible to this disease. These investigations appeared to be necessary in spite of the morphological differences which are evident between the trypanosoma found in the "original calf" and the trypanosoma of surra (see Plate I, fig. 7, and Plate V, fig. 27); for the surra trypanosoma has not yet been cultivated artifically successfully and no one can know what form it will assume in the culture. I, also, have been unsuccessful in cultivating the trypanosoma of surra from the blood of cattle, horses, and monkeys. In the culture media mentioned above which is favorable for the development of the trypanosoma obtained from the "original calf," the trypanosoma of surra appears to die out quickly; this is another point of differentiation between the two. Therefore, the trypanosoma cultivated from the blood of the "original calf" is evidently not *Trypanosoma evansi,* but is a form not hitherto described.

PREPARATIONS FOR A CONTINUATION OF THE WORK.

These investigations did not decide definitely whether the trypanosomata were developed from the piroplasmata or whether the trypanosomata being extremely scarce in the blood of the "original calf" or being present in an undeveloped form simply multiplied in the culture, as certain varieties of trypanosomata are known to do. In order to solve these questions it was necessary to carry on other experiments. The artificial transmission of the infection to other calves at once suggested itself. This was undertaken, but great difficulties were immediately encountered. The pathogenicity of both the piroplasma and trypanosoma could only be determined by the inoculation of nonimmune animals. It was extremely difficult to obtain such animals, since in Luzon numerous cattle diseases appear to be rife. It was, therefore, necessary either to import cattle from districts free from piroplasmosis or, as a last resort, to use animals relatively slightly immune, that is, new-born calves. The importation of cattle was impracticable, because it was desirable to begin the inoculations at once, owing to the fact that it could not be known how long the parasites would remain in the blood of the "original calf." It would have taken weeks and perhaps months to import the foreign cattle.

The calves of the native carabao were not used because the daily bath, which would have been necessary for them, would have consumed too much time. I chose, therefore, for the experiments the new-born calves of cows imported from Indo-China. Through the kindly assistance of Dr. Gearhart, of the Bureau of Agriculture, the Laboratory finally obtained seven of these calves. One of them died soon after its arrival from a severe phlegmon of the abdominal wall, and one was dead when it arrived at the Laboratory. Experiments were begun with the remaining five. These calves were all less than eight days old and hence only an hereditary immunity had to be considered. This I hoped to overcome, in case it existed, by inoculating very large doses of the infectious material, as I had found it possible to do in the case of rinderpest at Tsingtau, Shantung.

The calves were nourished with preserved milk which caused disturbances of nutrition and of development; these disturbances must be mentioned as they served as possible factors favoring the infection. The servants had to be especially trained to feed the animals. I omitted temperature determinations in the experiments, because I did not care to leave this to the servants and had not the time to perform the work myself. Observations on the temperature were moreover not essential, since the chief aim in view was a study of the parasites, and the clinical features of the condition were considered to be of only secondary interest and were reserved for later work. Ticks (*Boophilus australis* Fuller, as determined by Mr. Banks of this laboratory) were found on the first of these young calves. The calf was placed for ten days in quarantine to see if it would develop Texas fever; since this disease did not appear during a further period of ten days the animal was regarded as free from the infection. All the animals were placed in a division of the vaccine stable of which Dr. Ruediger was in charge; here they were protected from ticks, flies, and mosquitoes. I take this opportunity of thanking Dr. Ruediger for his cordial coöperation. Owing to the fact that the same servants attended all the animals in the stables, the calves were perhaps exposed to unknown infectious intestinal diseases, since occasionally animals used for the preparation of smallpox vaccine died; a study of these intestinal disorders was not made. I can speak of them, therefore, only in general terms. All of the five calves used in my experiments finally died of intestinal disorders, fortunately, however, after the investigations had been carried to a successful issue. The further experiments with other calves were carried on in a special stable constructed for the purpose, which was also protected from ticks, flies, and mosquitoes; separate servants were also provided for these animals and so, any possibility of intercurrent infections from other calves was excluded. At this time older calves of cows imported from Australia had been obtained, and on these the first experiments were repeated and the previous results confirmed.

Another difficulty in continuing the work was due to the fact that during the dusty month of March it was hard to keep the blood specimens sterile; it was, therefore, often necessary in spite of the tropical heat to carry on the experiments with the calves, in the laboratory with the windows and doors closed.

It was also difficult to keep the incubators at the desired constant temperature because of the frequent changes in the atmospheric temperature rendering necessary frequent regulation of the incubators. It is desirable to mention these circumstances in order to give a correct understanding of the difficulties encountered in carrying on the work.

EXPERIMENTS WITH NEW-BORN CALVES FROM FRENCH INDO-CHINA.

In the following experiments an attempt was made to determine:

1. Whether the piroplasmosis of the "original calf" constituted a species of Coast fever or one of Texas fever.

2. Whether the trypanosomata, when isolated and injected into calves, would cause in these animals a piroplasmosis or a trypanosomiasis, or both.

3. Whether after the injection of the fresh blood of the "original calf" into other calves trypanosomata could be obtained from the animals by culture.

EXPERIMENTS.

These experiments were carried on in the following manner:

Calf No. 1 (*infected with cultures*).—January 26, 1909; new-born female calf, from Indo-China; ticks (*Boophilus australis*) present; nourished artificially. Blood smears examined daily for piroplasmata and trypanosomata negative. Blood culture negative. In order to exclude infection with surra, a monkey was injected with 30 cubic centimeters of the blood subcutaneously; it remained healthy and free from parasites. (In all of the experiments, the native monkeys were kept under observation for several months, and examinations of the blood were made daily).

On the 5th of February, 1909, calf No. 1 was injected with two five-day-old cultures made from blood of the "original calf," and showing a good growth of trypanosomata; at the same time a monkey was inoculated with a similar culture subcutaneously. I had been unable to find piroplasmata in these cultures on the day of the injection. The monkey remained healthy and free from parasites. On the 9th of February, 1909, the calf developed diarrhœa, but without undergoing much disturbance of its general health. On the 12th of February, 1909, the diarrhœa stopped.

On the 12th of February a culture was attempted with the blood of the calf, but gave negative results. On the 15th of February blood smears showed piroplasmata of the same morphology as those of the "original calf" and some like the *Pirosoma bigeminum*. (See Plate II, fig. 1, *a*, *c*, *e*, *f*, *g*, *h*, and Plate V, figs.

20, 21, and 24.) On the 16th of February an attempt at culture of the blood of this calf was again made, but contamination with bacteria occurred.

On the 17th of February another attempt at cultivation of the parasite was made which resulted positively. On the 19th of February trypanosomata were found in this culture. Diarrhœa began again on the 18th of February and led to a rapid loss of strength and finally to the death of the calf on the 22d of February. The death of the animal was probably due to stall infection through carelessness of the stable boy, or to unfavorable conditions produced by artificial feeding.

Autopsy.—Marked emaciation, discharge from eyes and nostrils, lungs hyperæmic. The mesenteric glands were hæmorrhagic and swollen to about the size of a small bean. Catarrh of the large and small intestines was present. Otherwise no pathological changes of importance were noted.

The plasma bodies regarded by Koch as characteristic for Coast fever were not found in smears from either the spleen or lymph glands.

This experiment showed—

1. The presence of an infection which belongs in the Texas fever group. An infection with a variety of Coast fever did not enter into the question, because the piroplasmata of this disease are not transferable by a single blood inoculation, but only by repeated ones (Koch).

2. The possibility of transferring the trypanosoma to animals by the inoculation of cultures. The question of whether these trypanosomata had developed from the piroplasmata remained unanswered; for the culture succeeded only after the piroplasmata had been found in the blood; on the other hand, the piroplasmata could be recognized in the cultures up to the fifth day, during which time the trypanosomata had shown a marked increase; stages of these parasites which might have been regarded as transition forms from the piroplasmata were never seen.

For fear that this animal (upon which ticks were discovered at the beginning of the experiment) might have been infected with Texas fever in spite of the precautions taken, it seemed necessary to repeat the same experiment with another calf (see calf No. 3, below).

Calf No. 2 (infected with fresh blood).—February 5, 1909; new-born calf from Indo-China, female, free from ticks; at first fed with mother's milk, later after the death of the mother, fed artificially with preserved milk. Blood smear free from piroplasmata and trypanosomata. Blood culture negative. A monkey was given 30 cubic centimeters of its blood subcutaneously and remained healthy and free from parasites.

On the 5th of February the calf was injected subcutaneously with 30 cubic centimeters of blood from the "original calf."

On the 18th of February the first piroplasmata appeared in the blood and were of the same appearance as those observed in the new-born calf No. 1. (See also Plate II, fig. 1, *b* and *d*, and Plate V, figs. 23 and 25.)

On the 19th of February the mother of the calf died with symptoms of rinderpest. Artificial feeding was begun. On the 21st of February diarrhœa began, leading to a rapid loss of strength and death of the calf on the 23d of February. Cause of death probably the same as of calf No. I.

Autopsy.—Marked emaciation. Discharge from eyes and nostrils; mesenteric glands hæmorrhagic and swollen to the size of a pea or small bean. Catarrh of the large and small intestines present. Liver shows slight icterus. Otherwise no change noted. The plasma bodies of Koch were not found in smears from either the spleen or lymph glands.

The attempt to cultivate trypanosomata from the blood of this calf resulted negatively, although the culture medium showed no contamination with bacteria, which might have hindered the development of the trypanosomata.

The experiment with calf No. 2 showed—

1. The existence of a variety of Texas fever as in calf No. 1; infection with Coast fever was not considered for the reasons already mentioned in the experiment with calf No. 1.

2. The failure in this instance to transfer trypanosomata by means of the fresh blood of the "original calf."

Therefore, the results of the experiments on the first two calves showed a striking contrast. Hence the question arose whether the piroplasmata, which I had, to be sure, not found on the fifth day of culture when I injected the cultures of the blood of the "original calf" into calf No. 1 on the 5th of February, had nevertheless been present in the culture in a condition able to cause infection, and whether they were not transferred together with the trypanosomata and succeeded in developing in calf No. 1.

An experiment with another calf (No. 3) was planned to settle this question.

Calf No. 3 (repetition of the experiment on calf No. 1).—February 14, 1909; new-born female calf from Indo-China; free from ticks; fed artificially. A daily examination of the blood for parasites was made with negative results. A culture from the blood remained sterile. A monkey was injected with 30 cubic centimeters of the blood and remained healthy and free from parasites. The calf received subcutaneously on the 24th of February two seven-day-old cultures from the blood of the "original calf." These cultures showed a good growth of trypanosomata, but piroplasmata could no longer be found in them. At the same time a monkey was given subcutaneously a similar seven-day-old culture. The monkey remained free from parasites, but died on the 2d of April, 1909, from an unknown cause. A blood specimen examined shortly after its death revealed no parasites.

The calf became sick on the 27th of February with diarrhœa, rapidly lost strength, and died on the 3d of March. The cause of death was the same as in calves Nos. 1 and 2.

Autopsy.—Marked emaciation, catarrh of the large and small intestines; mesenteric glands the size of a pea or a small bean. Otherwise no pathological changes were noted. The plasma bodies of Koch were not found in smears from the spleen and lymph glands.

A blood culture made on the 3d of March shortly before the death of the calf developed a growth of trypanosomata, while piroplasmata were never found in spite of repeated daily examination of the blood.

This experiment resulted in the cultivation of trypanosomata in the absence of piroplasmata.

Seven-day-old cultures were chosen for producing the infection, because it was hoped that the piroplasmata would have died out in the cultures during this time, it already having been shown that the trypanosomata live longer than this. Nevertheless the results of this experiment might have been accidental, since a piroplasmosis in this calf might have existed and escaped observation. This point deserves especial consideration, since Miyajima(7) (page 90) in performing similar experiments observed on one occasion that in a calf inoculated with a trypanosoma culture, after three days developed trypanosomata in its blood as was proved by obtaining cultures of trypanosomata from it, while piroplasmata were only found seven days later than this.

Therefore, it was planned to repeat this experiment with piroplasmata which had been subjected to conditions much more unfavorable to their life and development.

Calf No. 4 (repetition of the experiments carried on with calf No. 2).—February 26; new-born male calf from Indo-China; free from ticks; fed artificially; blood free from parasites; blood culture negative. A monkey was given 30 cubic centimeters of blood subcutaneously and remained healthy and free from parasites.

On the 26th of February calf No. 4 was inoculated with 30 cubic centimeters of blood of the "original calf" subcutaneously.

On the 5th of March piroplasmata, of the same appearance as those encountered in calves Nos. 1 and 2, were found present.

On the 7th of March a bloody stool was passed. An examination of the peripheral blood showed numerous red blood cells infected with piroplasmata.

On the 10th of March a discharge from the eyes and nostrils appeared. Diarrhœa was present and the animal appeared to lose strength rapidly.

On the 13th of March after the blood had been taken again for culture the calf died. The cause of death was probably the same as in calves Nos. 1, 2, and 3.

Autopsy.—Marked emaciation, discharge from eyes and nostrils; mesenteric lymph glands hæmorrhagic and swollen to the size of a pea or small bean; catarrh of the large and small intestines; liver sligthly icteric. Otherwise no pathological changes observed. The plasma bodies of Koch were not found in smears either from the spleen or from the lymph glands.

A blood culture made on the 5th of March showed no development of protozoa, probably on account of contamination with bacteria.

Attempts at cultivation on the 9th, 10th, and 11th of March showed the presence of forms which I had not encountered either in cultures from the "original calf" or in those from calves Nos. 1 to 3. In these cultures from calf No. 4 the piroplasmata showed no development into trypanosomata, but on the other hand forms were found to be present which Robert Koch(1,*c*) had encountered in ticks and described as the first stages of development of *Piroplasma bigeminum*. (See Plate II, fig. 2, *a, b, c,* and Plate VI, figs. 30 and 31.)

On the first day of cultivation the piroplasmata, which showed two distinct chromatin masses, were found to have become free from the red blood cells which they had severely injured. The injury to the red blood cells could be recognized by the irregular form which they assumed and by the marked metachromasia present. The piroplasmata assumed a rounder shape and became collected in larger groups. A number of them showed the characteristic rays first described by Robert Koch, which are probably composed of protoplasm, since with the Romonowsky-Giemsa stain they acquire the same blue color as the remaining protoplasm. These ray forms appeared to be especially distinct on the second or third day of cultivation. The piroplasmata in the culture became larger and showed as a rule only two chromatin masses in the blue ground of their protoplasm. Later the forms of Koch with chromatin points appear; usually they are found on the third day for the first time.

These forms recall those resembling an arrow point which were found within the red blood cells of the "original calf." There is a temptation to assume a relationship between them. (See Plate I, fig. 4, *a,* and Plate II, fig. 2, *d,* and Plate VI, fig. 32.)

Beside these forms there were still others observed in the cultures which were of about the size of a red blood cell and which contained from two to three bright red chromatin masses and several (2 to 4) dark brown red chromatin granules. Their form was in general oval; many of them showed rays which stained the same bright blue color as the remaining protoplasm. These large forms were found scattered among the smaller ray forms and occasionally were situated apart from them. The significance of these forms is not clear. In morphology they conform so closely to those observed outside the red blood cells which were found in the fresh blood of the "original calf," that one must think of a relationship between the two (see Plate II, fig. 2, *e,* and Plate VI, figs. 33 and 34; and Plate I, fig. 5, *c,* and Plate III, fig. 8.)

One might be inclined to regard them as macrogametes; yet there is need of further proof before such an opinion is justified. Also the idea that the forms with chromatin points which appear at the same time are microgametes requires confirmation. Further stages of development have not been observed. All these forms described above apparently died after from five to about eight days in the culture media kept at a temperature of 28° to 29° C.

This experiment showed—

1. The presence of a variety of Texas fever organism in the blood of calf No. 5 as in that of calves Nos. 1 and 2.

2. The failure to transfer trypanosomata by means of the inoculation of the fresh blood of the "original calf," as was the case with calf No. 2.

Calf No. 5 (repetition of the experiment performed on calves Nos. 1 and 3).—March 4, 1909; new-born male calf from Indo-China; free from ticks; fed with preserved milk; blood smears show no parasites; blood culture negative. A monkey received 15 cubic centimeters of its blood subcutaneously and remained healthy and free from parasites.

On the 4th of March the calf was injected subcutaneously with a 28-day-old culture containing trypanosomata which were feebly motile and in which piroplasmata were no longer found; other cultures were unfortunately not at hand.

On the 13th of March an attempt at cultivation from the blood of the calf was unsuccessful, although no contamination of the culture media with bacteria resulted.

On March 16 the attempt at cultivation was again unsuccessful, although there was no contamination of the culture media with bacteria.

March 17: Diarrhœa began which led to a rapid loss of strength and death of the calf on the 18th of March. The cause of death was probably the same as in the cases of calves Nos. 1 to 4.

Autopsy.—Marked emaciation; mesenteric glands the size of a pea to a bean; catarrh of the large and small intestines. Otherwise no pathological changes noted. The plasma bodies of Koch were not found in smears either from the spleen or from the lymph glands.

This experiment showed—

The possibility of the failure of an attempt at infection of a calf with the trypanosomata, from the injection either of too small an amount of the culture, or of too old a culture, that is, of one which is weakened in its virulence. The early death of the calf leads one to assume that this conclusion is only conditionally correct, since, if the animal had lived longer, further attempts at culture might have shown finally, the presence of an infection with trypanosomata. Nevertheless the experiment was valuable as indicating in future experiments the inadvisability of employing for inoculation the contents of a single culture tube or that of one so old.

EXPERIMENTS WITH CALVES FROM INDO-CHINA AND AUSTRALIA.

The experiments with the following calves were made in a new stable protected against rinderpest and other infection that could be acquired by contact. The calves were well beyond the first days of life. No. 6 was a calf from Indo-China not quite a month old; Nos. 7, 8, and 9 were Australian calves four to five months old. They were all free from ticks. Calves Nos. 6, 7, and 8 were fed with preserved milk and dry food, calf No. 9 with dry food alone.

Calf No. 6 (repetition of the experiments with calves Nos. 2 and 4).—March 26, 1909; a male calf from Indo-China; free from ticks; blood smears free from parasites; blood culture negative. Smears made from the surface of the centrifugated, defibrinated blood were free from parasites. Thirty cubic centimeters of its blood were injected subcutaneously into a monkey; the monkey remained healthy and free from parasites.

March 26: The calf received subcutaneously 50 cubic centimeters of the blood of the "original calf."

April 3: Piroplasmata found in blood smears.

On April 3, 6, 10, and 14 and May 4 attempts at blood cultures were negative, as regarded trypanosomata, although there was no contamination with bacteria.

Piroplasmata like those seen in the other calves were found in the cultures until the 24th of April. They were usually scarce. A change of the piroplasmata into the developmental forms of Koch as seen in the cultures from the blood of calf No. 4 was not observed. On account of the scarcity of the parasites these forms were not specially searched for, since, according to the experience with calf No. 4, a multiplication of the piroplasmata in these cultures was not to be expected.

The calf became thin, but suffered in general only slightly from the infection as is the custom with calves inoculated with virulent blood from Texas fever cases.

It was killed on May 12 and no pathological lesions were found in the internal organs; no plasma bodies of Koch were seen in smears from the spleen and lymph glands.

Calf No. 7 (repetition of the experiments on calves Nos. 2, 4, and 6).—March 26; female Australian calf about 4 months old; free from ticks; blood culture negative; smears from the surface of the centrifugated defibrinated blood, free from parasites. Thirty cubic centimeters of the blood of the calf were injected subcutaneously into a monkey, which remained healthy and free from parasites.

March 26: The calf received subcutaneously 50 cubic centimeters of blood from the "original calf."

April 1: Piroplasmata found present in blood smears. They remained numerous until the 5th of April, and from that time were present only in small numbers.

On April 1, 2, 3, 14, and 30 blood cultures were made which were *negative in regard to trypanosomata, but positive with regard to the developmental forms of the piroplasmata described by Koch.* (See Plate VI, figs. 28 and 29.)

April 3: Animal passed a very hard stool with streaks of blood.

April 30: Examination of the blood showed that almost all the piroplasmata revealed the morphological characteristics of those observed in the "original calf"; the *Piroplasma bigeminum* form was rare.

The calf suffered but little from the infection. Only a moderate anæmia was present.

It was killed on May 12. The autopsy showed a slight icterus of the liver, which was the only pathological change observed. No plasma bodies of Koch were found in smears from the spleen or lymph glands.

The results of the experiments on calves Nos. 6 and 7 confirm those obtained with calves Nos. 2 and 4.

They show—

1. The presence of an infection belonging to the Texas fever group.

2. The failure to transfer trypanosomata by means of an injection of the fresh blood of the "original calf."

After experiments on calves Nos. 2, 4, 6, and 7 had resulted as described above it only remained to confirm the results of the experiments on calves Nos. 1, 3, and 5. The experiment on calf No. 3 had indicated that by using a trypanosoma to culture seven days old the pirosomata contained therein could be excluded so far as the production of an infection with them was concerned. Therefore, it was possible that the trypanosomata alone and without the piroplasmata had caused infection. Experiment with calf No. 5 seemed to demonstrate that either the number of trypanosomata in a single culture tube might not be sufficient to produce an infection or that the culture, which was twenty-eight days old, had become so attenuated that not only the pirosomata, but also the trypanosomata had been deprived of their power of causing infection. The object of the following experiment was to kill the piroplasmata and at the same time to preserved the trypanosomata alive in the culture.

Calf No. 8 (*repetition of experiments on calves Nos. 1, 3, and 5*).—April 3, 1909; female Australian calf about 4 months old; free from ticks; blood smears free from parasites; blood culture negative; smear from the surface of the centrifugated blood free from parasites. The inoculation of two monkeys with 20 and 50 centimeters respectively of the blood of the calf gave negative results.

April 12: After the blood of the calf had been found to be free from parasites by daily examination of simple blood smears and smears from the surface of the centrifugated blood, the calf was given subcutaneously three five-day-old trypanosoma cultures obtained from the blood of the "original calf." The culture had been grown at a temperature of 29° to 31° C. A monkey was given a similar culture subcutaneously. Piroplasmata could not be found in these cultures. Cultures grown at this high temperature were chosen because under such circumstances it was anticipated that the piroplasmata would die out, while it had already been determined that the trypanosomata remained alive at this temperature. Both the calf and the monkey remained healthy and lively. Daily examinations of simple blood smears and repeated examinations of the centrifugated fresh blood gave negative results.

On April 21 and on May 5 trypanosomata were cultivated from its blood, but they could not be shown to be present in any other way. In spite of most careful examinations piroplasmata were never found up to the thirty-seventh day after the infection.

On May 17, the thirty-seventh day after the infection, the calf was killed. The autopsy showed that the organs were normal. The plasma bodies of Koch were not present in smears from either the spleen or lymph glands.

Calf No. 9 (*repetition of the experiments on calves Nos. 1, 3, 5, and 8*).—This experiment was planned in case experiment No. 8 should have been unsuccessful.

April 16: Australian male calf, 4 months old, free from ticks; blood smears and smears from the surface of the centrifugated blood showed no parasites; blood culture negative. A monkey was inoculated with 30 cubic centimeters of the calf's blood but it remained well and no parasites appeared in its blood.

On April 17 the calf received four ten-day-old cultures of trypanosomata made from the blood of the "original calf." These cultures had been grown at a temperature of from 29° to 31° C. and no longer contained piroplasmata. The calf remained healthy and lively. Daily examinations of blood smears and repeated examination of centrifugated fresh blood gave negative results; neither piroplasmata nor trypanosomata were found. *However, trypanosomota were cultivated from its blood* *on April 28 and May 5. Piroplasmata were still absent on May 17, the thirty-second day after infection with the cultures.*

The calf was killed on May 17. The autopsy showed hæmorrhagic lymph glands which were somewhat enlarged. Otherwise no pathological changes were noted. The plasma bodies of Koch were not found in smears from the spleen or from the lymph glands.

The experiments on calves Nos. 8 and 9 show that it is possible to *separate the trypanosoma and the piroplasma,* the parasites infecting the "original calf." The importance of this result is the same, whether it was accomplished by the fact that both of the calves were immune to the piroplasma or, as I believe, by the killing of the piroplasma through keeping the culture for a long time at a temperature of 29° to 31° C., whereby the capability of the trypanosoma to cause infection was not destroyed.

FURTHER HISTORY OF THE "ORIGINAL CALF."

The "original calf" remained in good health and its blood contained continuously the piroplasma described above; the trypanosoma was cultivated repeatedly from its blood, for the last time on April 7. At this time piroplasmata were also still present, but trypanosomata could not be found by microscopical examination even in centrifugated blood. On May 19 while still in the best of health the calf was killed. The autopsy showed numerous hæmorrhagic lymph glands which were swollen to the size of a pea or bean; this was particularly noted in the mesenteric glands. The spleen was enlarged and somewhat soft. Otherwise no pathological changes were observed. The plasma bodies of Koch were not found in smears either from the spleen or from the lymph glands. An infection with Coast fever could, therefore, be excluded. A mild infection with Texas fever, or a variety of this disease had undoubtedly existed.

RESULTS OF ALL THE EXPERIMENTS.

From all the experiments we may conclude:

1. The "original calf" was infected with a piroplasma belonging to the Texas fever group.
2. It was also infected with a trypanosoma hitherto unknown.
3. No evidence was obtained of a transition in the blood cultures of the piroplasmata into trypanosomata or, on the other hand, of a transition of the trypanosomata, in the blood of the animal infected with them, into piroplasmata.
4. The infection with piroplasmata of calves Nos. 2, 4, 6, and 7 rendered calves Nos. 6 and 7 slightly sick, while calves Nos. 2 and 4 died of another disease, before sufficient time had elapsed for the symptoms of piroplasmosis to develop.
5. Calves which have been inoculated with the trypanosoma apparently

merely harbor this parasite and are not rendered visibly sick by infection with it.

The following questions remained to be answered:

1. Why did I not succeed in obtaining in culture media the developmental forms of Koch from the piroplasmata of the "original calf"?

2. Why did I not succeed in infecting with trypanosomata calves Nos. 2, 4, 6, and 7 by means of the direct inoculation of the fresh blood of the "original calf" without the use of culture media?

In relation to the first question, it may be stated that a growth from the forms in the blood of the "original calf" into well-developed piroplasmata probably took place; however, these well-developed forms of Koch were probably very rare as compared with the number of rod-shaped and similar ones present in the blood (owing to the animal being relatively immune though carrying the parasites) and for this reason they escaped observation. Apparently this was also true in the case of calves Nos. 2 and 4. The piroplasmata do not multiply typically in the culture media, but only undergo a simple change in morphology, the meaning of which is at the present time not fully known to us. In spite of the most careful study I have never seen the parasites having rod-like and similar forms develop into those which Koch described; the former always appear to disintegrate. Furthermore, it might be mentioned here that I have not observed among the forms of the Manila piroplasma the amœba-like cells and those containing vacuoles which Miyajima describes as being stages in the development of his piroplasma. I have likewise not noticed the increase in size or the differentiation, in the ring forms mentioned by him, so that such forms are not stages in the development of the piroplasma I have observed. I believe, however, that I have seen somewhat similar forms in incubated mixtures of normal fresh blood of cattle and bouillon. When the piroplasmata were present in enormous numbers, as for example, in calves Nos. 4 and 7, I have seen them develop in the culture media into the ray forms of Koch and to the forms with chromatin points. However, when they were present in smaller number, the developmental forms simply escaped observation. If there had been an abundance of time which I had not needed for more important work, I am convinced that I could have found these forms also in such instances.

The second question with regard to the failure to infect with trypanosomata the calves Nos. 2, 4, 6, and 7 by means of the inoculation of fresh blood of the "original calf" can also be answered. The fact that, in spite of the inoculation of cultures containing enormous numbers of trypanosomata (as in the experiments with calves Nos. 1, 3, 5, 8, and 9), I could not find trypanosomata in their fresh blood, even after centrifugation, shows that the trypanosomata have undergone only a limited multiplication in these animals which, therefore, must have a high degree of natural immunity against the trypanosomata. This is shown even more strikingly by the fact that as a rule only a third of the ten to twenty cultures from the calves showed trypanosomata; in fact, not infrequently trypanosomata were found in only a single tube. Hence they must have been present in extremely small numbers in the blood of the infected calves. This fact is in full accord with my experiences with a strain of *Trypanosoma brucei* of low virulence with which I(10) worked for years under the direction of Robert Koch. I succeeded in infecting other animals with the strain, but in the blood of the original animal itself, a mare from Togo, I did not find trypanosomata in spite of observations lasting for months. I am inclined to believe that the trypanosoma described in the present experiments would appear in greater number in the fresh blood of a species of animal which is especially susceptible to it could one be found. Dogs which were given very large doses of the blood of the Togo mare, subcutaneously or intraperitoneally, after a certain period of incubation, showed the tsetse trypanosomata in their blood. The failure to find trypanosomata in the fresh blood of the "original calf" and in the blood of the calves inoculated with cultures of this trypanosoma can hence be explained by the extreme scarcity of the trypanosomata. However, it is possible that the parasites are present in an especial form, but not that of the piroplasmata described.

CONCLUSIONS.

The experiments justify the following conclusions:

1. In the Philippine Islands there are domestic cattle apparently quite healthy which are carriers of the parasite of surra. These cattle are a continual danger, especially for horses in which surra always runs a fatal course, as has been shown by the works of Smith and Kinyoun(11), Curry(12), Salomon and Stiles(13), Strong(14), Musgrave, Williamson and Clegg(15, 16).

2. In the Philippine Islands there exists a variety of Texas fever which is perhaps identical with that seen by Jobling and Woolley(17) in the years 1903 and 1904. However, this can not be stated with certainty to-day, because these investigators gave no accurate description of their parasites. The piroplasma is probably of Indo-Chinese origin. It is a variety of *Piroplasma bigeminum* and shows in certain culture media developmental forms which correspond to those described by Robert Koch in the tick for *Piroplasma bigeminum*. Forms similar to those seen in the early stages of the development of *Piroplasma bigeminum* by Koch and to those of the Manila piroplasma have been found in artificial media by Kleine(18) for *Piroplasma canis*, and by Marzinowsky(19) for *Piroplasma equi*. Besides the early forms of Koch, the Manila parasite shows other forms with a different morphology.

3. This piroplasma, when kept in the bouillon employed and at a temperature of 29° to 31° C., dies within five to ten days.

4. In the Philippine Islands there occurs a trypanosoma of cattle which is different morphologically and biologically from *Trypanosoma evansi* and from the other trypanosomata of mammals. Its virulence for the Indo-Chinese and Australian calves appears to be slight.

5. This trypanosoma could not be discovered in the fresh blood by microscopical examination, but could be cultivated in a mixture of blood and bouillon, and could be transferred to healthy calves by the subcutaneous injection of the cultures.

6. The trypanosoma remains alive and capable of causing infection for at least ten days in the bouillon employed when kept at a temperature of 29° to 31° C. Since the piroplasma which was present at the same time in the blood of the "original calf" died out at this temperature within the above-mentioned time, it was possible to isolate the trypanosoma and to transfer it, thus separated from the piroplasma, to calves (Nos. 8 and 9).

7. These culture experiments prove the great importance of this method for the differentiation of blood parasites. The absence of the plasma bodies of Koch, the presence alone at autopsy of an icterus of the liver, and the possibility of transmitting the infection to another animal by a single inoculation of the blood, all indicated that a variety of Texas fever and not one of Coast fever was present in the "original calf." I was further confirmed in this belief by finding in the cultures made from the blood of the "original calf," developmental forms like those of *Piroplasma bigeminum* which Koch discovered in ticks. Therefore, further proof was given that a variety of the Texas fever parasite, *Pirosoma bigeminum,* and not the Coast fever parasite, was present.

8. The value of the culture experiments may also be seen by the fact that through them alone was it possible to demonstrate the presence of a trypanosoma in the blood. This to-day is of especial importance in the search for carriers of protozoa and in the study of the numerous drugs employed in the treatment of the various forms of trypanosomiasis, and especially of sleeping sickness. While the inoculation of animals can give a positive result only when the trypanosomata are virulent for the species of animal used, one can employ the method of artificial cultivation without regard to the virulence of the trypanosoma and thus can obtain results which are perhaps impossible by animal inoculation, or which at any rate, may involve much work and expense.

The cultivation of protozoa has in general an advantage over the cultivation of bacteria, since for the identification of a bacterium usually a tedious biological differentiation is necessary, while in the case of a protozoön the morphology in the culture alone often suffices to identify it.

For all these reasons careful attempts in the cultivation of these protozoa after the manner of Novy-McNeal(20), Rogers(21), Miyajima(7) and Nicolle(22) should be made until finally a simple and sure method of culture has been discovered for all pathogenic trypanosomata.

LITERATURE.

(1) Robert Koch. (*a*) Interim report on Rhodesian red-water or African Coast fever. Salisbury, Argus Printing and Publishing Company (1903).

(*b*) Second report on African Coast fever. Argus Printing and Publishing Company (1903).

(*c*) Vorläufige Mitteilungen über die Ergebnisse einer Forschungsreise nach Ostafrika. *Deutsch. med. Wchnschr.* (1905), **31**, 1865.

(*d*) Beiträge zur Entwicklungsgeschichte der Piroplasmen. *Ztschr. f. Hyg. u. Infektionskrankh.* (1906), **54**, 1; Plate 1, Figs. 15 and 16.

(2) Dschunkowsky and Luhs. Die Piroplasmosen der Rinder. *Centralbl. f. Bakt. etc.* (1904), **35**, 486.

(3) Miyajima and Shibayama. Ueber das in Japan beobachtete Rinderpiroplasma. *Ztschr. f. Hyg. u. Infektionskrankh.* (1906), **54**, 189.

(4) Martini. (a) Ueber ein Rinderpiroplasma der Provinz Schantung (China). *Arch. f. Schiffs- u. Trop.-Hyg.* (1907), **11**, 507.

(b) Ueber das Vorkommen eines Rinderpiroplasmas in der Provinz Petschili (China). *Ibid.*, 718.

(c) Ueber die Rinderzecken Schantungs und ihre Beziehungen zu den dortigen Piroplasmosen. *Ibid.*, 740.

(5) Hunter. Annual sanitary report of the colony of Hongkong for the years 1903 and 1904.

(6) Schein. Observations sur la piroplasmose des bovidés d'Indo-Chine et constatations de piroplasmose chez les buffles. *Ann. Inst. Pasteur* (1908), **22**, 1004.

(7) Miyajima. On the cultivation of a bovine Piroplasma. A preliminary communication. *This Journal, Sec. B.* (1907), **2**, 85.

(8) Wrublewski. Ein Trypanosoma des Wisent von Bielowesch. *Centralbl. f. Bakt. etc.* (1908), **48**, 162.

(9) Banks, Ch. S. The Australian tick (*Boophilus australis* Fuller) in the Philippine Islands. *Pub. Bu. Gov't. Lab.*, Manila (1903–04), **3**, 13.

(10) Martini. Untersuchungen über die Tsetsekrankheit swecks Immunisierung von Haustieren. Unter Leitung von Robert Koch. *Ztschr. f. Hyg. u. Infektionskrankh.* (1905), **50**, 1.

(11) Smith and Kinyoun. A preliminary report on parasitic diseases of horses. Army pathological Laboratory, Manila (1901).

A preliminary report on parasitic diseases of horses. Reprint, with additions by Smith. General Orders, No. 390, Headquarters Division of Philippines. December 11 (1901).

(12) Curry, J. J. Report on a parasitic disease in horses, mules, and carabaos of the Philippine Islands. From report to the Surgeon-General, U. S. Army. December 17 (1901); *Am. Med.* (1902), **3**, 512 to 513.

"Surra" or nagana. *Ibid.*, **4**, 95.

Report on a parasitic disease in horses, mules, and carabaos in the Philippine Islands. *Vet. Journ.* (1902), **54**, 292.

(13) Salmon and Stiles. Emergency report on Surra. Bull. No. 42, Bureau of Animal Industry. U. S. Dept. of Agri. (1902), 1 to 130.

Ann. report of Bureau of Animal Industry, U. S. Dept. of Agri. (1901), 41 to 182.

(14) Strong, R. P. Animal diseases, Surra. Ann. report of the Biological Laboratory ending Aug. 31. (1902), **1**, 578.

(15) Musgrave and Williamson. A preliminary report on Trypanosomiasis of horses in the Philippine Islands. *Pub. Bu. Gov't. Lab.*, Manila (1903), **3**.

(16) Musgrave and Clegg. Trypanosoma and Trypanosomiasis, with special reference to Surra in the Philippine Islands. *Ibid.*, 5.
(17) Jobling and Woolley. Texas fever in the Philippine Islands and the Far East. *Ibid.* (1904), 14, 5.
(18) Kleine. Kultivierungsversuch der Hundepiroplasmen. *Ztschr. f. Hyg. u. Infektionskrankh.* (1906), 54, 10.
(19) Marzinowsky. Ueber die Züchtung von *Piroplasma equi. Ibid.* (1909), 62, 417.
(20) Novy and McNeal. Contributions to medical researches. June (1903), 549 to 577.
On the cultivation of *Trypanosoma brucei. Journ. Infect. Dis.* (1904), 1, 1 to 30.
(21) Rogers, L. Preliminary note on the development of Trypanosoma in cultures of the Cunningham-Leishman-Donovan bodies of cachexial fever and kala-azar. *Lancet* (1904), 2, 215. *Journ. Trop. Med.* (1904), 7, 259. *Brit. Med. Journ.* (1904), 1, 1249 to 1251. *Ibid.*, 2, 645 to 650. *Lancet* (1905), 1, 1484.
(22) Nicolle, Ch. Culture du parasite du bouton d'Orient, présentée par M. Laveran. *Compt. rend. Acad. Sci.* (1908), 146, 842.
(23) v. Prowazek. Studien über Säugetiertrypanosomen. Arbeiten aus dem Kaiserlichen Gesundheitsamt. (1905), 22, 351; Fig. 37.

ILLUSTRATIONS.

Plate I.

Schematic drawings from preparations stained with Giemsa's solution. Magnification about 1,500 diameters.

Figs. 1 to 5. The piroplasmata in fresh blood smears from the "original calf."

Fig. 5, *c*. Form seen in the centrifugated blood. It is not clear what stage in the life cycle of the parasite this form represents.

Fig. 6. The trypanosomata in a bouillon culture of the blood.

Fig. 7. *Trypanosoma evansi* from a smear of the fresh blood of the calf infected with surra.

Plate II.

Schematic drawings of preparations stained with Giemsa's solution of the first pirosomata observed in calves Nos. 1 and 2. Magnification about 1,500 diameters.

Fig. 1. *a, c, e, f, g,* and *h* from blood of the calf No. 1; *b* and *d* from blood of calf No. 2.

a. A pirosoma which apparently is endeavoring to enter the red blood cell with its pointed end situated anteriorly; this form was repeatedly observed in stained preparations.

b. *Pirosoma bigeminum,* which apparently has entered recently an enlarged metachromatic erythrocyte and which has drawn after it the connecting band of protoplasm. Probably on account of the increased resistance in the red blood cell the nucleolus has moved to one side and the nucleus to the pointed end. This form was also occasionally observed in calf No. 2.

c, d, e, f, g, and *h*. These forms require no explanation. The red blood cells which contain parasites at this stage in their development are distinctly matachromatic; their shape is no longer round and in many it is irregular.

Fig. 2. The piroplasmata in artificial culture media, lying outside of the red blood cells; from calf No. 4. Magnification about 2,000 diameters.

a. Piroplasma; the earliest free form observed in the blood bouillon; compare with Koch's illustrations: Beiträge zur Entwickelungsgeschichte der Piroplasmen. *Ztschr. f. Hyg. u. Infektionskrankh* (1906), 54, Table I, figs. 6 and 7.

b and *c*. Ray forms; compare also with Koch's illustrations; reference as above, Table I, figs. 9 to 14.

d. Forms with chromatin points; compare with Koch's illustrations; reference as above. Table I.

e. Round form with chromatin points.

PLATES III TO VI.

Magnification in figs. 1 to 17 and 20 to 34, 1,000 diameters. Magnification in fig. 18, 1,250 diameters, in fig. 19, 450 diameters. The photographs were made by Mr. Charles Martin, photographer of the Bureau of Science. Preparations stained by Giemsa's solution.

PLATE III.

FIG. 1. Narrow forms of the piroplasmata in fresh blood smears from the "original calf" made on January 18, 1909.

FIG. 2. Ring form in fresh blood smear from the "original calf" made on January 18, 1909.

FIG. 3. Binuclear form in a fresh blood smear from the "original calf" made on January 27, 1909.

FIG. 4. Double binuclear form from a fresh blood smear from the "original calf" made on February 16, 1909.

FIG. 5. Cross form from a fresh blood smear from the "original calf" made on January 18, 1909.

FIG. 6. Arrow form from a fresh blood smear from the "original calf" made on February 1, 1909.

FIG. 7. Form resembling a trypanosoma from a fresh blood smear from the "original calf" made on February 1, 1909.

FIG. 8. A form lying outside of the red blood cell in the fresh centrifugated blood from the "original calf."

FIG. 9. Rare form of trypanosoma from the bouillon culture from the "original calf" made on January 23, 1909, seen on January 25, 1909. To the left, below is seen an indication of the undulatory membrane; at the left a slight club-like swelling indicates the flagellum.

FIG. 10. Division form of a trypanosoma from the blood culture from the "original calf" made on February 5, 1909, seen on February 8, 1909.

FIG. 11. A small, well-developed trypanosoma from the bouillon culture of the "original calf" made on January 18, 1909, seen on January 20, 1909.

FIG. 12. A large well-developed trypanosoma from the blood culture of the "original calf" made on January 23, 1909, seen on January 25, 1909.

FIG. 13. Very slender trypanosoma prepared the same day from the same culture as in fig. 12. Perhaps a male individual; compare with Prowazek's illustrations (Studiem über Säugetiertrypanosomen (23)). Fig. 37.

PLATE IV.

FIG. 14. Form showing beginning division; prepared from the same culture on the same day as fig. 12. The blepharoblast shows a contraction in the middle, and the nucleus is drawn out in the direction of the long diameter of the parasite. In one of the red blood cells is seem a persisting piroplasma.

FIG. 15. Continuation of the process of division; two flagella are now visible; preparation made the same day and from the same culture as fig. 14.

FIG. 16. Continuation of the process of division made on February 5, 1909. Daughter cells, on the point of separating; from a bouillon culture of the "original calf" seen on February 8, 1909.

FIGS. 17 and 18. Groups of trypanosomata from the same culture made on January 23, 1909, seen on January 25, 1909. In fig. 18 the magnification is about 1,250 diameters.

Plate V.

Fig. 19. Culture of trypanosomata photographed alive in a hanging drop preparation; from a bouillon culture of the "original calf" made on January 18, 1909, photographed on January 23, 1909. Magnification about 450 diameters.

Fig. 20. Form like *Pirosoma bigeminum* in the fresh blood of calf No. 1. (Free form.)

Fig. 21. Intracellular forms observed on the same day as the forms illustrated in fig. 20.

Fig. 22. Intracellular forms observed on February 20, 1909, preparation from the fresh blood of calf No. 1.

Fig. 23. A form resembling *Pirosoma bigeminum* from the fresh blood of calf No. 2. (Free form.)

Fig. 24. Intracellular form resembling a trypanosoma found in the fresh blood of calf No. 1.

Fig. 25. Intracellular form resembling a trypanosoma found in the fresh blood of calf No. 2.

Fig. 26. Involution forms of trypanosomata found on the fifth day of a culture made from the blood of the "original calf."

Fig. 27. *Trypanosoma evansi* from the calf found infected with surra.

Plate VI.

Fig. 28. A group of the developmental forms of Koch; *Pirosoma bigeminum* on the second day of cultivation in bouillon; parasites lying between the red blood cells. Preparation from calf No. 7.

Fig. 29. Larger group of the same forms observed the same day as those illustrated in fig. 28. Parasites lying between red blood cells and leucocytes. Preparation from blood of calf No. 7.

Fig. 30. Ray form of Koch. Preparation from blood of calf No. 4.

Figs. 31 and 32. Form with chromatin points described also by Koch. Preparation made from blood of calf No. 4 on the third day of cultivation.

Fig. 33. Large oval form with three chromatin masses and four chromatin tips, together with small developmental forms lying between the swollen erythrocytes. Preparation made from calf No. 4 on the third day of cultivation.

Fig. 34. Large oval form, lying isolated between swollen erythrocytes. Preparation from calf No. 4 on the third day of cultivation.

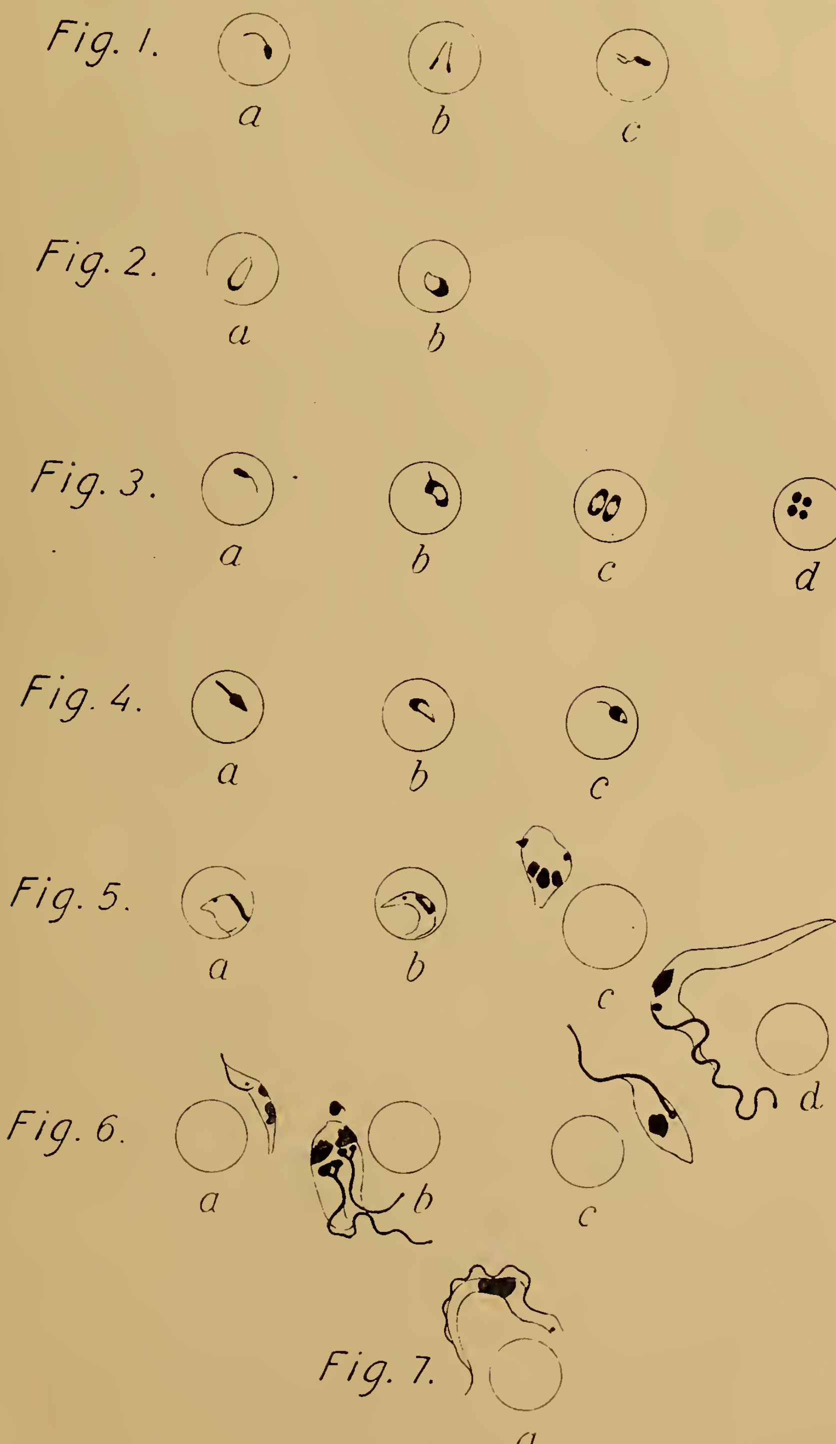

PLATE I.

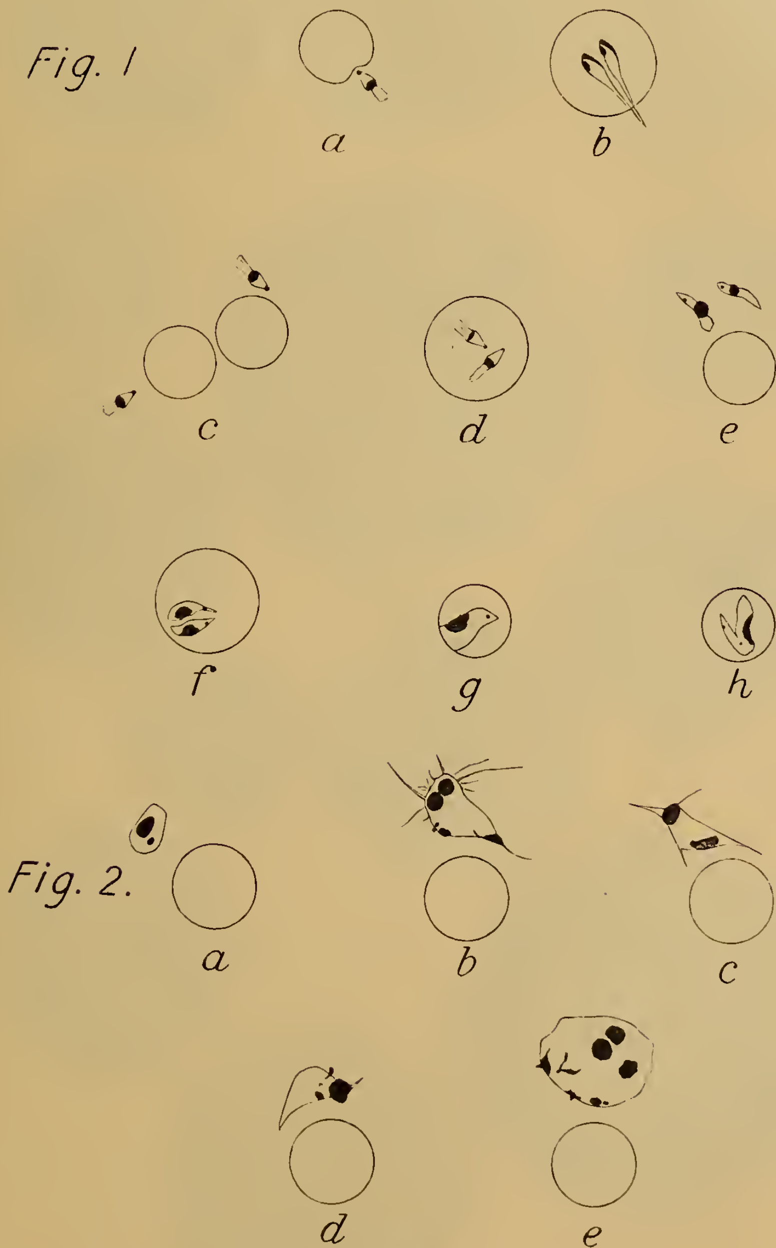

PLATE II.

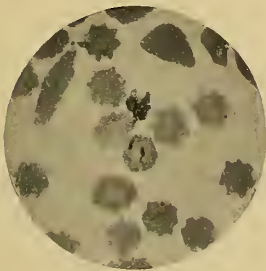
FIG. 1.

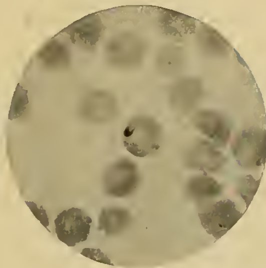
FIG. 2.


FIG. 3.


FIG. 4.

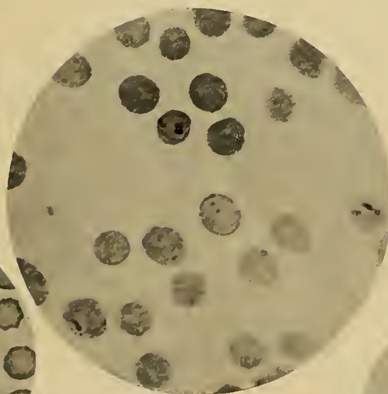
FIG. 5.

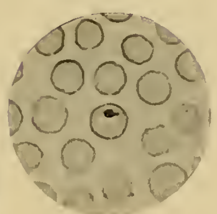
FIG. 6.


FIG. 7.


FIG. 8.


FIG. 9.

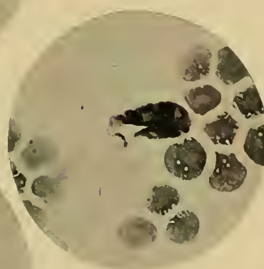
FIG. 10.


FIG. 11.


FIG. 12.

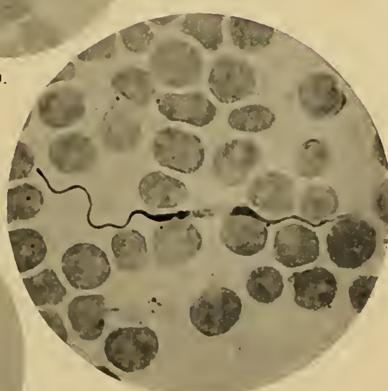
FIG. 13.

PLATE III.

FIG. 14.

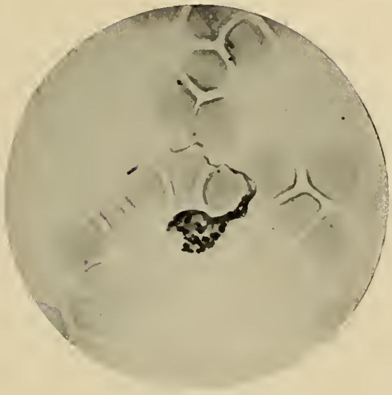

FIG. 15.

FIG. 18.

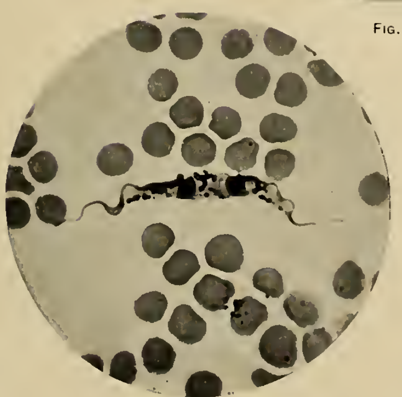

FIG. 16.

FIG. 17.

PLATE IV.

FIG. 19.

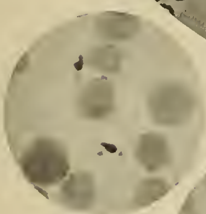

FIG. 20.

FIG. 23.

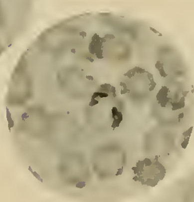

FIG. 21.

FIG. 22.

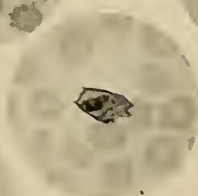

FIG. 24.

FIG. 26.

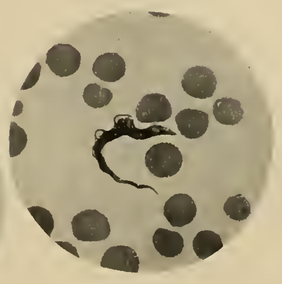

FIG. 27.

FIG. 25.

PLATE V.

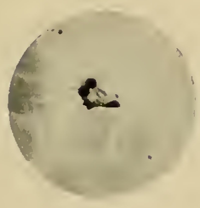

FIG. 30.

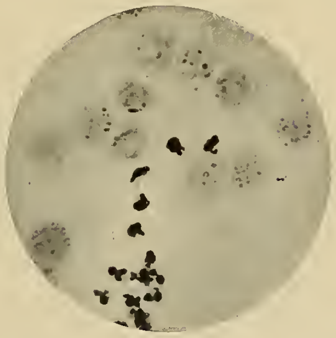

FIG. 28.

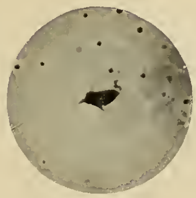

FIG. 31.

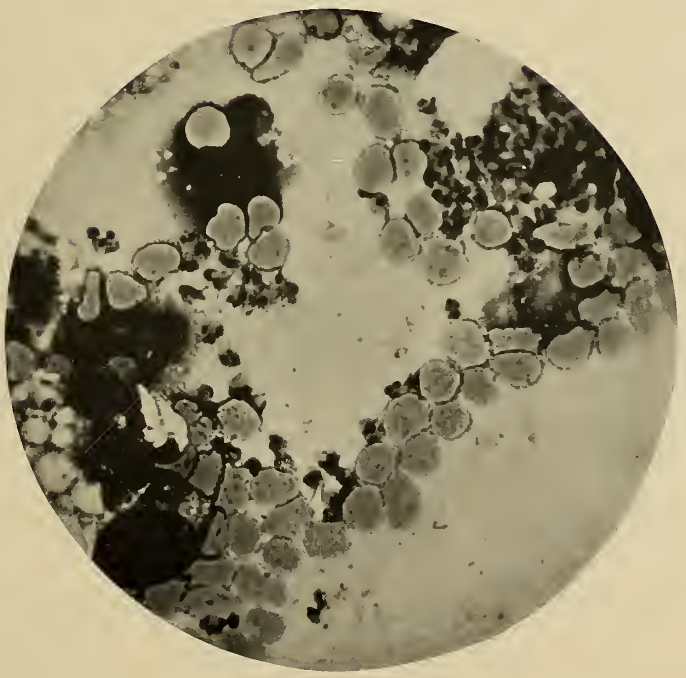

FIG. 29.

FIG. 32.

FIG. 33.

FIG. 34.

PLATE VI.

THE BACTERICIDAL SUBSTANCES IN FIBRIN.

By A. F. Coca.

(From the Biological Department of the Krebs Institut, Heidelberg (Professor von Dungern, Director), and the Biological Laboratory, Bureau of Science, Manila, P. I.)

The claim has been made, in recent years, that fibrin is a carrier of considerable quantities of bactericidal and hæmolytic substances and therefore is an important therapeutic means in the combating of infections, chiefly of a localized inflammatory nature.

In 1904 Ottolenghi [1] published the results of experiments with *Bac. anthracis* which seemed to show in the fibrin of certain animals—rabbit, ass, and horse—the presence of substances capable of reactivating an anti-anthrax serum. Such substances were lacking in the fibrin of the guinea pig, ox, and dog, the serum of which animals is, in this respect, likewise inert.

According to the later experiments of Sieber [2] nonspecific bactericidal substances can be obtained from fibrin by extraction with chloroform-thymol water during five to ten days.

A more recent contribution to this question has been made by S. Bergel,[3] who claims to have found both antibodies and complement in washed fibrin, and who was the first to make practical use of this element of the blood as a therapeutic agent. Proceeding upon the assumption that all the early tissue and vascular changes taking place in the process of inflammation have for their purpose the combating of the causative microörganisms and their toxic products, Bergel has endeavored to demonstrate in fibrin the presence of the two categories of bactericidal substances, namely, complement and immune body. Instead, however, of experimenting directly with pathogenic organisms, as his predecessors had done, he chose, as an analogous and more convenient system, red blood corpuscles and the specific hæmolysins and hæmagglutinins. A few experiments were also made with bacterial agglutinins.

The fibrin extract was prepared by Bergel in the following manner: blood drawn from a vein was whipped until all the fibrin had collected

[1] *Centralbl. f. Bakt., etc.* (1904), 37, 584.

[2] *Ibid.* (1905), 32, 571.

[3] *Deutsche med. Wcsnschr.* (1908), 34, 369.

in a firm mass upon the stick used for whipping. This mass of fibrin was then cut into small bits and after having been washed well in physiological salt solution, was pressed between layers of filter paper, once more washed in the salt solution and suspended in a volume of that medium corresponding to the volume of the blood from which the fibrin had been derived. In a few cases the blood was not whipped, but centrifugalized as soon as possible after being drawn, and the fibrin obtained from the upper layer of coagulated plasma by simple expression of the serum. Instead of salt solution, glycerin was sometimes used for the extraction of the substance sought.

Extracts of fibrin obtained from guinea pig, rabbit, man, horse, and dog, were studied, and in these extracts were sought the normal and artificially produced hæmolysins (complement and immune-body) and the hæmagglutinins and bacterial agglutinins.

The results of the experiments were in every case positive, all the substances mentioned being found in one or another of the extracts examined.

On the basis of these experiments Bergel recommended the local injection of fibrin in the treatment of abscesses and "other surgical conditions" and reported that he had already obtained favorable results by this practice.

The latest study of this subject was made by Kindborg,[4] who approached it from a different standpoint from the other investigators.

The principal purpose of Kindborg's experiments was to demonstrate the power of fibrin to absorb bactericidal and hæmolytic substances of specific sera. In order to prove this he left the washed fibrin, which had been sterilized by moist heat, for various lengths of time in contact with bactericidal and hæmolytic serum, and determined in the sera thus treated the resulting diminution of these substances.

The experiments with bactericidal sera showed that their power to destroy the respective microörganisms was diminished by prolonged contact with fibrin, provided that the experiment was carried out at a temperature of 37° C.; at room temperature—averaging 10° C.—little or no effect was produced.

In interpreting this observation Kindborg considers only two possibilities, namely, the absorption either of antibody or of complement. He ignores the obvious possibility of substances being generated in the fibrin, particularly when the latter has been kept in contact with an active serum for many hours at body temperature—substances which are injurious to the labile complement. No experiments are reported in his article showing directly that it is not complement which is affected by contact with fibrin.

[4] *Centralbl. f. Bakt.* (1908), 48, 335.

The experiments with a hæmolytic serum derived from a rabbit that had been immunized against bullock's blood corpuscles, showed, first, that the addition of sterilized bullock's fibrin to the serum deprived the latter of its specific dissolving power against bullock's blood and, secondly, that this effect was due to the absorption of the immune body.

In summing up the results of his investigations Kindborg assumes, without any discussion, that the action of the fibrin in both sets of experiments is identical. His conclusion, then, based upon the experiments with the hæmolytic immune serum, is that fibrin possesses a nonspecific power of absorbing the specific immune bodies. In all the experiments, however, upon which this conclusion rests the fibrin used was derived from the animal against whose blood corpuscles the immune body was directed, so that its ability to unite with that substance can by no means be regarded as nonspecific. It is not to be overlooked that fibrin holds in its meshes the stromata of both red blood corpuscles and blood platelets both of which possess a specific property of uniting with the corresponding antibodies.

Kindborg expresses surprise that Sieber should find bactericidal substances liberated by fibrin, whereas he himself has observed just the opposite action of this substance—a prevention of bacteriolysis. The explanation of this apparent contradiction is clear. Sieber subjected his fibrin to a prolonged autolysis and tested the products of this process directly upon the various microörganisms. Kindborg, on the other hand, treated his fibrin for a considerably shorter time by a similar process and exposed the much more sensitive complement to the injurious products.

Kindborg also questions Ottolenghi's conclusions, arguing that in his own experiments instead of a diminution of bactericidal property upon the addition of fibrin an increase of this power, according to Ottolenghi, must have resulted. To this argument Ottolenghi [5] replies that his conclusions are applicable only to the case of anti-anthrax serum and its special complement.

From this brief review of the literature we see that the experiments of Bergel are the only ones upon which the prospect for any practical use of fibrin as a therapeutic agent can be based.

In the course of some investigations carried out in the cancer institute in Heidelberg, I took occasion to repeat some of the experiments described by Bergel and by reason of the wide discrepancies between his results and my own and in view of the practical significance of the matter, I have thought it worth while to continue the study systematically. Part of this work was done in the biological laboratory, Bureau of Science, Manila.

In repeating Bergel's experiments the fibrin of rabbit and guinea pig has been used, both from normal and immunized animals, and the sub-

[5] *Ibid.* (1909), 49, 615.

stances sought were complement, hæmolytic immune-body, and the hæmagglutinins, all of these being readily detected both qualitatively and quantitatively.

The method of preparing the fibrin extract was identical with that adopted by Bergel with the exception that sometimes the quantity of salt solution used for the extraction was less than the amount of blood yielding the fibrin.

Complement in fibrin.—The entire amount of fibrin obtained from 15 cubic centimeters of guinea pig's blood by whipping, after having been thoroughly washed in physiological salt solution and finely cut up with scissors, was suspended in 15 cubic centimeters of the salt solution and left for thirty hours at 15° ; the serum from the same animal was kept at the same temperature.

The relative amount of hæmolytic complement in both serum and fibrin-extract was then determined in the usual manner:

Series of tubes A:

In all tubes 1 cubic centimeter 5 per cent sensitized bullock's blood corpuscles.

Diminishing quantities of fibrin-extract, 2.4 cubic centimeters, 1.6 cubic centimeters, 0.8 cubic centimeter, etc.

Series of tubes B:

In all tubes 1 cubic centimeter 5 per cent sensitized bullock's blood corpuscles.

Diminishing quantities of guinea pig's serum, 1/20 cubic centimeter, 1/40 cubic centimeter, 1/80 cubic centimeter, etc.

At the end of the usual period of observation no trace of hæmolysis was to be found in Series A, whereas in Series B 1/20, 1/40, and 1/80 cubic centimeter of serum had produced complete solution, 1/160 cubic centimeter moderate solution.

The amount of available complement in the fibrin from 2.4 cubic centimeters of guinea pig's blood is, therefore, less than that present in 1/160 cubic centimeter of the blood-serum of the same animal.

Hæmolytic immune-body in fibrin.—Rabbit No. 21 was given in the ear vein 5 cubic centimeters of washed bullock's blood corpuscles and two and one-half weeks later a similar injection of 10 cubic centimeters. Eight days after the second injection the animal was killed and the fibrin from 50 cubic centimeters of its blood used for the following experiment. The fibrin-extract was prepared as before, only 10 cubic centimeters of salt solution being used for the extraction.

Series of tubes A:

In each tube 1 cubic centimeter 5 per cent bullock's blood corpuscles.

Diminishing quantities of fibrin extract, 4/10, 2/10 cubic centimeter, etc., to 1/160 cubic centimeter.

Series of tubes B:

In each tube 1 cubic centimeter 5 per cent bullock's blood corpuscles.

Diminishing quantities of serum, 1/160, 1/320 cubic centimeter, etc., to 1/1280 cubic centimeter.

After one and one-half hours at room temperature no hæmolysis having occurred in any of the tubes, all of them were centrifugalized and the fluid poured off. To each of the tubes were then added 1/10 cubic centimeter of normal rabbit serum and 1 cubic centimeter of physiological salt solution. After two hours at 37° C. and twenty hours at room temperature, in series A complete solution had taken place in the tube containing 4/10 cubic centimeter of fibrin extract; 2/10 cubic centimeter had produced strong solution, 1/10 cubic centimeter none. In series B complete solution had been produced by 1/160 and 1/320 cubic centimeter of serum, almost complete solution by 1/640 cubic centimeter, and very strong solution by 1/1280 cubic centimeter of serum.

The entire amount of fibrin, therefore, in 50 cubic centimeters of the blood of rabbit No. 21 had yielded a quantity of hæmolytic immune-body equivalent to that possessed by 1/25 cubic centimeter of the same animal's serum.

Hæmagglutinins in fibrin.—Rabbit No. 11 was given the washed corpuscles of 10 cubic centimeters of chicken's blood into the ear-vein and ten days later was bled from the jugular vein; for the following experiment the fibrin from 30 cubic centimeters of the blood was obtained by whipping. For the extraction, which lasted twenty-four hours, 10 cubic centimeters of salt solution were used.

It was found that whereas 1/20 cubic centimter of the inactivated serum produced complete agglutination of 1 cubic centimeter of a 5 per cent suspension of chicken's blood corpuscles, it required 1.6 cubic centimeters of the extract to agglutinate completely 1 cubic centimeter of the same suspension, while 0.8 cubic centimeter agglutinated slightly and 0.4 cubic centimeter not at all.

Therefore the amount of agglutinins available in the fibrin from 30 cubic centimeters of this blood equaled that found in about 1/3 cubic centimeter of the same animal's blood-serum.

These experiments and others of the same nature were often repeated and always with the same result, namely, *that there is an incomparably greater quantity of the substances under consideration in the serum than in the fibrin of the same specimen of blood.* Consequently, the logical conclusion of this study is, that if the benefit derived from fibrin injections is dependent upon the classes of substances under investigation, it must be considerably more advantageous to use the corresponding sera for the purpose of treatment. However, when we remember how unsatisfactory, as yet, the treatment has been with antistreptococcic and antistaphylococcic sera, and it is the microörganisms with which these sera are prepared which are chiefly responsible for the local inflammations, it becomes apparent that if the injected fibrin does prove to be efficacious in the cases mentioned, it will not be because it carries bactericidal substances.

THE DEVELOPMENT OF THE MIRACIDIUM OF PARAGONIMUS UNDER VARIOUS PHYSICAL CONDITIONS.[1]

By PHILIP E. GARRISON [2] and RICARDO LEYNES.[3]
(*From the Biological Laboratory, Bureau of Science.*)

INTRODUCTION.

The present paper presents observations made during the past two years upon the development of the ova of *Paragonimus* under various physical conditions. It is in part based upon the repetition on a more extensive scale of the experiments and observations of Manson (1882), Kellicott (1894), Kerbert (1881), Otani (1887), Miura (1889), and Nakahama (1883), and in a large part upon experimental work which, so far as we are aware, has not been previously done.

The work was undertaken with three practical purposes in mind, namely, to add to our knowledge concerning, first, the prophylactic treatment of paragonimiasis, especially as regards the care of infected patients; secondly, the possibility of introducing the lung-fluke into colder climates; and thirdly, the life-cycle of the parasite, notably, its probable intermediate host.

With these purposes in view experiments have been made, first, to determine the most favorable conditions for the development of the ova and the time required for such development; secondly, their resistance to varying degrees of temperature and light, to desiccation, and to salt solution of various strengths.

MATERIAL.

Sputum and fæces containing *Paragonimus* eggs have been used from about fifteen different patients, one, a patient at the Civil Hospital, the others in the hospital at Bilibid Prison. By far the greater number of experiments have been made with the sputum of a Bilibid prisoner, number 3680–P, who for over a year past (when he came under observation) has expectorated daily from 10 to 30 cubic centimeters of blood-tinged, mucoid sputum, heavily loaded with *Paragonimus* ova.

[1] Read at the Sixth Annual meeting of the Philippine Islands Medical Association, February 13, 1909.

[2] Assistant surgeon, United States Navy; detailed medical zoölogist to the Biological Laboratory, Bureau of Science.

[3] Student demonstrator in Medical Zoölogy, Philippine Medical School.

NORMAL DEVELOPMENT.

The ova of *Paragonimus* were first developed to the free miracidial stage by Manson in 1880, who after shaking the sputum with water and renewing the water daily for about a week found the motile miracidia developed in from four to six weeks after the sputum was expectorated. The favorable results of such a method were entirely in harmony with what was known of the development of the ova of other digenetic trematodes and in our hands the method has never failed throughout a series of several hundred such cultivations of the ova, provided two important requirements were complied with, namely, that the washing of the ova be thorough and that it be not too long delayed after the sputum is expectorated.

Sedimentation.—The method we have used for clearing the ova from the sputum or fæces is as follows:

The specimen (sputum or fæces) is placed in a tall museum jar, holding about 2,500 cubic centimeters and about 10 centimeters in diameter. Such a jar while holding a good volume of water confines the sediment to a comparatively limited area. Tap water is run into the jar as violently as possible in order to break up the mucoid or solid parts of the specimen and the jar allowed to stand until the ova have sunk to the bottom, which usually happens in from one to four or five hours, depending upon the specific gravity of the solution.

If the specimen be sputum, after standing for an hour or two, the water is decanted off to as close to the sediment as possible and the jar refilled and allowed to stand until the following day, when the water is again changed. If, after sedimentation has taken place, the water is perfectly clear it is poured off and the sediment transferred to a bottle of half a liter capacity or less and not again disturbed, unless the water it contains becomes clouded or covered with a scum by the excessive growth of bacteria or other organisms.

Fæces are more difficult to wash satisfactorily. In the case of stools with a large amount of soluble matter, we have frequently used 10 liters or more of water in order to get the first solution sufficiently light to allow the ova to settle and it was found to be necessary to change the water repeatedly until the fæcal character of the stool apparently disappears. When once thoroughly washed, the ova from fæces develop as well apparently as those from sputum, but we have frequently failed to get them sufficiently and quickly clean and both for this reason and also because of their bulk and of the larger amount of sediment remaining fæcal specimens have been little used in our experimental work.

Conditions of temperature and light.—Cultures of the ova, including those used as controls for experiments, regularly have been kept uncovered, out of direct sunlight, upon a laboratory shelf, where the temperature varies from 25° to 34° C.

Since thoroughly washed ova kept under these conditions developed satisfactorily and as under no variation from these conditions was development more constant, more rapid, or apparently more healthy, we have used the maximum development so obtained as the standard for comparison and considered it, at least for the laboratory, as normal.

Time required.—Manson found developed miracidia in from four to six weeks, at a temperature of from 26°.7 to 34°.4 C. Nakahama (1883) reported that the ciliated miracidium developed in twenty-eight days, at a temperature of 30° C.

In our own cultivations we have endeavored to record the length of time from the day the sputum was expectorated to (1) the day of the first motile miracidia, (2) the day of the first free swimming miracidia, and (3) the day the last motile miracidia were found in the culture.

Referring to the observation of Kerbert (1881) of the presence of ova in the uterus of the worm developed to the gastrula stage, and to that of Manson (1882) of ova segmented several times in the sputum, we may say in this connection that in freshly expectorated sputum we have never been able to detect segmentation of the germ-cell.

We have repeatedly been able to grow the motile miracidium in fifteen days from the time the sputum was expectorated, but in order to do this, it was essential that the ova be thoroughly sedimented on the day the specimen was obtained and that the water be promptly changed whenever it became at all clouded. Any delay in the first washing or failure to keep the water clean resulted in a longer period of development, though not necessarily in degeneration.

All cultivations, although the most favorable conditions were complied with, did not develop the motile miracidium in so short a time, some requiring from twenty to twenty-five days.

Such variations did not appear to correspond to such slight differences of temperature as occurred in the laboratory at different times of the year. Motile miracidia have developed in fifteen days, while the thermometer ranged from 25° to 28° C.; at other times, with a temperature of from 29° to 31° the development was slower.

Therefore it is apparent that a difference in temperature does not explain the more rapid development obtained in our cultivations than it did in those of Manson and of Nakahama. From our experience it would appear that a more important factor than temperature within the limits indicated is the prompt and thorough washing of the ova and the cleanliness of the water in which they grow.

We have never found free-swimming miracidia in our cultures in less than twenty-five days from the time the sputum was expectorated, but in from twenty-five to thirty-five days they have frequently been noted. Therefore it is evident that the miracidia require, after they first acquire motility, a considerable period for further development before they are capable of leaving the shell.

A more striking observation is the length of time motile miracidia may remain in the shell before hatching. While as a rule practically all the shells in a culture thirty days old, contained actively motile miracidia, active, unhatched organisms would persist in the same culture for one hundred and fifty days, and in one case we found shells containing motile miracidia in a culture one hundred and sixty days (twenty-three weeks) old. In cultures kept a longer time than this, we were never able to find anything but empty shells or degenerated ova.

Therefore it would appear that while the ova develop comparatively uniformly until the miracidia are, to all appearances, fully mature, the escape of the miracidia from their shells is, for a given number of ova, a matter of considerable variation and that the hatching of the ova thrown out in a single expectoration may be distributed throughout a considerable period of time—according to our experience, seventeen to eighteen weeks. This observation appears to explain the fact that we have never been able to find a great number of free-swimming miracidia in our cultures at any one time, even though the sediment was very heavily loaded with ova and it is possible that the gradual hatching of the ova may prove to be not without significance when the complete life-cycle of the parasite is known.

Having determined the laboratory conditions under which development of the ova of the lung-fluke was most favorable and observed the time and manner of such development, the remaining experiments, with which we are here concerned, were performed with the idea of ascertaining the variations from these conditions under which development would still take place.

DEVELOPMENT UNDER VARIOUS CONDITIONS OF TEMPERATURE.

Cultures placed in the incubator at body temperature (37° to 38° C.) not only showed no development, but rapidly degenerated. Subjected to such a temperature for ten days, the cellular content of the ova appeared broken down into an amorphous mass of granules and, if removed from the incubator, gave no evidence of development though kept beside a control culture for several weeks.

Cultures kept at room temperature until the miracidia were developed and then placed in the incubator at 37° gave similar results. Within an hour the organisms became quiescent, although those on a control slide were still actively motile. Within a few days they became broken down into a mass of granular débris.

The results of these two experiments would seem to be at least presumptive arguments against the reported observation of partly developed ova in the tissues of the final host of the parasite (see Kellicott, 1894) and also against the possibility more recently suggested (see Manson, 1908) that the miracidia of *Paragonimus* might be the infecting stage for man.

Cultures kept in cold storage at from 11° to 15° C., 10° to 12° C., and from 9° to 10° C. gave no signs of development after ten weeks, but likewise no degeneration, and when removed from the cold storage to room temperature, never failed to develop motile miracidia in about the same length of time after leaving the cold chest as was required for its original control at room temperature.

It would appear, therefore, that while temperatures above 15° C. are required for the development of *Paragonimus* ova, temperatures as low as 10° do not destroy or, apparently, even impair their vitality.

Ova from the fresh sputum, when frozen solid and immediately thawed, apparently developed as well as did their controls. Likewise, ova frozen solid for five or six minutes seemed uninjured, and, although at times the proportion of undeveloped ova seemed somewhat larger than in the unfrozen controls, the difference certainly was very slight and the greater number of the eggs developed apparently as promptly and as normally as those in the controls. Ova frozen longer than five to six minutes, however, began to show injury, in that development was apt to be delayed and an unmistakably higher proportion failed to develop. Nevertheless, we have had cultures which were frozen for ten minutes develop apparently as well as the control ones, though, perhaps a few days later; other cultures, frozen approximately the same length of time, have shown a high percentage of degenerate ova. Ova frozen fifteen, twenty, and twenty-five minutes showed with fair consistency an increasing proportion of ova which failed to develop, and those frozen thirty minutes revealed only a few motile miracidia and these required about forty days for development. No ova after being frozen solid for over one-half hour gave any signs of development.

The results obtained from freezing the developed miracidia were very similar. The actively motile organisms in their shells could be frozen solid for five minutes, with impunity, resuming their activity when thawed. If frozen for ten minutes, however, only about one-half remained motile, and if for fifteen to twenty minutes, perhaps one-third, or less. Motile miracidia frozen twenty-five minutes or longer have consistently failed to retain their motility when thawed, and have invariably died and degenerated.

If the freezing be repeated after once thawing, the effect is more pronounced. A culture of motile miracidia, frozen, immediately thawed, refrozen for five minutes and again thawed, showed but a few motile organisms remaining, and these appeared to have died by the next day, when no motile miracidia could be found.

DEVELOPMENT UNDER VARIOUS CONDITIONS OF LIGHT.

Ova exposed to direct sunlight rapidly degenerated, and ova from which light was absolutely excluded developed practically step by step with the controls which were exposed to the reflected light of the laboratory room.

Referring to the observation of Looss (1890), that the miracidia of the conical amphistome (*Amphistoma cervi*) of cattle and sheep escape from the shell only when exposed to light, we would say that we have repeatedly found from three to five free-swimming miracidia in one cover-glass preparation from a culture of *Paragonimus* ova which had been kept in a sealed stone jar and which had been exposed to light only for the fraction of a minute necessary to place a drop of the sediment under the microscope.

Therefore it would appear not only that direct sunlight is fatal to the life of the ovum, but that the presence of any light is not necessary to its development, at least to the free-swimming, miracidial stage.

EFFECT OF SALT SOLUTIONS.

The ability of the ova of the lung-fluke to develop in salt or brackish water would not be without its important practical bearings. In sea water, taken from Manila Bay, the eggs invariably and rapidly degenerate. Such water contains about 3 per cent of sodium-chloride. In solutions of commercial salt, containing 1.5 per cent or more of the salt, no development took place. In 1 per cent solutions, from one-third to one-half the ova developed motile miracidia, the others degenerating. In 0.5 per cent solutions the development was nearly as good as in the tap-water controls, though degenerated eggs appeared to be more frequently encountered. In neither the 0.5 or 1 per cent solutions were free-swimming miracidia ever seen.

DESICCATION.

Aside from the actual demonstration of the intermediate host and the mode of infection of *Paragonimus,* there is perhaps no question more important in paragonimiasis than the possibility of the dissemination of the ova in dried sputum or dust.

As remarked by Stiles, the long retention of the ova in the moist sputum, corresponding to the experimental conditions of Manson, would seldom occur in nature. The natural fate of the ova expectorated in the sputum of the ambulatory paragonimiasis patient (and most such patients are ambulatory) would be either for them to be washed into a body of water or, having been washed free from, or while still retained in the sputum, to become dried on the surface of the ground. It was with a view of determining the probable fate of these ova which become dried that we made a study of experimentally dried ova.

All ova which were allowed to become dry, even for a few minutes, by evaporation at room temperature, failed to develop thereafter.

Such a result was surprising in view of the great power of resistance to desiccation shown by the ova of certain other parasites, but repetitions of the test consistently gave the same result.

In our first tests, the cultures were allowed to remain dry for from one to forty days before the water was renewed. All of the ova degenerated, without showing signs of development.

Cultures were then left dry for from one to several hours, with the same results.

Finally, cultures in petri dishes were carefully watched until the last water had evaporated and the sediment was left dry in the bottom. After a short interval, which approximated and certainly did not exceed ten minutes, fresh water was added. When examined under the microscope, the shells were shrunken and the cellular contents broken down and though the cultures were kept under observation for several weeks after the control-cultures had developed motile miracidia, no development occurred in those previously dried.

It would seem safe to conclude, therefore, that desiccation, even for a few moments, is fatal to the life of *Paragonimus* eggs and that the ova can not be disseminated otherwise than in water.

The theory which has been broached that infection of man might occur by means of ova blown about in the air, even though there were no other objections to it, would appear to be absolutely excluded by the failure of the ova to withstand drying.

REFERENCES.

For complete bibliographical references to articles quoted see Stiles and Hassall, Index Catalogue of Medical and Veterinary Zoölogy, Bulletins of Bureau of Animal Industry, Washington, D. C.

THE INTESTINAL WORMS OF 385 FILIPINO WOMEN AND CHILDREN IN MANILA.[1]

By PHILIP E. GARRISON[2] and ROSENDO LLAMAS.[3]

(*From the Biological Laboratory, Bureau of Science.*)

Last year a paper was presented before this association giving the results of the examination of over 4,000 adult, male, Filipinos for the prevalence of animal parasites.[4]

The differences which have been reported by numerous authors between the frequency of infection with the various species of parasitic worms in males and in females and in adults and in children were used at that time to make a general forecast of what frequency of infection might be expected in Filipino women and children. However, it remained to definitely inform ourselves concerning the parasites of women and children by actual examination. The results here reported are the first step in that endeavor and are based upon the examination of 385 women and children in Manila. The examinations were made at Bilibid Prison, Hospicio de San Jose, St. Paul's Hospital, and the School for Deaf and Dumb Children of the Bureau of Education, and to these institutions we would acknowledge our indebtedness for the facilities provided.

Of the total 385 persons examined, 342 or 89 per cent were infected with intestinal worms as against 84 per cent of the male prisoners at Bilibid. The total number of infections found in the 385 women and children was 533, or 138.7 infections to each 100 persons examined, against 142 infections with intestinal worms in each 100 men.

Of the 385 persons examined, 227 were women—and of these alone

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, Manila, February 13, 1909.

[2] Asistant surgeon, United States Navy; detailed medical zoölogist to the Biological Laboratory, Bureau of Science.

[3] Student assistant in medical zoölogy, Philippine Medical School.

[4] Among the 385 women and children examined, amœba were found 37 times (10.8 per cent) and other intestinal protozoa 24 times (7.0 per cent). These figures are excluded from our statistics since the examinations were frequently made under conditions unfavorable for diagnosing these infections, most often owing to the lapse of time after the specimen was passed before the examination could be made.

192 were infected, or 85 per cent—while of the remaining 158 children, 150, or 95 per cent, were infected. The women gave 291 infections with intestinal worms or 128 infections per 100 examined; while the children gave 242 infections or 153 per 100.

The infections with each parasite found were as follows:

	Infections.	Per cent.
Trichuris	300	87.60
Ascaris	182	53.22
Hookworms	46	13.45
Strongyloides	2	.6
Oxyuris	2	.6
Tænia	1	.3

A comparison of the frequency of these parasites in men from all over the Islands and women and children in Manila is shown in the following table:

Animal parasites.	Men.	Women.	Children.
	Per cent.	*Per cent.*	*Per cent.*
Trichuris	59.00	84.00	92.00
Ascaris	26.00	51.00	56.00
Hookworms	52.00	15.00	11.00
Strongyloides	3.00	0	0
Oxyuris	0.8	0	1.33
Tænia	0.7	0	.66
Hymenolepis	0.1	0	0

A higher rate of infection with *Ascaris* and *Trichuris* among women and children than among men was anticipated from the relative frequency of these worms in the two sexes and among different ages in other localities. The frequency of hookworms is strikingly lower than was found among the Bilibid prisoners.

The infections with the other parasites are too few for purposes of comparison. In view of the fact that the greater frequency of *Hymenolepis* among children than among adults has been recorded by several authors, it is worthy of note that no infections with the dwarf tapeworm were encountered among the 158 children examined, although it was found in about 1 per cent of the adult males examined at Bilibid Prison.

RELATION OF THE INDIAN FORM OF RELAPSING FEVER TO AFRICAN TICK FEVER.[1]

By Richard P. Strong.

(*From the Biological Laboratory, Bureau of Science.*)

In 1904 Manson,[2] after examining the blood of a patient from Gibraltar suffering from her eighth paroxysm of relapsing fever, suggested, on the ground of the unusually large number of relapses and the locality in which the infection was acquired, that there might be several forms of this type of disease due to different species or varieties of spirochætæ. Ross and Milne [3] in the same year stated that it was possible there might be more than one form of tick fever, and Sambon [4] suggested that a spirillum which was so widely distributed and fostered by different invertebrate hosts in different countries might be represented by a number of more or less distinct varieties or species. In 1906 Novy and Knapp [5] studied a case of relapsing fever in the United States, and on account of morphological characteristics which they were able to detect in several stained specimens of the spirochæta from their own case, and in those of African spirochætæ obtained by them from the Liverpool School of Tropical Medicine, concluded that relapsing fever and tick fever are distinct. They also based this claim upon the published experiments of Dutton and Todd [6] and particularly upon those of Breinl and Kinghorn,[7] who found that the spirochæta of the tick variety was frequently fatal to rats and mice and that in rats from three to four relapses occurred before death. Novy and Knapp [8] found that in the case of the spirochæta, which they regarded as *Spirillum obermeieri,* the infection in rats was of shorter duration and that no relapses occurred. They also believed that

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 13, 1909.

[2] *Brit. Med. Journ.* (1904), 1, 538.

[3] *Brit. Med. Journ.* (1904), 2, 1453.

[4] *Brit. Med. Journ.* (1905), 2, 1266.

[5] *Journ. Am. Med. Ass.* (1906), 46, 116; *Journ. Infect. Dis.* (1906), 3, 291.

[6] *Brit. Med. Journ.* (1905), 2, 1259; *Mem. Liv. School of Trop. Med.* (1905), 17, 1.

[7] *Lancet* (1906), 1, 668; *Mem. Liv. School Trop. Med.*, 20, 61.

[8] *Loc. cit.*

the diffuse flagella of the organism of tick fever as pictured by Zettnow [9] served as an additional "clinching" proof and effectually differentiated it from *Sp. obermeieri* which had, according to their observations, but a single terminal flagellum. Uhlenhuth and Hændel [10] later claimed that Novy was not working with *Spirochæta obermeieri*, but with another species, an American variety. Fränkel [11] claimed that numerous flagella were present on Novy's organism. Breinl and Kinghorn [12] found that a monkey and several rats immunized against the American spirochæta (supposed to be identical with *Sp. obermeieri*) remained susceptible to the African species. They were also able to infect a horse, dogs, rabbits, guinea pigs and other animals with the tick-fever parasite. They therefore concluded that the two varieties, American and African relapsing fever, are distinct. In 1896 and 1897 Gabritschewsky [13] and Loeventhal [14] suggested and employed the serum for diagnostic purposes in cases of relapsing fever, observing its bactericidal and agglutinative reaction under the microscope. Later Karlinski,[15] Routkewitsch,[16] Mielkich [17] and particularly Hodlmoser [18] also employed this method for diagnostic purposes, though not always with satisfactory results. In 1906 Novy and Knapp proposed to differentiate the different species of spirochætæ by serum reactions, specific agglutinins and bacteriolysins, as well as by animal inoculations. Uhlenhuth and Haendel [10] and Fränkel,[19] during the past year, and very recently Manteufel,[20] by means of animal inoculations as well as by agglutinative and bacteriolytic reactions, have found that different results are obtained with the European, African and American spirochætæ, and they regard them as three distinct species.

I have emphasized elsewhere [21] the difficulties encountered in performing agglutinative and bacteriolytic tests with the spirochætæ of this group and the frequency with which pseudo-reactions occur. By far the most accurate method of differentiation of these species of spirochætæ is by the inoculation, with the strain of the spirochæta to be

[9] *Ztschr. f. Hyg. u. Infectionskrankh.* (1906), **52,** 539.

[10] *Arb. a. d. k. Gsndtsamte* (1907), **26,** Heft I, 1.

[11] *Hyg. Rundschau* (1907) **17,** 263.

[12] *Lancet* (1906), **1,** 1690; *Mem. Liv. School Trop. Med.* (1906), **20,** 61, 69, and **21,** 1.

[13] *Ann. Inst. Past.* (1896), **10,** 630.

[14] *Deutsche med. Wchnsch.* (1897), **23,** 560.

[15] *Wien. klin. Wchnsch.* (1903), **16,** 447; *Centrbl. f. Bakt.*, etc. (1902), abt. 1, **31,** 566.

[16] *Baumg. Jahresb.* (1898), **14,** 613.

[17] *Baumg. Jahresb.* (1900), **16,** 434.

[18] *Wien. med. Wchnsch.* (1904), **54,** 2310; *Zeitschr. f. Heilh. Abt. Interne Med.* 1905 new series **6,** 506.

[19] *Berl. klin. Wchnsch.* (1907), **44,** 681.

[20] *Arb. a. d. k. Gsndhtsamte* (1907), **27,** Hefte II., 327.

[21] *This Journ. Sec. B.* (1908), **3,** 231.

tested, of an animal which has already been rendered thoroughly immune to the strain of spirochæta supposedly different. Schellack [22] has recently described the morphological differences in the European, American and African spirochætæ of the recurring fevers but Leishman [23] could not make any distinction between them from a morphological standpoint. Kolle and Schatiloff [24] have reported upon the use of the complement fixation reaction with human immune serum, from cases convalescent from relapsing fever, for the purpose of the differentiation of the different species.

The question then suggested itself whether the form of Indian relapsing fever, known as Bombay spirillum fever constituted another disease, or one which was caused by one of those species of spirochætæ already recognized and described. This fever has been known to be very common in India since 1852 and was carefully described by Van Dyke Carter in 1877.[25] The important descriptions which have been previously published upon the relation which this fever bears to the European relapsing fever are those of Novy and Knapp [26] and of Mackie [27] of Bombay. Novy and Knapp, after a study of several blood smears sent them by Patton from Bombay, concluded from several very minor differences in morphology, such as slight variations in thickness (the American spirillum appearing thicker), and a tendency of the Indian spirillum to form loops, particularly in agglutination, and to show multiple transverse division, that perhaps the Indian strain constituted a new species, different from the American one. Novy and Knapp admitted, however, that there might be some question about the Indian variety of spirochæta representing a distinct species and in the absence of fresh material they were unable to settle the question. They stated that several division zones like those of the Bombay organism, and like those present in *Spirochæta Duttonni,* are not found in the American species of spirochæta. However, Oppenheimer [28] found these same phenomena in the American species. She concludes that—

"1. The New York *Spirochæta Obermeieri* can not yet, as has been attempted, be separated from the African spirochæta, upon the following grounds: (1) The length of its stay in the peripheral blood of the rat, (2) the number of relapses in the rat, (3) the lack of figure-8 and circular forms, (4) the absence of several transverse breaks; for the length of stay in the peripheral blood probably varies with the method of passage, relapses are an uncertain quantity since it is perhaps not positively established that they occur at all; figure-8 forms and circles and finally several division zones exist in the New York spirillum as well as in *Sp. Duttoni* and in the spirillum of Bombay."

[22] *Arb. a. d. k. Gsndtsamte* (1907), 27 Heft II., 364.
[23] *Lancet* (1907), 1, 806.
[24] *Deutsche med. Wchnsch.* (1908), 34, 1176.
[25] *Med. Chir. Trans.* (1877), 41, 274.
[26] *Loc. cit.*
[27] *Lancet* (1907), 2, 832.
[28] *Collected Studies Research Lab., Dept. Health,* N. Y. (1906), 2, 146.

The published description of Mackie, who had plenty of material at his disposal for study, also does not lend support to the morphological differences which Novy described for the Indian spirochæta. Mackie found the American spirochæta thinner than the Asiatic one. Novy, moreover, conjectured that the Indian species possessed diffuse flagella, while Mackie describes the appearance of only a single flagellum in the Indian species, which, however, he regards as a collapsed sheath rather than a true flagellum. Mackie performed some agglutinating experiments with an agglutinating serum prepared against the American spirochæta and sent him by Novy. However, the serum failed to agglutinate the Bombay spirochæta. Whether this was due to the fact that the serum had lost its agglutinating properties after leaving Novy's laboratory, or that a more specific complement might have been necessary than that supplied by the Bombay rat, or to the fact that the Bombay spirochæta was of a different variety, Mackie could not state. I have already called attention to the uncertainty in obtaining the agglutination test with these spirochætæ. In a later article [29] Mackie has summarized the evidence he was able to collect from the literature and made a comparison of all the strains.

I therefore determined to try to throw further light upon the question of the nature of Bombay spirillum fever. The various strains of spirochætæ—African, American and European—were collected during my travels in the different countries. I desire to thank Professors Prowazek of Hamburg, Flexner of New York, and Dryer of Egypt for supplying me from their respective laboratories with strains of these organisms. As most of you are aware, these spirochætæ can only be kept alive successfully in the animal body and can not be cultivated in the test tube on artificial media.[30] White mice are the only animals satisfactorily susceptible to all of the species. It was therefore necessary, in order to carry out this work, to travel with a plentiful supply of these animals as well as with a supply of white rats. Moreover, in order to be sure not to lose any of the strains, it was found necessary to inoculate with each strain a fresh mouse with the infected blood of another animal every third or fourth day. There were some difficulties encountered in carrying out these successive inoculations while traveling from continent to continent during a period of four months. In passing, it may be of interest to remark that in Egypt I was able to find and identify several cases of relapsing fever which were caused by the European variety of spirochætæ, as well as a case of African tick fever caused by the *Spirochæta Duttoni*.

[29] *N. Y. Med. Jour.* (1908), 88, 337.

[30] The collodion sac method of cultivation in the abdominal cavity of an animal, as descibed by Levaditi and subsequently by Novy and Knapp, is too uncertain to be always relied upon.

When I finally reached Bombay with my animals, I was unable to find any cases of relapsing fever there. Only just before my departure from that city several cases occurred in the Hospital for Infectious Diseases, presided over by Doctor Choksy. However, these cases were evidently in a stage of relapse and their blood was of no value for experimental purposes. As my supply of white mice was by this time exhausted, my experiments in relation to the Indian form of relapsing fever would have failed but for the timely assistance of Captain Mackie of the Indian Medical Service of Bombay. Fortunately I had secured in Egypt through the kindness of Dr. Keatinge, director of the Cairo School of Medicine, some white rats which, during the voyage to India, I had immunized against the different spirochætæ. At my request, Captain Mackie kindly consented, when a fresh case of the Indian disease should occur, to attempt to infect with the Indian spirillum my rats which had been immunized separately against the African (Koch and Dutton strains), European and American strains of spirochætæ. Each animal had been highly immunized with one of these strains by repeated injections of blood containing the spirochæta in question and the animals were no longer capable of being infected with the respective organisms. Captain Mackie was unable to obtain suitable blood containing the Indian species of spirochæta until forty-eight days after my last injection of the rats with the spirochætæ, at this time, however, the attempt was made to infect them. As immunity in such animals has been shown to persist for many months by Novy, Manteufel and myself, they were evidently still immune to the strain with which they had been previously inoculated at the time the attempt to reinfect them was carried out by Doctor Mackie. The rats were all inoculated with about 0.4 cubic centimeter of pure blood in citrate solution. The blood at the time of the inoculation contained numerous actively motile spirochætæ. All of the injections were made intraperitoneally. Control, normal rats were also inoculated at the same time. Twenty-four hours after the injections were made a microscopic examination of the blood of the animals showed that no spirochætæ were present in those immunized with the American and with the European strains, but that spirochætæ were present in the blood of all those animals immunized against the African strains as well as in the blood of the control normal animals. Forty-eight hours after infection the spirochætæ were still present in the blood of one of the animals immunized against the African species, and, as might be expected, in one of the control, normal animals; in all of the others the spirochætæ had disappeared. An examination seventy-two hours after infection showed the blood of all the animals negative for parasites and the organisms did not appear or reappear again in any, as was evidenced by repeated careful examinations. I take this opportunity publicly to thank Captain Mackie for kindly carrying out these inoculations. The details of the experiments are as follows:

EXPERIMENTS ON IMMUNIZED RATS REINOCULATED WITH "SPIRILLUM CARTERI" OF INDIAN RELAPSING FEVER.

Rat No. 1, immunized against Koch's African spirochæta.
Rat No. 2, immunized against American spirochæta.
Rat No. 3. immunized against European spirochæta.
Rat No. 4, immunized against Dutton's African spirochæta.
Mouse No. 5, immunized against Koch's African spirochæta.
Rat No. 6, nonimmune (*Mus Rattus*, Bombay).
Rat No. 7, nonimmune (*Mus Rattus*, Bombay).
Monkey, nonimmune (*Macacus Sinicus*).

The material with which the animals were inoculated was obtained from a monkey (*Macacus Sinicus*), No. 85, whose blood contained many active spirilla and which was at the height or just before the height of the attack (thirty-six hours before crisis). An equal quantity (about 0.4 cubic centimeter of pure blood) of this citrated blood was injected into animals Nos. 1, 2, 3, and 4. No. 5 received 0.25 cubic centimeter pure blood. Nos. 6 and 7 received 0.35 and 0.4, respectively, of pure blood. All the injections were made intraperitoneally.

Results (twenty-four hours after injection):
Rat No. 1, 3 spirilla found in twenty minutes' search.
Rat No. 2, none seen in forty minutes' search.
Rat No. 3, none seen in thirty minutes' search.
Rat No. 4, 4 spirilla seen in twenty minutes' search.
Mouse No. 5, 25 seen in five minutes' search.
Rat No. 6 (first control), 6 spirilla seen in fifteen minutes' search.
Rat No. 7 (second control), 7 spirilla seen in five minutes' search.
Monkey, no spirilla seen.

Results (forty-eight hours after injection):
Rat No. 1, none in twenty minutes' search.
Rat No. 2, none in fifteen minutes' search.
Rat No. 3, none in fifteen minutes' search.
Rat No. 4, none in ten minutes' search.
Mouse No. 5, 25 seen in ten minutes' search.
Rat No. 6, none in ten minutes' search.
Rat No. 7, 8 seen in fifteen minutes' search.
Monkey, 1 spirillum seen to a field.

Results (seventy-two hours after injection):
Blood of rodents all negative after ten, fifteen, or twenty minutes' search.
Monkey, 3 or 4 spirilla seen to a field. Animal went through a typical attack of the disease.
On the two subsequent days no spirilla were found in any of the rodents, and no spirilla have since reappeared.

These experiments seem to show that Bombay spirillum fever is distinct from African tick fever, but that it constitutes a form of relapsing fever very closely related, if not identical, with the forms of relapsing fever encountered in Europe and the United States. If anyone wishes to repeat these experiments I must warn him that he will be unable to obtain any white mice after leaving Europe. Neither in the laboratories of Africa nor of India was I able to obtain these animals.

Finally, from a consideration of the work performed by other investigators and from my own experiments, carried on with all these different strains of spirochætæ, including a study of the morphological characteristics, serum reactions, and animal inoculations, it appears to me that the African and European strains of spirochætæ are distinct species. However, it does not yet seem clearly demonstrated that the American and Indian strains are distinct from the European; if not identical, these strains must certainly be very closely related to one another.

DIET AND NUTRITION OF THE FILIPINO PEOPLE.[1]

By Hans Aron.

(*From the Department of Physiology, Philippine Medical School, Manila, P. I.*)

A study of the food and nutrition of a people is of great importance, both from a hygienic standpoint and from that of the intelligent practice of medicine. On the one hand, a large number of those microörganisms which we recognize as the cause of different diseases are introduced into the human body with the food. On the other hand, the quality and quantity of the food consumed is the fundamental factor in the maintenance of a normal and healthy condition of the body. It is the latter phase of the question which will receive consideration in this paper.

The study of the nutrition of a tropical people has an especial scientific interest, because our knowledge of this subject is quite limited.

The first point to be considered is the nutritive value of the food measured by its content in proteins and fuel substances, such as carbohydrates and fats. From the fact that a great part of the ingested food is burned, in order to maintain the normal temperature of the body, it has been argued that the number of calories needed by the body in a hot climate is less than the quantity required by the same body in a cold climate. This statement has met with widespread acceptance and has even found its way into scientific papers. I believe it is possible to show that this is not in accordance with the facts.

There are two main factors which regulate the heat of the human body—the one is the production of heat by combustion of organic material; the other is the loss of heat which takes place, either by conduction or radiation of heat from the surface of the body or by evaporation of water from the lungs and skin. Of minor importance is the warmth of the ingested food or the inspired air. The lower the temperature of the atmosphere, the greater is the relative amount of heat lost by conduction and radiation. Above 36° to 37° C. no heat can be lost in this way, and only water evaporation can lower the body

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 12, 1909.

temperature. The whole heat regulation consists therefore of a balance between the production of heat by the chemical process of combustion (the chemical heat regulation) and the loss of heat by physical means (the physical heat regulation).

It has been known for a long time that in a cold climate there is an increased combustion of food stuffs, and an accelerated metabolism in general. This increase of combustion which corresponds to the burning of more coal in the furnace on a cold day, can be demostrated by estimating the amount of carbon-dioxide expired by an animal under the same conditions at different temperatures. Rubner obtained the following values in such an experiment on a guinea pig:

Temperature of air.	CO_2 in 1 hour, per kilogram of animal.
°C.	*Grams.*
11	2.15
21	1.77
26	1.54
30	1.32
35	1.27
40	1.45

While these results are unquestionably correct, it would be wrong to apply them to man for the following reason: A person living in an atmospheric temperature below 30° to 35° C., by suitable clothing protects the surface of the body against the loss of heat by conduction or radiation. Since air is a very bad conductor of heat, a layer of stationary air protects the body against loss of heat, even if the surrounding atmosphere has a lower temperature. Rubner has shown this very clearly by an experiment performed on a dog. The animal with its normal coat of hair was first kept at different temperatures and its heat production estimated, then it was shaved and the heat production again determined by the same method.

The heat production calculated per kilogram of body weight was as follows:

Temperature of air.	Dog with normal coat of hair.	Dog shaved.
°C.	*Calories.*	*Calories.*
20	55.9	82.3
25	54.2	61.2
30	56.2	52.0

This table shows that the dog with its normal coat of hair requires no additional food to maintain its normal body temperature when the atmospheric temperature is lowered from 30° to 20° C. A layer of fat has about the same protective influence as a layer of hair. This has been shown by an experiment similar to the one just described. These facts which have been demonstrated experimentally for the dog are even more strikingly true in the case of man. In civilized countries, man endeavors to render the chemical regulation of body temperature unnecessary by covering the skin with clothing, the cooler the climate, the thicker the clothes worn. Air is, moreover, the most efficient and important constituent of clothing. Fine furs are warm because they contain 98 per cent of air, which is a much poorer conductor of heat than fiber. Rubner has, furthermore, shown that a man feels comfortably warm only when the chemical regulation is completely eliminated: if this is not the case, he has a chilly feeling. Now it is clear that man in different climates will not require different quantities of fuel material to maintain his normal body temperature. As a matter of fact, by means of variations in the amount and the character of clothing, we live in all climates under about the same conditions with regard to our chemical heat regulation; and only under the supposition that we wore the light clothing of the tropics in cooler climates, would the hypothesis mentioned in the beginning of this discussion be correct. As Rubner has expressed it, man in the temperate zone is in a tropical climate as regards his heat regulation. Furthermore, we should not forget the importance of adipose tissue as a factor in heat regulation. I agree fully with Graham Lusk when he says "there can be no doubt that climatic conditions modify racial characteristics. The emigrant from northern Europe, living upon a farm in a hot and often moist climate of an American summer, must restrict his layer of adipose tissue if he is to live comfortably. The same holds true in Italy. On the contrary, the Eskimo cultivates a thick fat layer to protect himself from frost." In the Filipino there is, as a rule, an almost complete absence of the fat layer. These considerations and the conclusion that the demand for food of a civilized man in a temperate climate is not higher than in a tropical climate have been verified by the extended researches of Ejkman,[2] who has applied the method of Zuntz to determine the quantity of oxygen inspired and carbon-dioxide expired. He determined the consumption of oxygen per minute and found:

	Oxygen consumed per minute (cc.)
In Batavia, in Malays (average)	251.3[a]
In Batavia, in Europeans (average)	245.7[a]
In Europe (cold weather), in Europeans (average)	250.3[a]

[a] These figures are calculated for a body weight of 64 kilograms.

[2] *Arch. f. die gsmte. Physiol. des Mensch. u. d. Thiere.* (1896), 64, 57–78.

The best method of determining the diet of a people is to observe how much and what kind of food they consume when they choose their food according to their usual custom. It is well known that such researches were very carefully performed, first by C. v. Voit in Germany, and afterwards by many other investigators, especially by Atwater and his collaborators in America. This method is beset with great difficulties and there is the possibility of error, even if the subject is an intelligent individual. A second method consists in investigating the composition of rations dealt out to groups of individuals who have no choice as to their food, the quantity and quality of the food selected in this case being determined by the custom of the people.

By controlling the food given to soldiers, prisoners, patients in hospitals, and inmates of various other institutions, the normal diet of the average man can be determined. The following table shows the standard values of normal diets determined in this manner and for comparison those I have obtained for Filipino prisoners in Bilibid Prison in Manila.

Table I.

	Protein.	Fat.	Carbohydrates.	Calories.
	Grams.	*Grams.*	*Grams.*	
For a man performing medium work (according to Voit)	118	56	500	3,055
For a man performing medium work (according to Atwater)	125	Not fixed.		3,400
German prisoners (average)	107	26	550	2,959
Filipino prisoners	75	27	510	2,647

Through the courtesy of Mr. Wolfe, Director of Prisons, I have obtained an accurate list of the food-stuffs purchased for a hundred Asiatic and Filipino prisoners for the different days of the week. I have calculated, according to the average composition of the same food-stuffs as given in standard works, the content in protein, fat, and carbohydrate of this diet where there was no reason to assume a variation from this average. In other instances, where the products, such as bread, fish, and native plants, are peculiar to the Philippines, I have made some determinations myself. I am all the more inclined to believe that this method gives sufficiently accurate average values, because the composition of the food-stuffs purchased in the different months also varies; therefore it may even be more exact to regard *average* values for the composition of the food than the values found in one or two samples determined from the food-stuffs directly. The values calculated as described above are given in the accompanying table, the rations being arranged according to their protein content.

TABLE II.

	Protein.	Fat.	Carbo-hydrates.	Total calories.
	Grams.	*Grams.*	*Grams.*	
Sunday	50	47	463	2,315
Monday	60	28	521	2,640
Saturday	69	46	504	2,773
Tuesday or Friday	74	19	465	2,385
Thursday	82	18	533	2,686
Tuesday	84	23	458	2,436
Friday	89	18	571	2,872
Wednesday	96	21	572	2,934
Average	75	27	510	2,646

We see that the food given daily contains on an average about 75 grams protein, this protein content varying from about 50 to 96 grams. The caloric value of the food is about 2,650 calories and varies between 2,315 and 2,934 calories. In Table III is given the composition of the food considered from a physiological standpoint.

TABLE III.

Each prisoner receives daily:

270 grams rice 45 grams sugar 300 grams bread about 250 grams camotes or potatoes 50 to 100 grams onions	Representing about 45 grams protein and 2,100 calories.

In addition the following articles are given to each prisoner on the different days:

Sunday:	70 grams bacon,
Monday:	90 grams pork,
Saturday:	45 grams bacon and 90 grams beef,
Tuesday or Friday:	75 grams salmon, or 115 grams fresh fish,
Thursday:	100 grams corned beef and 45 grams mongo,
Tuesday:	115 grams beef and 90 grams dry fish,
Friday:	150 grams salmon and 90 grams mongo,
Wednesday:	115 grams beef and 150 grams mongo,
Daily:	3 grams tea, 5 grams coffee, 6 grams ginger root.

We see that for every day of the week, a vegetable diet, consisting of rice, sugar, bread, potatoes, and onions constitutes by far the greater portion of the nutriment furnished. This food alone, which is about the same for the different days, furnishes more than four-fifths of the calories of the entire food ingested and a great deal of the protein. In addition to this vegetable diet, the people receive some animal food-stuffs, which show variations on the different days both in regard to their protein content and in their caloric value. For this reason the variations noted in the first table occur. We see from Table III that on certain days of the week, beside the animal food, a native vegetable called *mongo* is issued as food. This vegetable, according to our analysis, is very rich in nitrogen. A very small amount of stimulants, tea, coffee or ginger root, is also given to the prisoners.

If we would compare these data with the standards given above for Europeans, we must consider that the Filipino is of considerably smaller stature than the European. While the latter has an average weight of 65 kilos, the Filipino weighs only about 50 to 55 kilos. This means that the standard value of protein determined for Europeans or Americans would have to be reduced by about 20 per cent when applied to Filipinos. The caloric requirements of a living body depend not upon its weight, but upon the extent of its surface. Now approximately the surface decreases only with the second power, while the weight decreases with the third power; in addition, I believe we should also consider that the Filipinos are thinner and taller than the European of the same weight. These considerations render it probable that the requirements in calories for Filipinos may be only about 10 per cent less than those of the European standard. If we now compare the Filipino food with that given to a European under similar conditions, we find that the caloric value of the prisoners' food corresponds to that of a workman in Europe or America, performing moderately hard labor, and also to the caloric value given in the average German prison. We have here a practical confirmation of the introductory theoretical remarks concerning the amount of calories required in the Tropics. The protein content of the food seems, even if we make a reduction of 20 per cent from the standard values, somewhat lower than that of the average European diet. Our ideas in regard to the amount of protein required by a healthy individual have recently undergone considerable changes. After Voit had given his standards for protein, some investigators showed that many people do not ingest the quantity this investigator thought necessary. At the same time the physiological question concerning the minimum quantity of protein upon which a man is able to live has been extensively investigated. It is a fact that much less protein in the food than was determined by Voit is sufficient to maintain life and health, and the values given as necessary by Chittenden, who has done the most extensive work in this direction, are considerably lower than the protein intake of the Filipinos. Therefore, even if we regard the protein quantity of the Filipino food as low, nevertheless, it is certainly sufficient. People living on an almost pure vegetable diet always take a smaller amount of protein than do meat eaters. The quantity of protein, for instance, taken by the lower caste Bengalese in India, according to a recent research by McCay from the Medical College in Calcutta,[3] is only 30 to 40 grams. I believe that this fact depends on the wholly vegetable diet partaken of and not upon the tropical climate. One often finds in the literature the statement that the amount of protein needed in the tropics is lower than that required in a temperate climate; furthermore, because the natives eat much less protein, it is assumed that it would be unhealthful for a European to take the same amount of protein as at home. I have attempted to show that this doctrine is incorrect.

The next question to be answered is whether or not the rations issued at Bilibid Prison are a fair sample of an average Filipino diet. As already mentioned, it is very hard to answer such a question accurately, even when dealing with educated people. Therefore we will have to be content with roughly approximate values. Our most reliable method is to study the protein metabolism. The nitrogen in the urine is a measure of the protein bodies burned by the subject and if we choose for the experiment an adult man, who does his usual work, and eats his accustomed food, we can with great probability assume that the nitrogen of the protein of his food, so far as the protein is digestible, appears in the urine.[4] My student-assistant, Mr. Santós, and myself have examined the total nitrogen excreted in twenty-four hours in at least three different samples of urine from our Filipino laboratory servants. In the examinations made up to this time, we have never obtained less than 10 grams of nitrogen in twenty-four hours, and usually we have found about 12 grams, which corresponds to about 70 to 75 grams of absorbed protein. Some nitrogen determinations which were prepared on the urines of Filipino students showed a nitrogen content of about 12 to 15 grams, corresponding to from 70 to 100 grams protein. The results of these examinations warrant the statement that the quantity of protein found on an average in the prisoners' food corresponds to the protein intake of the average Filipino workman.

Concerning the estimation of the caloric value of the food of the people, we are forced to apply a rougher method. The Filipino is accustomed to take his food, together with others, from the same dishes and is hence unable to state with accuracy the quantity of food that he individually consumes. We know that the Filipino lives principally on rice and fish, some vegetables and fruits, and very seldom eats meat for the reason that it is not always, for him, obtainable. According to observations on my house servants and from information obtained by questioning my students, I have found that the amount taken is from 650 to 700 grams of rice per day and about 200 to 250 grams of fish.

[3] *Sci. Mem. Off. Med. San. Dept. India*, Calcutta, (1908) 34, 1.

[4] A part of the nitrogen is excreted in the sweat.

Such an amount of rice may be purchased for 10 centavos and the fish for 7 centavos. Such a ration would furnish about 70 to 75 grams protein, 10 grams fat and 525 grams of carbohydrates. The caloric value and also the protein value of the vegetables and fruit eaten occasionally may be neglected in such a rough calculation as this. The ration just given, of 70 to 75 grams protein, 10 grams fat, and 525 grams carbohydrates, corresponds very well in its composition and in its caloric value of 2,500 to 2,600 calories with the food issued in Bilibid.

I would like to direct your attention to still another point. Not all Filipinos, especially in the provinces and even in towns, are able to purchase regularly such a quantity of fish as I have mentioned. What would be the result if a man should omit the fish and live entirely on rice, fruits and vegetables? With the fish only a small amount of calories are ingested, chiefly proteins. The caloric value of 250 grams fish would be replaced by 60 grams rice, containing only 4 grams protein, so that the man eating only rice receives with about 2,600 calories only 50 grams protein at the most. If he wished to take the quantity of protein contained in the mixed food, in the form of rice he would have to take an immense excess of carbohydrates. This may account for the idea that rice is heating, a statement made to me by a Spanish-Filipino physician. Furthermore, vegetable proteins are not so completely digestible as animal proteins, 85 to 90 per cent of the former being digested as compared with 96 per cent of the latter.

One other point must not be forgotten. The recent researches on the chemistry of protein bodies on the one hand, and the biological reaction on the other hand, show that the question as to what constituents make up the albuminous substances may be of great importance for their value in nutrition. While it is certain that a man may continue in good health for a long time on a carefully selected purely vegetable diet, nevertheless we see that it is very often impossible to properly nourish young animals exclusively on one kind of vegetable protein. I have made such experiments on rabbits fed with corn. This has been attributed to a want of certain constitutents in vegetable proteins. Finally, I will remind you that wherever the people live exclusively on one single kind of vegetable protein, we find the appearance of certain diseases which probably have some connection with this food. I am thinking of the association of beriberi and rice, of corn and pellagra, and perhaps of the so-called scurvy of sailing vessels. I have by no means exhausted my theme, since there are many other interesting problems concerning the diet and nutrition of the Filipino people, some of which I hope to solve during my stay in these Islands.

POISONOUS SNAKES OF THE PHILIPPINE ISLANDS.[1]

By Lawrence E. Griffin.

(From the Biological Laboratory, Bureau of Science, Manila, P. I.)

Nearly seventy species of snakes have been described as occurring in the Philippine Islands, of which thirty species, at least, are poisonous. In view of the large number of species known, it is a matter of some surprise that snakes are so seldom encountered by those whose business leads them into the forest or through the high grass; in fact, the majority of people seem to believe that very few snakes exist here. The finding of two new species in the small collection of the Biological Laboratory, Bureau of Science, leads me to believe that when our Philippine snakes have been carefully collected and studied, a considerable number of species will be added to the herpetological fauna of the Islands.[2] As the technical description of these two snakes is uninteresting and is to appear in Section A of the Journal,[3] I beg your permission to digress from this subject to that of Philippine poisonous snakes in general.

Of most general interest is the snake known as the rice-snake, or "*dahun-palay*" (*Dryophis prasinus*), of which the natives stand in such fear. An extremely slender snake, generally bright green in color, it is supposed to live among the rice stalks. As a matter of fact, while it may be found occasionally in the rice, it is really a tree snake, living often in the tops of the coconuts, or branches of forest trees. Its bite is supposed to be fatal, death ensuing in from fifteen minutes to half an hour. Many natives believe that the leaves wither upon which its breath has fallen. While undoubtedly poisonous, this snake is one of those in which the fangs are at the back end of the maxilla, so far back that the snake would have to stretch its mouth tremendously to bite an object the size of a man's leg. Information as to deaths proven to have been caused by the bite of this snake will be appreciated.[4]

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 13, 1909.

[2] Since reading this paper, there have been found in collections of snakes from Palawan, P. I., alone, four new species, and three species not hitherto recorded from the Philippines.

[3] *This Journal, Sec. A* (1909), 4, 55.

[4] The Director of Health has kindly sent me a copy of a letter relating to two deaths from snake bite, supposed to have been caused by the *Dahun-palay*. In neither instance was the snake seen, while the nature and place of the attacks leaves the possibility open that cobras were responsible for both deaths.

The question is often asked, "are there any cobras in the Philippines?" We have three species of cobras in our collection. First, the hooded cobra, the cobra de capella, *Naja naja*, one fully grown female specimen of which has been caught within 4 miles of Manila. There seems to be good reason to believe that cobras are much more plentiful in the Islands than is supposed, and that many of the deaths from snake bite are to be laid to them. A nearly black variety, which may prove to be a distinct species, is found in Palawan. Secondly, a large specimen of the king cobra, *Naja bungarus*, measuring more than 8 feet in length was caught in Benguet, and is now in the collection of the Bureau of Science. In spite of its size and venom, this species probably lives to our benefit rather than harm, for it is said to feed on nothing but other snakes. Finally, in Samar, Leyte, and in Mindanao, is a species of cobra found only in the Philippines, *Naja samarensis*. If, as I believe, certain reports of a snake in Samar, which have come to me lately, refer to this species, it is as active a pest as its relative in India.

Probably the most vicious appearing snake in the Philippines is the bamboo snake, *Trimeresurus gramineus*. This snake is found in clumps of bamboo, or hanging from the limbs of trees by its short prehensile tail. The general color of the body is bright green, while the tail is red. It is armed with fangs four times as large in proportion to its size as those of the cobra, though it is doubtful if its venom is as deadly as that of the cobra. This snake is fairly common, and widely distributed. In the southern Islands there are found at least three more species of the same genus. In China this species is considered very dangerous on account of its habit of hanging suspended by its tail from branches, and striking when disturbed.

The other poisonous land snakes of the Islands are mostly of small size. A few species are greatly feared, but most of them are too small to do much damage to human beings. The snakes of the genus *Doliophis* are interesting because of the enormous development of the poison glands, which occupy a third the length of the body, and which, by their extension backward, have crowded the heart some distance posterior to its usual position. There is on the part of the Filipinos a great deal of fear and superstition regarding another snake, the tiny *Typhlops braminus*, which, when full grown, is no larger than a small earthworm. It is found very often in termite nests, without regard to whether or not these are occupied. The most usual native superstition regarding this snake is that if it bites a carabao the latter will die immediately. Inasmuch as the mouth of the *Typhlops* would scarcely admit a single hair of the carabao, and microscopic teeth are borne only by the maxilla, one is at a loss to find the basis for this superstitious belief.

REVIEWS.

A Text-Book of General Bacteriology. By Edwin O. Jordan, Ph. D. Pp. 557. Price $3.00 net. Philadelphia and London: W. B. Saunders Company, 1908.

Professor Jordan in his General Bacteriology has not only presented much of his material from new points of view, but he has arranged it to the best advantage. This is especially true of his treatment of the very important group of colon-typhoid organisms. The chapter on immunity is short but it includes the essential points and these are given in a clear, concise manner. The illustrations are exceptionally good and add much to the value of the book. The language is clear and the subject-matter is treated in an easy, attractive style. It would seem that the field of protozoölogy has assumed such proportions that it should be considered in a separate book and not in such a work on bacteriology, since it forms no true part of this subject. However, Professor Jordan's chapter on the protozoa does not detract from the value of the book. The closing chapters upon the higher organisms, the bacteriology of milk and milk products, the nitrogen cycle, etc., serve to enhance its value as a text-book. The author has stated facts as facts and where differences of opinion prevail has given both sides impartially, yet he does not hesitate to express his own opinions. The bibliography is not extensive but is ample, and includes the most recent and most important references. In my opinion it is the best text-book in English on bacteriology and it will be used in the Philippine Medical School.

The topography and general make-up of the book are in keeping with its contents, and both author and publisher are to be congratulated on the result of their work. The book will be valuable not only to the student of medicine but to the general practitioner and to the advanced bacteriologist.

V. L. Andrews.

Diseases of the Skin and the Eruptive Fevers. By Jay Frank Schamberg, A. B., M. D. Pp. 534. Price $3.00 net. Philadelphia and London: W. B. Saunders Company, 1908.

Doctor Schamberg devotes 380 pages of this volume to diseases of the skin and the rest of his space to the eruptive fevers. While the discussion of the various skin diseases is necessarily brief, it is clear and practical. The discussion of the eruptive fevers is confined mainly to the skin manifestations of these diseases. Yaws is given one page, while syphilis is given twenty-seven pages. *Treponema pallidula* is not mentioned in connection with yaws, though *T. pallida* is given as the probable cause of syphilis. It is not believed that the simple statement that mild cases of yaws "yield readily to mild parasiticides," and that tonics are required for the severe cases, fairly states the requirements or the present practice in the treatment of the disease. Oriental sore is not mentioned. Blastomycosis cutis is described twice. The articles on actinotherapy and radiotherapy, radium, and serum eruptions are concise and to the point.

The numerous illustrations are excellent. The book will be a welcome addition to the library of the general practitioner.

E. R. WHITMORE.

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(Now Section of Ornithology.)

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57. *1905, Bulletin No. 4.*—A Preliminary Reconnoissance of the Mancayan-Suyoc Mineral Region, Lepanto, P. I. A. J. Eveland, Geologist.
58. *1905, Bulletin No. 5.*—The Coal Deposits of Batan Island. Warren D. Smith, B. S., M. A., Geologist.

Division of Mines.

301. *1908.*—The Mineral Resources of the Philippine Islands, with a Statement of the Production of Commercial Mineral Products during the year 1907, issued by Warren D. Smith, Chief of the Division of Mines.

Ethnological Survey.

(Now Division of Ethnology.)

401. *Vol. I, 1905.*—The Bontoc Igorot, by Albert Ernest Jenks. Paper, ₱2; half morocco, ₱3.
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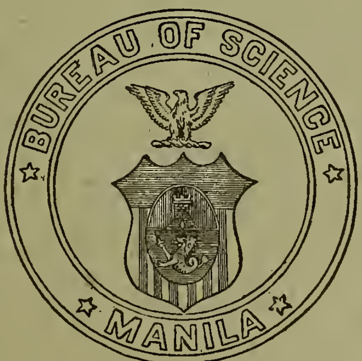

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B. MEDICAL SCIENCES

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MEDICAL SURVEY OF THE TOWN OF TAYTAY.

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MEDICAL SURVEY OF THE TOWN OF TAYTAY.

I. INTRODUCTION.

By Richard P. Strong.

(From the Biological Laboratory, Bureau of Science, Manila, P. I.)

It has been the policy of the Biological Laboratory for several years past to send men to various provinces outside of Manila when opportunity presented itself, for the study of disease. During the present year, it was suggested by Doctor Garrison, United States Navy, medical zoölogist of the Laboratory, that a group of advanced students from the Philippine Medical School be selected and taken by him during their vacation of several months to some provincial town where a dispensary could be established and a study made of the diseases affecting the inhabitants. It was the intention not only to provide the students with practical training in medical zoölogical work, but at the same time to examine the inhabitants of the town, particularly with reference to the parasitic diseases with which they were affected. After consultation with the Director of the Bureau of Science and the Chief of the Biological Laboratory, it was decided to organize a more extensive expedition for the purpose of carrying on a complete medical survey of the inhabitants of such a town. A short time after this, the Director of Health requested assistance from the Biological Laboratory in carrying on a campaign in a provincial town for the purpose of examining and treating the natives for infection with intestinal worms, with the special purpose of determining the importance of hookworm infections in relation to the public health. As the extent and the nature of hookworm infections in the Islands was one of the questions which the expedition from the Bureau of Science had already planned to investigate, it was agreed that the Bureau of Health should join in the work of this survey.

The object of the expedition as finally planned was to make a complete study of a native town in the Philippine Islands under normal conditions. The investigations were performed by members of the staff of the Bureau of Science and of the Philippine Medical School, by three of the students of the school, and by Doctor Clements of the Bureau of

Health. The laboratory work extended over a period of three months, March, April and May of the present year.

The town of Taytay (Plate VIII, fig. 1, and Plate IX, fig. 2), which is situated on the eastern border of the Mariquina Valley, Province of Rizal, Luzon, was chosen because of its size (it has a population of about 6,000); and because in the past it has suffered severely from smallpox and from several epidemics of cholera, and has had a bad reputation from a sanitary standpoint. If a larger town had been chosen, it obviously would have been impracticable to have made as careful a study of the inhabitants as was planned.

It was the intention during the survey not only to observe how much sickness there was present and the nature of such sickness, but to examine into the character of the population, the conditions under which the people lived, the food which they ate, the water which they drank, and the diseases to which they were liable to be exposed. Following out this idea, a geological study has been made of the contour and formation of the country, the water supply has been examined and a chemical and bacteriological study performed of the well waters of the town used for drinking purposes; a botanical examination of the vegetable food stuffs and a general one of all material offered for sale in the markets have been carried out. The cost and quality of the food and the nutritive value of the diet of the people, from a physiological standpoint, have been studied. An entomological investigation of the mosquitoes and other insects of interest from a medical point of view has been accomplished. As regards the inhabitants, anthropometric measurements were performed, and in the case of those who visited the station, and particularly in those who were found at all sick or abnormal, a medical history was taken and a physical examination performed; the blood, fæces and sputum were examined microscopically, and, in many cases where the nature of the complaint warranted, serum reactions, differential blood counts, and examinations of the urine were made. The Bureau of Health in addition, through its representative, Doctor Clements, made a study of the general sanitary conditions under which the people lived, and a study of the vital statistics of the town. A dispensary was established at which all of the cases were treated and furnished with medicine free of charge. Various maps of the town were prepared and a census was taken.

Laboratory investigations.—The helminthological work and the general laboratory investigations of the expedition carried out at Taytay were placed under the direction of Doctor Garrison, and it is largely to his efforts and to those of Doctor Nichols of the United States Army and of Doctor Clements of the Bureau of Health, that the success of this portion of the work is due. A suitable nipa house near the center of the town was rented, and in this was established a station comprising the laboratory, a clinic and a dispensary. (See Plate VII.) An adjoining house was rented also, in which the members comprising the expedition lived. The people throughout the town were invited to visit this station, first, as a place of curiosity for those who were well, where they could see laboratory apparatus, observe their own blood under the microscope, etc.; and second, as a place which offered to those who were sick an opportunity of being cured and of obtaining medicine free of charge. The plan of work at the clinic and laboratory was outlined as follows: To each individual who presented himself a ticket bearing his name was given; and a number, together with the name, sex, age, occupation and residence of the individual, was placed upon a clinical record card. A separate alphabetical index of names was kept in order to avoid error if a ticket were lost. Each person was then supplied with a test tube or bottle in which he was instructed to bring a specimen of his fæces on the following day. As many as could be examined were then passed to another room where they were subjected to a physical examination. A hæmoglobin estimate and an examination for malarial or other parasites was then made of the blood. The results of the examinations were then entered on the clinical card. In addition, separate records were kept of all laboratory examinations. If an individual proved of any particular interest from a medical standpoint, he was detained for further examination; otherwise he was discharged, or, if sick, was sent with his clinical card to the dispensary where his ailment was prescribed for and where he was given special instructions regarding treatment or regarding his return to the clinic and the bringing of specimens of fæces, sputum, or urine. In addition to the treatment of patients at this daily clinic, those who were unable to attend were visited in their homes, all the records of these cases being kept likewise. The time from 4 o'clock until dark was devoted usually by the members of the expedition to the mapping of the town and to making a census of the population. In the course of this work, the entire town was covered by a house-to-house inspection, the name, sex, and age of each inhabitant together with the surrounding conditions under which he lived, being entered upon a separate card for each house. The members of the expedition were able by means of this census to locate cases of serious or interesting diseases which otherwise might not have come to their attention. In some cases a person afflicted with a disease was able to direct the members of the expedition to other persons similarly afflicted, thus assisting in the discovery of all cases of disease in the town. This was particularly true in regard to goitre and yaws, diseases which the people could recognize easily.

The results of these investigations have all been collected and published together in the present number of the JOURNAL, with the exception of those carried on by Doctor Bean on racial anatomy at Taytay; these studies are not yet entirely completed and will appear later in Section A, General Science, Vol. IV, No. 5, of this JOURNAL, during the present year.

While the various divisions of the work were systematically distributed among the members of the expedition, each giving his special attention to the work to which he was assigned, nevertheless considerable of the work was carried on by all the members of the expedition together; as, for example, the mapping of the town and the preparation of the census. Hence, while the individual reports have been written by those members of the expedition who performed the greatest relative amount of work upon the subject, nevertheless it should be understood that much of the work of the expedition was carried out by all of its resident members working together.

Special bacteriological examinations, such as of the waters of the town and of fæces for cholera vibrios, were performed at the Biological Laboratory in Manila where these specimens were sent daily by messenger.

In perusing the individual reports, it must be considered that in determining the incidence of certain diseases the members of the expedition relied solely upon the attendance of the individuals at the clinic; while in determining the incidence of the others, practically the entire population of the town was canvassed carefully. Therefore, the results obtained in relation to each disease must be carefully interpreted if they are to be used as an expression of the prevalence of such disease in the general population; obviously the same basis can not be used in computing the percentages for all diseases among the Filipino population throughout the Island of Luzon.

In the preparation of the reports upon the laboratory work performed at Taytay and the study of disease there, the subjects were considered and discussed jointly by Doctors Garrison, Nichols and Clements, and have been prepared for publication by these gentlemen, Doctor Teague and the writer.

This expedition is probably one of the most extensive of its kind that has ever been carried out and is certainly the most extensive medical survey that has ever been undertaken in the Philippine Islands. Its accomplishment was largely made possible through the efforts of Doctor Freer, Director of the Bureau, who, before his departure on his vacation early in April, did much to organize, arouse interest in and to stimulate the work of the expedition. The special reports of the members of the survey follow.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

II. GEOLOGY AND WATER SUPPLY.

By George I. Adams.

(From the Division of Mines, Bureau of Science, Manila, P. I.)

Taytay is situated on the eastern border of the broad Mariquina Valley, and at the western foot of the upland which extends from Antipolo into the Binangonan Peninsula. The church, which may be regarded as the nucleus of the settlement, stands on a low hill which is the western end of a peninsular area, intermediate in elevation between the valley and the hill country. (Plate VIII, fig. 1.) The town is nearly surrounded by lowlands devoted to the cultivation of rice. To the east of the town there are hills covered with cogon grass. Along the streams there is a growth of bamboo and in the valleys between the hills a variety of trees are found, which extend irregularly up the hill slopes. (Plate I.)

There are two streams which pass through Taytay. One comes from the north and has its course through the western part of the town. The other comes from the east and passes through the southern border. They join in the southwest part and the resulting stream continues to Bay Lake (Laguna de Bay). There is also a cut-off from the Cainta River which comes from the west but this is practically dammed now by the railroad grade. During the dry season the water of the streams stands in stagnant pools or entirely disappears, but in the wet season it has a considerabe volume and affords communication to the lake by banca.

The main routes of travel from Taytay are westward to Cainta and across the Mariquina Valley towards Pasig and Manila and eastward to Antipolo. There is also a road southward to Angono and Binangonan, but it is little traveled. Banca traffic to the lake for fishing is important during the wet season. Taking these facts into consideration, it is easy to understand why the growth of the town in former times has been along the roads to the westward in the direction of the rice fields, and especially toward the juncture of the streams where fish are brought to market. Lately, with the building of the railroad, the town has begun to grow near the station and it is probable that in a short time the towns of Taytay and Cainta, the latter but a short distance to the west, will form a continuous settlement. From a hygienic standpoint it would have been better if the inhabitants had built their homes on the hill land, but the advantages of a healthful location have been sacrificed for convenience in pursuing the agricultural and fishing industries.

Geology.—Besides the alluvium which forms the cultivated lands, the geologic formation at Taytay consists of a water-laid volcanic tuff, which in places contains conglomerate beds. Tuff outcrops conspicuously in the streets near the church and the municipal building, and along the road towards Antipolo. It forms the peninsula-shaped elevated area mentioned in describing the situation of the town. The bedding of the tuff is quite even in some places, but in others shows a thickening and thinning of the strata and some irregularities of deposition, especially in the conglomerate portions. Eastward of the town on the road to Antipolo, there are heavy beds of this formation which outcrop in a flat-topped hill, producing escarpments. (Plate VIII, fig. 2.) There is a slight dip of the beds to the westward, due in part to the inclination of the sea bottom on which they were deposited, but the amount of dip can not be determined accurately from the exposures.

The alluvium forms a veneer only a few feet thick over the tuff. A well at the cockpit between the municipal building and the railway station reaches the tuff at a depth of about 5 meters.

To the east of Taytay at the foot of the first range of hills, the formation comes in contact with igneous rocks. These geological relations are shown diagrammatically in the accompanying figure, No. 1.

FIG. 1.—GENERAL GEOLOGIC RELATIONS AT TAYTAY.

Water supply.—Both the tuff formation and the alluvium are abundantly water bearing. To the east of the town there is a small spring which comes out of the tuff, but the place of issue is concealed by loose material. (Plate IX, fig. 1.) The water from this spring is usually made to run over a leaf from which it flows into a basin excavated in the tuff. During the dry season the stream of water is about the size of a lead pencil. This spring, although rather distant from the town, is largely used by the inhabitants who consider it the best water they can obtain, but it supplies a very inadequate amount.

The alluvium formation consists of a black soil which is cultivated for rice and is accordingly kept flooded with water during a large part of the year. The main streams at Taytay have low banks and during the flood season frequently overflow. Furthermore, there is a small branch from the rice lands which passes through the town when the fields are irrigated. Accordingly it will be understood readily that the alluvium formation is saturated thoroughly with water throughout most of the year.

The wells at Taytay fall into two classes—those which obtain water from the tuff formation and those which are dug into the alluvium. The deepest well in the tuff formation is situated in the *patio* of the convent which adjoins the church. It is not used by the public. The principal well of this class and the one most generally used by the town is situated in the street one block southwest of the municipal building. (Plate IX, Fig. 2.) It has a large cistern walled with blocks of tuff which are arched up to a rectangular opening, but the walls do not rise high enough above the ground to afford any protection from surface contamination. There are two smaller wells to the southeast near the border of the tuff area which obtain their water from this formation, and to the northeast of the town there are two shallow wells dug into the banks of the ravine and extending into the tuff. To the north of the town and beyond the limits of the map, there is a well excavated into the tuff which during the dry season contains only a little water. It is common for a man to climb down into this well and dip up the water, which is not present in sufficient amount to fill a bucket lowered from the surface.

The remaining wells of the town obtain water from the alluvium. Some of these are dug at a considerable distance from streams, others are on the banks of streams and some are in the stream channels, so that during the flood season they are overflowed. None of these wells have good curbs or walls to aid in the prevention of surface contamination. It is a usual thing for the people to take the water from the wells by means of buckets or oil cans lowered into the well on the end of a rope or pole, and in doing this they stand very near the opening of the well. Water accidentally spilled washes over the stones which wall the mouth of the well, and a part of it falls back into the well. Dirt which has been in contact with the natives' feet may fall into the well, or contamination may arise from dirt on their hands, which, upon drawing a second bucket of water, are more or less rubbed on the rope. The people of Taytay have the idea that wells near houses are apt to be dangerous sources of supply and so they generally prefer to bring water from the wells outside the town, especially during the dry season when the water has a lower level in the wells and becomes accordingly more turbid. The wells most frequented outside of the town are situated directly in the stream beds, and although the mouths of these wells are above the level of the water in the streams or the drying mud, there is every reason to suppose that they receive filtrations from the stream channels which in places contain carabao wallows and stagnant water covered with green scum.

Enough has been said to show that there is need of deep tubular wells in order to insure a safe water supply for the town. Fortunately, the geologic structure is favorable to drilling and it is possible that in the southwest part of the town near the juncture of the streams, where the land is low, sufficient hydrostatic head might be encountered to produce an artesian flow. It is recommended that a deep well be drilled at this place with the hope of obtaining an artesian flow. In case an artesian well is not obtained the remaining wells which may be drilled in the town should be made only sufficiently deep to prevent surface filtration.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

III. BACTERIOLOGICAL ANALYSES OF THE WATER SUPPLY.

By Moses T. Clegg.
(*From the Biological Laboratory, Bureau of Science, Manila, P. I.*)

The geologic conditions governing the water supply will be found in the article by Adams on page 211.

Well number 1, dug in alluvium, G and Fourth Streets. (Washing water.)
- Number of bacteria per cubic centimeter, 5,000;
- Bacillus coli communis;
- Vibrios;
- Amœbæ and flagellata.

Well number 2, dug in tuff, H and Third Streets. (Washing water.)
- Number of bacteria per cubic centimeter, 8,000;
- Bacillus coli communis;
- Bacillus pyocyaneus;
- Vibrios;
- Amœbæ and flagellata.

Well number 3, dug in alluvium, M and Third Streets. (Washing water.)
- Number of bacteria per cubic centimeter, 12,000;
- Bacillus coli communis;
- Vibrios;
- Amœbæ and flagellata.

Well number 4, dug on the bank of a stream, H and Fith Streets. (Washing water.)
- Number of bacteria per cubic centimeter, 7,800;
- Amœbæ and flagellata;
- Vibrios.

Well number 5, dug in alluvium, G, Fourth and Fifth Streets. (Washing water.)
- Number of bacteria per cubic centimeter, 4,800;
- Amœbæ and flagellata;
- Vibrios.

Well number 6, issuing from tuff. (Spring drinking water.)
- Number of bacteria per cubic centimeter, 500;
- Flagellata. No amœbæ.

Well number 7, dug in tuff. (Drinking water.)
- Number of bacteria per cubic centimeter, 800;
- Amœbæ and flagellata.

Well number 8, dug in a stream bed, "Pinagsalan." (Drinking water.)
- Number of bacteria per cubic centimeter, 4,000;
- Amœbæ and flagellata;
- Vibrios.

Well number 9, dug in a stream bed. (Drinking water.)
- Number of bacteria per cubic centimeter, 3,800;
- Bacillus coli communis;
- Amœbæ and flagellata;
- Vibrios.

Well number 10, dug in tuff, "Capt. Luis." (Drinking water.)
- Number of bacteria per cubic centimeter, 800;
- Amœbæ and flagellata;
- Vibrios.

Well number 11, dug in the bed of a stream, "Manining." (Drinking water.)
- Number of bacteria per cubic centimeter, 12,000;
- Bacillus coli communis;
- Bacillus pyocyaneus.
- Amœbæ and flagellata.

Well number 12, dug in the bed of a stream. (Drinking water.)
- Number of bacteria per cubic centimeter, not determined;
- Bacillus coli communis;
- Amœbæ and flagellata;
- Bacillus pyocyaneus.

Well number 13, dug in the bed of a stream. (Drinking water.)
- Number of bacteria per cubic centimeter, 9,000;
- Amœbæ and flagellata;
- Bacillus coli communis;
- Bacillus pyocyaneus;
- Vibrios.

Well number 12 was examined particularly for the typhoid bacillus since cases of typhoid fever had occurred in the vicinity of it. A small, actively motile organism was isolated, which was pathogenic for small animals. It belonged to the colon group, but was not the typhoid bacillus.

None of the vibrios isolated from the above well waters were cholera spirilla and they were not agglutinated by anticholera sera. Some of them gave the cholera red reaction, others did not. Some were very toxic for guinea pigs.

In some of the houses in Taytay the drinking water is kept in earthen jars which stand side by side, the same utensils being used for removing water from both jars. Examination made of the drinking water of seven jars showed all infected with amœbæ.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

IV. CHEMICAL ANALYSES OF TAYTAY WATERS.

By George F. Richmond and V. Q. Gana.
(From the Chemical Laboratory, Bureau of Science.)

Physical characters of Taytay waters.

Well No.	Color.	Odor.	Reaction to litmus.	Appearance on ignition.
1	Brownish	Earthy	Alkaline	Brown.
2	do	Fishy	Neutral	Do.
3	do	Earthy	Alkaline	Slight coloration.
4	do	do	do	Do.
5	do	Normal	do	Do.
6	Brown and turbid	do	Neutral	Blackening.
7	do	do	do	Do.
8	do	do	do	Brown coloration.
9	do	Like sewage	do	Positive blackening.
10	do	Normal	do	Slight brown coloration.
11	Slightly brown and turbid	Earthy	Slightly alkaline	Do.
12	do	Normal	Neutral	Brown coloration.
13	Turbid	do	Alkaline	No coloration.

Sanitary chemical examination, Taytay waters.

[In parts per million.]

Well No.	Total solids.	Mineral matter.	Organic matter.	Chlorine.	Oxygen consumed.	Nitrogen as—				Hardness.		
						Saline ammonia.	Albuminoid ammonia.	Nitrites.	Nitrates.	Temporary.	Permanent.	Total.
1	658.4	607.6	50.8	75.916	2.4	0.1153	0.1113	Nil.	1.5553	244.0	25.0	269.0
2	841.6	821.2	20.4	116.73	2.6	0.0447	0.1317	0.0202	23.035	162.0	100.0	262.0
3	1,489.6	1,415.2	74.4	367.34	2.2	0.0472	0.1417	0.0046	5.2982	430.0	250.0	680.0
4	2,295.2	2,126.4	168.8	438.77	3.4	0.1019	0.1789	Nil.	8.1511	364.0	630.0	994.0
5	1,359.2	1,256.0	103.2	263.26	2.3	0.0828	0.1094	0.0046	8.4746	334.0	340.0	674.0
6	268.4	258.0	10.4	6.122	7.5	0.1243	0.2312	Trace.	Trace.	66.7	Nil.	66.7
7	230.0	220.0	10.0	5.306	5.9	0.0621	0.1268	Trace.	Trace.	122.0	Nil.	122.0
8	255.6	242.0	13.6	5.306	0.6	0.0556	0.0278	0.0037	Trace.	115.0	Nil.	115.0
9	147.6	132.0	15.6	5.714	5.2	1.3623	0.2287	Nil.	Trace.	64.0	Nil.	64.0
10	230.2	218.4	11.8	10.204	1.2	0.0124	0.0447	Nil.	Trace.	96.0	Nil.	96.0
11	199.2	180.8	18.4	7.755	1.3	0.0149	0.0373	Trace.	Trace.	95.0	Nil.	95.0
12	199.2	176.0	23.2	4.898	0.95	0.0174	0.0770	Nil.	Trace.	88.0	Nil.	88.0
13	716.4	699.2	17.2	191.836	1.4	0.0323	0.0770	0.0128	2.2318	214.0	155.0	369.0

In interpreting the results of the chemical examination of these waters, the following conclusions would ordinarily be drawn: Waters from wells Nos. 1, 2, 3, 4, 5, 6, 7, and 9 would be considered entirely unsuited for drinking purposes in every respect on account of the high chlorine figures together with an excess of nitrogen in all of its forms. While the absence of chlorine is sufficient proof of the absence of sewage contamination, its presence does not necessarily indicate sewage contamination in countries adjacent to the sea. Therefore, not much importance should be placed upon high chlorine figures alone, but when they are accompanied by excessive amounts of nitrogen, particularly in the form of albuminoid ammonia and nitrites, the indication of pollution with sewage or drainage from refuse animal matter is almost conclusive.

Waters Nos. 8 and 13 would be considered of a doubtful character as the nitrogen as nitrites is above the allowable limits and the nitrogen in its other forms is too near the border line for safety.

Waters Nos. 10, 11 and 12 are well within the allowable limits of safety as regards the nitrogen in all its forms, the oxygen consuming power and chlorine content. In fact these waters from a chemical standpoint appear better in every respect than do many deep well waters which from the very nature of their source are free from surface pollution. When judged from the chemical findings alone, these three waters would be considered entirely safe for drinking purposes; hence too much reliance should not be placed on the sanitary chemical analysis of drinking waters alone. It is only when the source of the waters—i. e., location and kind of well—the physical characters and results of a biological examination of the water are known that the results of a sanitary chemical examination are of assistance in judging whether the water in question is potable.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

V. THE PRINCIPAL FOODS UTILIZED BY THE NATIVES.

By E. D. Merrill.
(*From the Botanical Section of the Biological Laboratory, Bureau of Science, Manila, P. I.*)

Comparatively little has been written regarding the dietary of the natives of the Philippines, although it is a well-known fact that, in common with most oriental people, their staple foods are fish and rice. Among the poorer classes there is probably little variation from these primary articles of food, though their diet is modified by a number of food products of secondary importance. Taytay is a typical provincial town and its food supply seems to be almost entirely local, although it is within a short distance from Manila; hence the town in this respect is characteristic of most medium-sized and small settlements in the Philippines.

Here, as in nearly all other parts of the Archipelago, rice is the basis of the meal, and fish, both fresh and dried, apparently ranks as the second most commonly utilized food. The town is situated in the midst of a large rice-growing region, and the supply of this staple is practically all local, although in times of scarcity foreign rice is brought from Manila. Comparatively few varieties of rice seem to be cultivated locally, at least in any great quantity.

Most of the fresh fish found in the local markets, and apparently most of the dried fish, are fresh-water varieties secured in Lake Bay, although some dried fish originating in salt water is brought from Manila. The variety found locally is very limited, the only kinds noticed by me in any quantity being the species known as *dalag* and *candoli,* both fresh-water fish brought from Lake Bay, and these were found fresh (alive) and salted. Other varieties said to be brought into the market at various times are *kitang, buan-buan, talilong, talakaitok, palos, tegiti, hito, bia, ayuñgin, tuyo* and *matinik.* Dried fish, imported from Manila, and apparently always to be found in the market or in the tiendas in greater or less abundance, are *halobabai, sapsap* and *dilis. Hipon*, a small fresh-water shrimp, is usually abundant in the market. No other shellfish were observed.

Meats play a very secondary part in the local dietary as in other parts of the Philippines. Apparently the only local supply that is at all constant is of fresh pork; pigs, both large and small, being abundant in the town and always offered for sale on market days. Goats are utilized for food to a limited extent. Beef is apparently never, or at least very rarely, offered for sale in the local market; a meat closely resembling it—that is, the meat of the water buffalo or carabao—is probably sold at times here as in other Philippine towns, but the supply must be very limited and inconstant as these animals are far too valuable for other purposes to be used for food under ordinary conditions, so they are probably rarely slaughtered for food except when incapacitated for further work. Here, as elsewhere in the Archipelago, animals such as horses and carabaos that have died a natural death from any cause are doubtless utilized as food, although no direct evidence is at hand bearing on the local case.

Fowls, especially chickens and ducks, are found abundantly locally and are considerably utilized for food, especially among the natives of the well-to-do classes, while eggs, both fresh and "balut" (incubated) are somewhat used. The comparatively high price of all meats, poultry and eggs, place these products beyond the means of the average native of the laboring class for regular articles of diet.

Various prepared foods are sold in the market and in the tiendas, such as *suman,* made of tapioca, rice and sugar, wrapped in banana leaves and boiled; *poto,* made of boiled rice flour and sugar; *poto seco,* the same thing, but dried after cooking; *bibinka ñg malagkit,* prepared from a glutinous variety of rice with grated coconut meat and sugar, and doubtless some other similar forms of food. Various prepared foods of Chinese origin are also sold, such as *gulaman,* made from a seaweed; *bihon,* made of rice flour, corresponding roughly to our spaghetti; and *miki* somewhat similar but made of rice flour and mongo beans (*Phaseolus mungo*). Cakes made from wheat flour, either baked locally or imported from Pasig or Manila, are sold in small quantities. Wheat bread is used scarcely at all, so that wheat can not be considered to have any place in the dietary of the average native.

Dairy products such as milk, butter and cheese have no place in the dietary of the natives, except the former, which is obtained from the water buffalo and is used to a limited extent.

In spite of the proximity of Taytay to Manila with its relatively very rich markets, its food supply seems to be almost entirely local as noted above. Imported preserved meats, fish, fruits, vegetables, milk, butter, cheese, etc., are not to be found in the local markets or tiendas, and are probably not at all utilized by the inhabitants of the town or else to a very limited extent and among a very limited class of inhabitants. Fresh potatoes, onions, etc., although always to be found in the Manila market, are rarely obtainable locally, and then only in very limited quantities.

Below is given a list of the different fruits, vegetables, pot herbs, and condiments found in the markets of Taytay, giving so far as possible their native, English and scientific names, their origin, whether grown locally or imported, and their uses. The list of fruits especially is a comparatively long one, but for many of them the season is comparatively limited, and with the exception of bananas and coconuts, none of them are to be found in the market throughout the year; doubtless a few additions could be made to the list by examining the products sold in the local markets at other seasons. It should be remembered also that a high percentage of the fruits utilized by the natives and many of the vegetables, judged from the European or American standpoint, are decidedly inferior and are scarcely ever or not at all utilized by others than the natives; while many of them are to be found in only very limited quantities so that the list of available foods is really smaller than one would be led to expect from mere examination of the appended list. Of the entire list of fruits given below, bananas, mangoes and pineapples are the only ones that can be ranked as first-class fruits from an edible standpoint.

FRESH FRUITS.

Bananas (including both the common banana and the plantain; *Musa sapientum* L., and *M. paradisiaca* L.). Three varieties are found in abundance, all grown locally—*gloria* and *latandal*, edible bananas, and *saba*, a plantain used for food only when cooked.

Anonas (custard-apple or bullock's heart, *Anona reticulata* L.). A fruit of American origin, grown locally and in small quantities.

Ates (sweet-sop, *Anona squamosa* L.). Like the preceding, a fruit of American origin, somewhat more abundant than the custard-apple.

Bayabas (guava, *Psidium guajava* L.). A fruit of American origin, very abundant and grown locally without cultivation; the fruits are inferior.

Bilimbi (*Averrhoa carambola* L.). A very acid fruit of American origin, usually eaten with fish or with other foods when something sour is desired; common but in limited quantities.

Calamansi (lime, *Citrus medica* Linn., var.). A small very acid lime, found in limited quantities, utilized like the preceding.

Camates (tomato, *Lycopersicum esculentum* Mill.). Of American origin, found in the markets in abundance, but inferior in size and flavor.

Camias (*Averrhoa bilimbi* L., and *Cicca disticha* L.). Found in limited quantities, similar in flavor and uses to Bilimbi.

Cahel (sour orange, *Citrus aurantium* L., var.). A very sour, tight-skinned, light-yellow orange, grown locally; found in small quantities.

Casoy (cashew, *Anacardium occidentale* L.). A fruit of American origin, eaten fresh; the seeds are roasted and eaten. Common.

Dayap (lime, *Citrus medica* L., var.). Abundant in season.

Granates (pomegranate, *Punica granatum* L.). Very rare, apparently used mostly for medicinal purposes.

Guanabano (sour-sop, *Anona muricata* L.). A fruit of American origin, grown locally; not abundant.

Lansones (*Lansium domesticum* Jack). In season; imported from the lake region.

Lucban (pomelo, *Citrus decumana* L.). Grown locally, rather common.

Manga (mango, *Mangifera indica* L.). Very abundant in season.

Melon (muskmelon, *Cucumis melo* L.). Occasional, inferior in flavor.

Naranjitas (orange, *Citrus aurantium* L., var.). The common looseskinned, sweet orange of the Philippines.

Niog (coconut, *Cocos nucifera* L.). Common in the market, imported from the lake region.

Papaya (papaw, *Carica papaya* L.). A fruit of American origin, very common.

Piña (pineapple, *Ananassa sativa* Lindl.). Abundant in season, of American origin.

Sampalok (tamarind, *Tamarindus indicus* L.). Abundant; in addition to the use of the fruit, the flowers and young leaves are cooked with fish.

Sandias (watermelon, *Citrullus vulgaris* Schrad.). Rather common, but inferior in texture and flavor.

Santol (*Sandoricum indicum* Cav.). A native fruit, inferior.

VEGETABLES.

Ampalaya (*Momordica charantia* L.). It is cooked with fish and used in stews; common.

Batao (*Dolichos lablab* L.). A common bean.

Bawang (garlic, *Allium sativum* L.). Found in all small stores and common in the market.

Calabaza (squash, *Cucurbita maxima* Duch.). Rather abundant but in limited quantities; the young shoots and flowers are also cooked as a pot herb.

Camote (sweet potato, *Ipomoea batatas* L.). Abundant.

Camoting cahoy (cassava, tapioca, *Manihot utilissima* Pohl). Common in cultivation, but not utilized extensively.

Cebollas (onions, *Allium cepa* L.). These are imported from Manila, in very small quantities; young onions grown locally and eaten raw as a relish are found in the market and are known as *cebollas na mura*.

Gabi (taro, *Colocasia antiquorum* Schott). The fleshy corms are common in the market. In many parts of the Philippines the leaves and petioles are cooked as a pot herb, but I am informed that they are not so used here.

Labong ñg cauayan (bamboo shoots, *Bambusa* sp.). Rather common, in season.

Maiz (Indian corn or maize, *Zea mays* L.). Of American origin; very commonly cultivated and found in abundance.

Mongos (green gram, *Phaseolus mungo* L.). A very small bean, found in abundance.

Opo (bottle gourd, *Lagenaria vulgaris* Seringe). Rather common.

Patatas (potato, *Solanum tuberosum* L.). Imported in small quantities from Manila.

Patola (*Luffa cylindrica* Roem. and *L. acutangula* Roxb.). Rather common.

Poso (banana flowers, *Musa paradisiaca* and *M. sapientum*). Common.

Rabanos (radishes, *Raphanus sativus* L.). The radish is found in abundance in season, and is eaten both raw and cooked.

Sincamas (turnip-bean, *Pachyrhizus bulbosus* Kurz). Very abundant in season, eaten raw.

Sitao (Chinese bean, *Vigna sinensis* Endl.). Abundant.

Talong (egg plant, *Solanum melongena* L.). Abundant.

Tsitsao (green peas, *Pisum sativum* L.). Rather abundant in season.

Tubo (sugar cane, *Saccharum officinarum* L.). Abundant.

Ubi (yam, *Dioscorea daemona* Roxb.). Found in small quantities; probably other varieties of yams are more or less utilized.

POT HERBS.

Calabaza (squash, *Cucurbita maxima* Duch.). The young shoots and flowers are commonly used for greens.

Camote (sweet potato, *Ipomoea batatas* L.). The young shoots and leaves are commonly used.

Caturay (*Sesbania grandiflora* Poir.). The large white flowers of this tree are cooked as greens.

Cancong (*Ipomoea reptans* Poir.). Much like sweet-potato leaves and shoots, and similarly used.

Mostaza (mustard, *Brassica juncea* Coss.). Cultivated, the stems and leaves utilized.

CONDIMENTS.

Achuete (arnatto, *Bixa orellana* L.). The seeds are used to give a reddish color to cooked rice, and to various dishes in which rice is the chief ingredient.

Alibangbang (*Bauhinia malabarica* L.). The leaves and young shoots of this tree have a pleasant acid taste and are cooked with rice.

Luya (ginger, *Zingiber officinale* Rosc.). Commonly found in the market.

Sanki (star anise, *Illicium verum* Hook.). The dried fruits are found in the tiendas; imported from China.

Sibug (*Acacia pennata* Willd.). The pods are used to flavor fish.

Sili (Chile pepper, *Capsicum frutescens* L.). Abundant, and much used.

Sampalok (tamarind, *Tamarindus indica* L.). The flowers and young shoots are cooked with fish, etc.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

VI. THE FOOD OF THE PEOPLE OF TAYTAY FROM A PHYSIOLOGICAL STANDPOINT.

By HANS ARON.

(*From the Physiological Laboratory, Phil. Med. School.*)

The importance of the quality and composition of the food of a population from the standpoint of health suggested that a study of this question with regard to the people of Taytay was necessary to complete the investigations being carried on concerning them. This material seemed also to offer a welcome supplement to my first investigations on the nutrition of the Filipino people,[1] since I hoped to get from it an idea of the nourishment of a tropical people living according to their usual custom in a provincial town free from white men. In my first paper I mentioned the difficulties which attend the study of such questions in such a country; however, the relative simplicity of the food of these people of Taytay makes it possible to collect the more important data with sufficient accuracy. The following plan was adopted in order to obtain the information desired.

A number of houses in every district of the town were visited and the head of the family questioned in such a manner as to obtain all data of interest for the subject under consideration. These inquiries were made as far as possible by the writer in Spanish, or, with the help of a student assistant of the Philippine Medical School as interpreter, in Tagalog.

The food of the Taytay population consists for the most part of rice, and fish is next in importance as an article of food. Vegetables and fresh fruits which vary with the season of the year are eaten also, but in relatively small quantities. Cane sugar and sweets made of sugar and rice flower, and other preparations rich in carbohydrates, such as agar-agar and tapioca, are eaten between meals. Beef and milk and

[1] *This Journal, Sec. B* (1909), 4, No. 3, 195.

its products have, under the present agricultural conditions, no significance as food products. Occasionally a carabao may be killed and its meat eaten during a *fiesta*, but this occurs only very rarely. Chickens and eggs are as a rule too expensive for the poorer and middle classes.

The above facts show that in making a study of the food and its nutritive value for these people, one has to consider principally the quantity of *rice* and *fish* eaten daily. The protein material found in the vegetables and fruits can be neglected and the protein in the few eggs occasionally eaten is too small in amount to be of any importance. However, the caloric value of the sugar and the sugar preparations and of the carbohydrates found in vegetables and fruits can not be disregarded altogether. This general discussion indicates sufficiently clearly the character of the inquiries which were made in pursuing this subject.

Rice is kept on hand in most of the houses and the people are able to state fairly accurately how much is used daily and also how many days a given amount will last. In measuring the quantity used, the old Spanish terms *gantas* (3 liters) and *chupas* (0.375 liter) are used. In a few instances only the amount of palay bought at certain intervals in the past is stated. In these cases 2 chupas of palay have been considered equal to 1 chupa of rice. One chupa of rice costs 3 centavos and 1 chupa of palay 1.5 centavos. It was more difficult to obtain similar data regarding the fresh food products which were purchased daily in the markets, because they were not sold in weighed amounts.

In every household we were able to obtain a fairly accurate idea of the average total amount of money (*gastos*) spent daily in the market in the purchase of fish, vegetables, sugar and cigarettes. It was found necessary to make separate inquiries as to the amount of money spent for fish alone, owing to the important place which this product occupies in the daily diet. Furthermore, the number of persons has been ascertained who take their meals regularly in the household; these are divided into four groups; adult males, adult females, children (under 10 years) and babies (under 10 months). Finally, an attempt was made to gather, by means of tactful inquiries and a careful observation of the general aspect of the house and its surroundings, some idea as to the class of society to which the inmates belonged, their occupation, the extent of their possessions and also the number of domestic animals on the place. Inquiries in twenty-five different families of all classes of the population of Taytay gave the following result:

TABLE I.

No.	Males.	Females.	Children.	Babies.	Chupas of rice per day.	Daily amount spent for all food stuffs except rice.	Daily amount spent for fish only.	Remarks.
1	------	4	3	------	11	₱0.50	--------	
2	4	2	------	1	8	.35	--------	4 hens are fed what remains.
3	2	3	2	------	11	.30	--------	
4	5	3	------	------	21	.50	--------	1 hen is fed what remains; very hard-working man.
5	4	1	1	1	16	.60	--------	7 hens are fed what remains.
6	1	1	2	------	8	.20	₱0.10	
7	1	1	[a]1	[b]1	6	.10	.08	1 pig costs extra 10 centavos daily.
8	1	1	[c]1	------	6	.10	.08	2 hens are fed what remains.
9	1	1	[d]2	------	6	.15	.08	4 hens.
10	1	1	------	------	6	.50	.40	Very wealthy; 15 hens; for these 2 chupas of palay are bought daily.
11	1	1	2	------	6	.40	.30	10 hens; for these 2 chupas of palay are bought daily.
12	1	3	[e]1	------	6	.40	.27	
13	4	2	2	[f]1	12	.50	.40	1 pig is fed the remainder.
14	1	2	2	------	7½	.30	.20	
15	1	1	1	------	6	.60	.48	Wealthy people; 6 hens are fed.
16	1	1	2	1	5	.25	.20	
17	1	1	2	[g]1	6	.25	20	1 pig is fed the remainder.
18	3	2	------	------	14	.80	.50	3 men working, have "tienda" in market.
19	2	2	[h]1	[i]1	10	.20	.20	No expenses for vegetables, etc.
20	2	1	[j]2	------	9	.40	.35	Chinelleria, middle class.
21	2	2	[k]1	------	9	.20	.10	Fisherman.
22	1	2	1	------	6	.20	.10	2 pigs are fed extra food.
23	2	1	1	------	6	.25	.20	2 hens are fed what remains.
24	1	2	[l]1	------	6	.20	.15	1 pig is fed extra food.
25	2	1	------	[m]1	6	.25	.15	

[a] 4 years.
[b] 11 months.
[c] 3 years.
[d] One 1 year and one 2 years.
[e] 6 years.
[f] 12 months.
[g] 2 months.
[h] 12 years.
[i] 14 months.
[j] One 9 years and one 6 years.
[k] 2 years.
[l] 13 years.
[m] 2 months.

For a clear understanding of this table, the data obtained must be reduced to a comparative basis; that is, the amount per person. This has been done by counting children above 10 years as adults, children from about 5 to 10 years as two-thirds of a person, from about 2 to 5 years as one-half a person, and children from about 1 to 2 years as one-third of a person. Babies under 10 months have been omitted altogether in Table II. At the same time the chupas of rice in this table have been changed into grams, taking 1 chupa of rice as 370 grams. In this way Table II has been obtained, which presents the data of Table I in a more readily comprehensible manner.

TABLE II.

No.	Males.	Females.	Children.	Babies.	Estimated number of members.	Amount of rice required in grams.	Daily amount spent for fish.	Rice per person in grams.	Fish per person.	
10	1	1	0	0	2	2,220	₱0.40	1,110	₱0.20	Very rich people.
8	1	1	[a]1	0	2½	2,220	.08	880	.03½	
15	1	1	1	0	2⅔	2,220	.48	840	.18	Wealthy people.
7	1	1	[b]1	[c]1	3	2,220	.08	740	.03	
9	1	1	[d]2	0	3	2,220	.08	740	.03	
11	1	1	2	0	3	2,220	.30	740	.10	
25	2	1	0	[e]1	3	2,220	.15	740	.05	
24	1	2	[f]1	0	3⅓	2,220	.15	670	.04	
6	1	1	2	0	3½	2,960	.10	850	.03	
16	1	1	2	1	3½	1,850	.20	560	.06	
22	1	2	1	0	3½	2,220	.10	630	.03	
23	2	1	1	0	3½	2,220	.20	630	.06	
17	1	1	2	[g]1	3½	2,220	.20	630	.06	
20	2	1	[h]2	0	4½	3,330	.35	740	.08	
14	1	2	2	0	4½	2,775	.20	620	.04½	
12	1	3	[i]1	0	4½	2,220	.27	500	.06	3 females.
21	2	2	[j]1	0	4½	3,330	.10	740	[m].02	Fisherman.
19	2	2	[k]2	0	5	3,700	.20	740	.04	
18	3	2	0	0	5	5,180	.50	1,030	.10	3 men working.
1	-------	4	3	0	6	4,070	([l])	660	---------	4 females.
5	4	1	1	1	6	5,920	([l])	980	---------	4 males.
2	4	2	0	1	6	2,960?	([l])	490?	---------	Unreliable.
3	2	3	2	0	6½	4,070	([l])	625	---------	
13	4	2	2	1	7½	4,440	.40	590	.05	
4	5	3	-------	-------	8	7,770	([l])	960	---------	

[a] 3 years.
[b] 4 years.
[c] 11 months.
[d] One 1 year and one 2 years.
[e] 2 months.
[f] 3 years.
[g] 2 months.
[h] One 6 years and one 9 years.
[i] 6 years.
[j] 2 years.
[k] One 1 year and one 12 years.
[l] Data not obtained.
[m] Price below average (fisherman).

In only a few instances does the amount of rice taken daily by one person differ markedly from the main average. It is easy to understand that the rich family, No. 10, consisting of only two persons, does not live as economically as the others. Families No. 2 and No. 12 give a very low average, and family No. 18 a very high average. It is well to eliminate these four families in determining the average food consumption of the people. If we now examine the remainder of the families, it is found that the amount of rice per person is higher if the members of the family are almost all males, while it is lower if the members are females. A comparison of families Nos. 1 and 5, for example, illustrates the physiological fact that the hard-working man needs a larger amount of carbohydrates than the less active individual and therefore takes more rice. The average amount of rice per person is about 700 grams, but for a hard-working man it is somewhat higher, from 850 to 900 grams.

The fish eaten by the people of Taytay deserves our attention especially as a source of protein, the content of fat in the Philippine fishes being very low, at the most only 1 to 2 per cent; this means that the fish contains only one-tenth as much fat as protein. As already mentioned, the amount of fish eaten per person can not be determined with the same accuracy as the amount of rice. The differences between the poorer classes and the richer are here more pronounced, but the possibility must be borne in mind that the richer man spends more money for this foodstuff not because he buys more fish but because he selects a better quality. If we omit the exceedingly high values of both the families marked as wealthy in Table I, we see that from 3 to 10 centavos daily are spent for fish and that a great number of the people, 5 out of 18 (28 per cent), live on 3 centavos worth of fish daily. From our standpoint it seems important to find out what quantity of nutritive food stuffs, especially protein, can be purchased daily in the markets of Taytay for this amount of money.

With this in view, I sent a reliable native boy of Taytay (and not a Filipino student, since the latter might be looked upon as a foreigner and hence get less for his money than a native of the village) to buy 10 or 20 centavos worth each of the different kinds of fish in the market. I then took the weight of each sample and determined the edible part and its percentage of nitrogen (Kjeldahl) as a measure of the protein content. Five kinds of fish were selected—*tiguiti,* as an example of a very cheap fish; *dalag,* as an example of an expensive fish; *tuyo,* a half-dried sardine; *dilis,* a small dried fish; and *hipon,* a dried shellfish.

The following table gives the results of the investigation:

TABLE III.

Name and kind of fish.	Cost in centavos of 100 grams edible material.	Amount nitrogen in 100 grams edible material.	Amount protein in 100 grams edible material.
Tiguiti, fresh fish, very cheap; only eaten by the poorer classes	1.1	2.52	15.75
Dalag, larger fish regarded as good	3.6	3.02	18.88
Tuyo, a fish resembling a small sardine not so highly esteemed	5.0	4.62	29.00
Dilis, very small dried fish imported from Manila	7.0	10.10	63.13
Hipon, small shellfish, partially dried	7.2	10.68	66.55

TABLE IV.

For 3 centavos the following amounts can be purchased:

Fish.	Grams protein.
Tiguiti	43
Hipon	28
Dilis	27
Tayo	18
Dalag	16

For 3 centavos 40 grams protein are available in a cheap kind of fish, but one may spend twice and three times as much to get the same amount of protein in one of the more expensive kinds of fish. In view of the amount of money found to be expended per person in fish, we are justified therefore in assuming that about 40 grams of protein are consumed in this way.

Finally, only a rough estimate can be made of the amount of money expended for fruits, vegetables, etc. For 2 centavos one could obtain in the Taytay market or "tiendas" about 100 grams of candy such as "caramelo," which would have a caloric value of less than 400. Fruits and vegetables purchased for the same money have a still lower caloric value. For example, for 2 centavos one can buy about from 200 to 300 grams of the edible portion of bananas; that means about 4 grams of protein and from 45 to 60 grams of carbohydrates with a caloric value of from 200 to 250. In the tropics where the bananas grow wild, one can usually obtain them daily without cost. Probably about 500 calories daily should be added for vegetables, fruits, etc.

In conclusion, the following table indicates the result of the attempt to find out the composition and caloric value of the food of the people of Taytay:

TABLE V.

	Daily.					
	For the average person.			For the hard-working man.		
	Quantity in grams.	Protein in grams.	Calories.	Quantity in grams.	Protein in grams.	Calories.
Rice	700	50	2,000	850–900	60	2,400
Fish		40	200		40	200
Vegetables			500			500
Total		90	2,700		100	3,100

The diet represents therefore 90 grams protein and 2,700 calories for the average person and for a hard-working man 100 grams protein and 3,100 calories. These amounts correspond very well with the data I collected in my first paper [2] concerning the food given to the prisoners in Bilibid Prison and also agrees with the result of inquiries made at that time in the city of Manila. I have considered also the rations of the native troops, known as Philippine Scouts, and have found the daily food per person represents about 3,000 calories.

Since the latest researches indicate a causal connection between certain kinds of rice and beriberi, and since rice is the most prominent constituent of the food of these people, it is interesting to note that not a single case of beriberi was found in Taytay. Practically all the rice used in this town belongs to the class of "cured" rice, which according to some observers never causes beriberi even when it forms the greater portion of the nutriment over a long period of time. The rice is prepared at home and is unpolished; polished or "uncured" rice is found only very rarely.

Finally I have calculated the cost of the daily food of a man living in the usual manner in the town of Taytay. This is shown in the following table:

TABLE VI.

Family No.	Average cost of the food of one person.	Family No.	Average cost of the food of one person.
1	₱0.14	14	₱0.12
2	.10	15	.27
3	.10	16	.12
4	.13	17	.14
5	.16	18	.24
6	.13	19	.10
7	.09	20	.15
8	.12	21	.11
9	.11	22	.12
10	.34	23	.14
11	.16	24	.12
12	.13	25	.15
13	.12		

If we omit the rich families No. 5, No. 10 and No. 18 which expended an excessively high amount for food, we see that the cost of the food for one person ranges between 9 and 16 centavos daily, with an average of 12½ centavos per person. It may not be without interest as having a bearing on many sociologic and economic questions in these Islands to state that in a provincial town a Filipino can live very comfortably on about 12 centavos a day.

[2] *Loc. cit.*

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

VII. MOSQUITOES AND OTHER INSECTS.

By Charles S. Banks.

(From the Entomological Section of the Biological Laboratory, Bureau of Science, Manila, P. I.)

In connection with the medical and sanitary investigations of the town of Taytay, it was thought desirable to give some attention to the mosquitoes and other insects found there with a view of establishing, if possible, the rôle that these pests now play in the transmission of disease, the likelihood of their becoming important in the future and the methods of dealing with them in this community or under similar conditions in other communities.

Taytay is situated in a fairly level plain, and hence there is almost no possibility for the establishment of such a system of drainage as would make it perfectly free from stagnant or semistagnant water; and even were the possibility of the installation of a drainage system to be considered, we would still be confronted with the fact that the town is in the center of a rice-growing district and the people depend largely upon rice raising for their livelihood and food. Therefore Taytay must always, during the rainy season, be surrounded by paddy fields which offer the best possible breeding places for mosquitoes and flies.

The streams, which practically surround the town, are never wholly dry at any season of the year and even at the height of the dry season they are semistagnant and offer excellent breeding places for mosquitoes. The wells, of which there are some 14 or more in or near the town, furnish still another breeding ground which, while not as productive as those bodies of water that are nearer the surface, nevertheless add their quota to the mosquito total of the town.

It will be seen by reference to the map (Plate II) that a good sized stream flows west of the town while another flows parallel with it through the western edge of the town for its whole length, the two streams finally join at the southern border. Before they join three other streams flow into the eastern one of these two, one from the east along the northern border of the town, one from the northeast through the middle of the town and one from the east through the southern portion. The main stream comes from north of Taytay; the others are simply outlets to the basin east of the town. These streams cease to flow during the dry season, and as the water evaporates more and more there forms in their basins a series of small ponds or puddles in which green algæ grow and which serve as ideal breeding places for *Myzomyia rossii* Giles, *Culex annuliferus* Ludl., *Culex argentinotus* Banks n. sp., and *Culex taytayensis* Banks n. sp. The paddy fields, while always serving during the rainy season as breeding places for *Myzomyia*, become such in the dry season only if sufficient rain falls to cause puddles of a week's or ten days' duration.

In view of the fact that *M. rossii* will breed wherever green algæ are present in bodies of stagnant water, even if no water occurred in the rice paddies during the dry season, there would always be sufficient water in the streams and shallow water around the wells to furnish an abundance of mosquitoes in the town. Such was the condition which I found at Taytay in the early part of May, that is to say, I discovered either adults, pupæ or larvæ of *M. rossii* in all the streams surrounding the town as shown by the accompanying map. (Plate II.)

Another excellent breeding place for mosquitoes, especially *Culex fatigans* Wied., and *C. concolor* Desv., is to be found in the sanitary midden pit adopted quite generally in Taytay since the last outbreak of cholera. It consists of a hole from 50 centimeters to 1.5 meters square and of the same relative depth, the sides sloping inward and the rim being reënforced with halves of bamboo trunks pressed into the soil around the hole. In addition, strips of bamboo are placed across those pits over which an outhouse is not built, a space being left in the center through which the fæces may fall. Those pits which lie in low land have from 20 to 40 centimeters of water in them constantly, and serve as admirable breeding places for the species of *Culex* above mentioned; the pits that are on higher ground may contain water after a heavy rain and thus serve the same purpose.

The level of the water in the wells seldom falls below 2 meters from the ground surface so that mosquitoes may breed there also. However, as only a few specimens were met with during the investigation I think these wells may be regarded as a rather negligible quantity in the way of breeding places.

Every house in the town of Taytay has one or more *galongs* or *bangas*, (earthern water jars.) The water is used for drinking and general purposes and these jars, though frequently covered with a board or other cover, may be found invariably to contain quantities of larvæ of the mosquito practically always present in the Philippines in the day-time, viz. *Stegomyia persistans* Banks. I found specimens of *S. samarensis* Ludl. occasionally in these jars, but only in very small numbers.

Another source of mosquitoes is to be found in the puddles which collect around the wells, especially around those wells which supply water for laundry purposes. As there are some 14 or more of these distributed through the town it will be seen that they are worthy of consideration. *Culex fatigans* was found breeding in several of these puddles, while in two cases *C. taytayensis* was found.

According to Doctor Nichols and Doctors Guerrero and Sevilla, who studied the distribution of malaria in Taytay, the majority of the cases of this disease were grouped along the large stream running north and south through the western edge of the town, and truly enough it was along this piece of water where the greatest numbers of *M. rossii* were taken. They occurred at points more remote from the center of the town, as at the well called "Pinagsalaan" and the large well southwest of the town; but, naturally, those mosquitoes found breeding within the limits of the town would be the most dangerous.

The very large majority of the people of Taytay use no mosquito nets; in fact, it is probable that not more than a half dozen families have these very necessary articles. It will thus readily be seen that the prevalence of malaria, either latent or sporadically active, would be largely a question of the abundance of malaria-carrying mosquitoes and the presence of individuals with the malarial parasite in the blood; in other words, the town of Taytay represents a locality in which no prophylactic measures against malaria are in operation.

The malarial parasite was found by Doctor Nichols in 3 per cent of those examined; 5 per cent of those persons who harbored malarial parasites showed no clinical symptoms of malaria. Enlargement of the spleen was encountered in 2.1 per cent of the children examined and in 1.4 per cent of the adults. These facts indicate a rather low degree of infection and are borne out by the rather noteworthy fact that while *Myzomyia rossii* was found in all the streams surrounding the town, the total number of this species was small in proportion to the area surveyed. This degree of prevalence of the mosquitoes is strikingly less than that found at Olongapo [1] and at Cervantes,[2] but it must of course be understood that the topography of both these places is entirely different from that of Taytay, a much larger area being covered with water in both Olongapo and Cervantes.

As far as the danger from malaria and the conditions of its propagation are concerned, Taytay is probably as favorably situated as any town which I have seen in the Philippines. Of course the ideal situation for a town would be one on very high ground away from streams or from the region of an open expanse of water, but towns of such character are few in these Islands.

[1] *This Journal, Sec. B* (1907), 2, 513.
[2] *Ibid.* (1908), 3, 335.

FLIES.

Musca domestica L., (The typhoid fly) breeds almost exclusively in horse manure, though in the absence of this it will utilize cow or carabao droppings. Other species of *Musca* breed more indiscriminately and many other of the Muscidæ taken in Taytay were found in decaying vegetable and animal matter.

In all, some 18 species of flies including 2 species of Tabanidæ (horse-flies) were collected in the town. Individuals of many species of flies were secured from the leaves of banana plants growing under trees infected with Coccidæ. The honey dew voided upon the banana leaves by the scale insects furnished an attractive food for the flies and I was thus enabled to collect a considerable number. With the exception of *Musca domestica* L., and *Stomoxys calcitrans* L., (the stable fly), which are the two forms most common in the dwellings in Taytay, the remaining species collected have been sent to Europe for determination and the list will appear later.

Aside from the nuisance of having large numbers of flies always present in a town like Taytay and the menace to health which results from the likelihood of their carrying different infectious diseases, there is another phase of their presence which is not unworthy of consideration, especially as cases have already occurred with a certain degree of frequency in other places in the Philippines. I refer to the constant danger of infections by both adults and children with the larvæ of many of the *Sarcophagidæ*. Indeed, numbers of cases of myiasis in Americans in these Islands have been reported during the past ten years.

BEDBUGS.

(*Cimex lectularius* L.) In only two instances were evidences of bedbugs noted in Taytay, both of these cases being found in houses in which high beds were used. It is quite evident that this pest is not at all serious in the town. In fact the majority of Filipino houses are quite free from it, owing to the kind of sleeping paraphernalia used by the general class: namely a *petate* or mat and a pillow. These articles are disturbed regularly at least twice a day and as they are frequently placed in the sun, there is little chance for bedbugs to breed in them. The open floors of Filipino houses and the ease with which they may be and are washed out, make lodgement for these insects very precarious.

HEAD LICE.

(*Pediculus capitis* De Geer.) This insect is general in the Philippines, occurring on the heads of both young and adult females, but only very rarely on young males and then only on those who wear the hair long and in a condition of questionable cleanliness. The lice are not limited to any social class and children of the best families, by contact with schoolmates and servants, acquire them readily. They are looked upon with abhorrence by the Filipinos and every means is employed for ridding the heads of those infested. The commonest method is that of individual removal, the hair, after a bath and a treatment with coconut oil, being examined carefully and both adult insects and eggs taken off and killed. The head louse was found in the usual degree of abundance in Taytay, the eggs being observed on the heads of girls on the street and occasionally on women who came to the hospital; and the usual process of removal was noted in the windows or doors of dwellings.

Phthirius inguinalis Leach appears to be unknown in Taytay, as frequent inquiry as to its presence or knowledge of it invariably elicited a negative reply. This seems equally true of *Pediculus vestimenti* L.

FLEAS.

A single species of flea was observed in Taytay. Specimens were taken from dogs and proved to be *Pulex serraticeps* Gerv. It is quite evident from the general appearance of the canines of this town that their lives are made miserable by the abundance of fleas which they harbor. Undoubtedly fleas from dogs cause some annoyance to the people and may prove a menace, but as long as dogs, half starved and ill-treated, form such a large factor in the community life of the Filipino, so long will the hope of a lessening of this menace be out of the question.

DOG TICKS.

(*Dermacentor* sp.) One or two of the dogs I examined closely were found harboring a few female individuals of *Dermacentor* sp., and from my experience with this species in other parts of the Philippines, I am led to believe that it is no less abundant in Taytay than elsewhere. From the facts that dogs live in the most intimate relation with man in these Islands and the habit possessed by these ticks, especially the males, of dropping off and migrating around habitations, they must certainly prove at least an annoyance to the human inhabitants. The nymphs also, of both sexes, before they attach themselves to canines, must occasionally attack the people of the house.

CARABAO LICE.

(*Hæmatopinus tuberculatus* Nitzsch.) Wherever the carabao is found in the Philippines the carabao louse may be found also. The few carabao examined in Taytay yielded their quota of this pest. The eggs as well as individuals in all stages of growth, may be taken from under the jaws, along the ventral and lateral surfaces of the neck and not infrequently in the ears. In many parts of the Islands they occur in great numbers and often cause sores upon the animal, from their bites and the efforts of the carabao to scratch the irritated part by rubbing against stones, trees, etc.

I mention this insect in this connection, though it does not directly cause annoyance to man, because of the possibility that its presence may have some bearing upon the spread of rinderpest or other diseases of the carabao.

In conclusion it may be stated that conditions with regard to the general prevalence of insects in Taytay do not differ essentially from those in most of the inland towns which I have visited in the Philippines. The life of the people is about the same as that in any other of a thousand Filipino communities and, to my mind, what would be true of Taytay with reference to hygienic and general sanitary or prophylactic measures would apply to most other towns.

At the end of this article a list is appended of the insects collected in Taytay, so far as they have been determined, together with a statement of their relative degree of prevalence. There is nothing new to report concerning those which have pathologic importance.[3]

I am of the opinion that the type of midden pit used at Taytay offers as serious a menace to health as the older plan of allowing pigs and chickens to be the general municipal scavengers, because under present conditions the flies which breed directly in the fæces and the mosquitoes found breeding in these pits, which may become partially filled with water, are certainly to be reckoned with as possible transmitters of typhoid bacilli, amœbæ, and filariæ; while the chance of infestation with parasitic worms through the media of pigs and chickens seems much more remote. If it were possible to have the midden pits nearly filled with water upon the surface of which a few tablespoonfuls of petroleum or crude carbolic acid were poured weekly, then all danger of flies or mosquitoes breeding in them would be removed; but at best this would be practicable only in the rainy season and the work would require a better system of inspection than that furnished by the average municipal health officer.

LIST OF MOSQUITOES AND OTHER INSECTS TAKEN AT TAYTAY.

DIPTERA.

CULICIDÆ.

Anophelinæ.

1. *Myzomyia rossii*[4] Giles, very common, taken in all streams where green algae were growing; the undoubted transmitter of malaria in this town.

[3] *Loc. cit.;* also Ashburn and Craig, *Ibid., Sec. B,* (1907), 2, 1.

[4] *Myzomyia rossii* Giles has been previously noted by me and also by others under the name *M. ludlowii* Theob., but during my stay in London last year I proved to my satisfaction that the Philippine species is none other than *M. rossii.* Professor Theobald told me that he had reached the same conclusion and that he expected to note it in his next volume on the Culicidæ. I examined several hundred specimens of *M. rossii* in the British Museum and compared them with an even larger number from the Philippines and could discover no essential differences.

2. *Myzorhynchus barbirostris* V. d. W. Very rare, two specimens.

3. *Stegomyia persistans* Banks. The day-flying "tiger mosquito" a universal breeder in practically every house in Taytay, a great annoyance.

4. *Stegomyia samarensis* Ludl., rare, taken only twice.

5. *Culex concolor* Desvoidy, rare, a half dozen specimens bred from water of stream at Pinagsalaan well.

6. *Culex fatigans* Wied., not common, bred in two midden pits. May be more common in this town in the rainy season as it is in Manila and other towns.

7. *Culex microannulatus* Theob., rather common, found associated with *Myzomyia rossii.*

8. *Culex taytayensis* Banks n. sp.,[5] not common, found in streams and shallow wells as shown on map.

9. *Culex argentinotus* Banks n. sp.,[5] very rare, only three specimens, bred from stream at Pinagsalaan.

10. *Banksinella luteolateralis* Theob., rather common, specimens bred from stream at Pinagsalaan.

MUSCIDÆ.

11. *Musca domestica* L., extremely abundant in-doors and out-of-doors.

12. *Musca* sp., very abundant, a species much larger than *domestica.* This with other Diptera sent to Europe for identification.

13. *Stomoxys calcitrans* Linn., very common, a great annoyance to horses especially at the railroad station where many vehicles congregate.

HEMIPTERA.

CIMICIDÆ.

14. *Cimex lectularius* Linn., apparently rather scarce in Taytay, specimens taken in only two houses.

PEDICULIDÆ.

15. *Pediculus capitis* De Geer, common.

16. *Hæmatopinus tuberculatus* Nitzsch, common as a parasite on carabao.

SIPHONAPTERA.

PULICIDÆ.

17. *Pulex serraticeps* Gerv., common, found on all dogs examined, not seen in houses but evidently a limited source of annoyance to man here.

ACARINA.

IXODIDÆ.

18. *Dermacentor* sp., not common on dogs, found on several of these animals examined.

[5] The description of these two species will appear in this JOURNAL, Sec. A, 4, No. 6, during the present year.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

VIII. VITAL STATISTICS.

By PAUL CLEMENTS.[1]
(*From the Bureau of Health.*)

As will be seen from the accompanying map (Plate III), the extreme dimensions of the town of Taytay are approximately a kilometer from north to south, and, including the extension of the town along the roads to Cainta and Antipolo, about 1½ kilometers from east to west. In this area there are over twelve hundred occupied dwellings on twenty-five streets. The streets have no names and the houses are not numbered, although the town is divided into four barrios—Dolores, San Juan, San Isidro, and Santa Ana. It was soon found that knowing the name of the barrio in which a patient lived was of little assistance in locating him afterwards in case he failed to return to the clinic. It was also realized that the official returns of the census of 1903, already six years old, did not afford a reliable foundation upon which to base statistics. The listing and enumeration of the population was therefore undertaken both for the purpose of procuring information which would enable us to trace patients and of ascertaining as exactly as possible the size of the population with which we were dealing. In the course of preparing this census, however, it was found that many cases of disease came to our notice in this way which would otherwise have escaped us and we regretted afterwards that it was not undertaken at the very beginning of the work in the town and pushed to completion before other studies were begun.

Our census deals only with the main portion of the town, and does not include the barrio of San José which is located about 2 miles to the southeast. Our results indicate a slight gain in population since 1903; the district covered by the census at that time had a population of 5,840, and has at present one of 6,094.

The excess of females shown by the census of 1903 is still maintained. In that year there was an excess of 163 females in a population of 6,067 for the entire municipality. The present census in the

[1] Medical inspector, Bureau of Health, Manila, P. I.

area covered shows an excess of 162 females in a population of 6,094. In spite of this fact, the age group, "under 5 years" shows a male excess of 39, which agrees with the birth records of the town of the past two years and which also show an excess of males. The excess of females is found principally in the groups "5 to 9 years," "15 to 19 years," and "20 to 24 years." In the groups "10 to 14 years" and "25 to 29 years" the sexes are almost exactly equal, while in all the groups falling between the ages of 30 and 60 a slight excess of males is shown. The excess of females in the groups "15 to 19 years" and "20 to 24 years" is probably to be explained to some extent at least, by the more pronounced tendency in the male to emigrate between those ages in search of better educational facilities, or of better opportunities of gaining a livelihood. This tendency would not apply to the group "5 to 9 years." In this group there are 347 females to 300 males, an excess of 47, which almost exactly coincides with the group "under 5 years" of 1903, in which there were 443 females to 399 males, or an excess of 44. The explanation is probably to be found in an upward swing in the female birth rate during the early half of the present decade. The total present population and its distribution in sex and age groups are shown in Table 1, and the percentage of distribution in Table 2.

TABLE 1.—*Population of Taytay by age and sex groups.*

	Less than 1 year.	1 year.	2 years.	3 years.	4 years.	5 to 9 years.	10 to 14 years.	15 to 19 years.	20 to 24 years.
Males	83	115	108	116	88	300	245	242	225
Females	103	110	112	90	76	347	247	313	305
Total	186	225	220	206	164	647	492	555	530

	25 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.	70 years and over.	Un-known.	Total.
Males	268	378	233	157	111	99	198	2,966
Females	271	363	209	138	121	84	239	3,128
Total	539	741	442	295	232	183	437	6,094

TABLE 2.—*Percentage distribution by age and sex groups.*[a]

	Less than 1 year.	1 year.	2 years.	3 years.	4 years.	5 to 9 years.	10 to 14 years.	15 to 19 years.
Males	1.46	2.03	1.90	2.05	1.55	5.30	4.33	4.27
Females	1.82	1.94	1.98	1.59	1.34	6.13	4.37	5.53
Total	3.28	3.97	3.88	3.64	2.89	11.43	8.70	9.80

[a] Calculated on 5,657 persons of known ages.

TABLE 2.—*Percentage distribution by age and sex groups*—Continued.

	20 to 24 years.	25 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.	70 years and over.
Males	3.97	4.73	6.68	4.11	2.77	1.96	1.75
Females	5.39	4.78	6.41	3.69	2.44	2.14	1.48
Total	9.36	9.51	13.09	7.80	5.21	4.10	3.23

	Number.	Per cent.
Under 5 years	1,001	17.69
From 5 to 9 years	647	11.43
From 10 to 19 years	1,047	18.50
From 20 to 29 years	1,069	18.89
From 30 to 39 years	741	13.09
From 40 to 49 years	442	7.81
From 50 to 59 years	295	5.21
From 60 to 69 years	232	4.10
From 70 years up	183	3.23

The register of births and deaths kept by the municipality is the only available source of data on these points. The register of deaths is believed to be complete, and as accurate as circumstances permit. A death certificate is required as a necessary preliminary to interment. With the exception of the most important fact in connection with a death, its cause, the required data are within the ability of a layman to ascertain. Previous to August, 1907, there was no physician in the town of Taytay, and it is in consonance with this fact that during the early months of that year only eight causes are assigned for all the deaths which occurred, viz: eclampsia, phthisis, fever, senile debility, difficult labor, cerebral congestion, colic, and fracture. For the latter part of 1907 and for the entire year of 1908, the causes of death assigned in the records are probably a much nearer approximation to the truth. When it is remembered, however, that in the great majority of cases in the town the physician is not called except after death and then only because he is required for the purpose of executing a death certificate, that the information to be obtained from the family and friends of the deceased is vague and unsatisfactory, and that an autopsy is practically impossible to obtain, it will be seen that even the cause of death as assigned by a competent physician frequently at best can be only approximately correct.

The registered deaths are 170 for 1907, or 27.91 per thousand, and 277 for 1908, or 45.42 per thousand. This considerable difference between the two years is largely accounted for by the absence of smallpox during 1907, and its presence during 1908, when the number of deaths from this disease was 76. Excluding smallpox, we find 201 deaths, or 33 per thousand for 1908. We feel safe therefore in stating that, exclusive of epidemics, the death rate for the town is between 27 and 33 per thousand.

In view of the unsatisfactory nature of the causes assigned in the records for deaths occurring during 1907, no attempt will be made to draw conclusions from the data for that year other than those which may be obtained from the age distribution. This is shown in Table 3. The percentage distribution, compared with the percentage distribution of population in age groups, is shown in Table 4.

TABLE 3.—*Distribution of deaths by age groups.*

	Less than 1 year.	1 year.	2 years.	3 years.	4 years.	5 to 9 years.	10 to 14 years.	15 to 19 years.	20 to 24 years.	25 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.	70 years and over.	Total.
1907	39	24	17	4	1	6	4	7	5	5	17	8	9	12	12	170
1908[a]	51	8	21	16	5	12	2	4	4	13	20	13	3	9	20	201
1908[b]	68	15	39	27	17	21	4	4	4	13	20	13	3	9	20	277

[a] Excluding smallpox. [b] Total.

Rate per thousand per year:

1907	27.91
1908, excluding smallpox	33.00
1908, total	45.42

TABLE 4.—*Percentage distribution of deaths, by age groups, compared with distribution of poulation.*

	Less than 1 year.	1 year.	2 years.	3 years.	4 years.	5 to 9 years.	10 to 14 years.	15 to 19 years.
Population	3.28	3.97	3.88	3.64	2.89	11.43	8.70	9.80
Deaths for 1907	22.94	14.12	10.00	2.35	0.59	3.53	2.35	4.12
1908, excluding smallpox	25.37	3.98	10.49	7.91	2.48	4.47	0.99	1.99
1908	24.55	5.41	14.08	9.75	6.13	7.58	1.44	1.44
Registration area, United States, 1907	19.08	4.01	1.74	1.11	0.79	2.22	1.53	2.67
Total			26.74					

	20 to 24 years.	25 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.	70 years and over.
Population	9.36	9.51	13.09	7.80	5.21	7.06	3.23
Deaths for 1907	2.94	2.94	10.00	4.70	5.29	7.06	7.06
1908, excluding smallpox	1.99	6.46	9.95	6.46	1.49	4.47	9.95
1908	1.44	4.69	7.22	4.69	1.08	3.25	7.22
Registration area, United States, 1907	4.05	4.29	9.17	9.29	9.89	11.76	18.17

The proportion of deaths occurring under one year is somewhat larger than occurs in the United States (Registration Area, 1907), 22.94 for 1907, and 24.55 for 1908, as against 19.08 for the United States. The excess is more marked in the age groups corresponding to childhood, the group "under 5 years" showing 50 and 59.92, respectively, against 26.74 for the United States. The difference from 10 to 39 years is not marked. The proportion of the death rate occurring in the groups above 40 is decidedly less.

Table 5 exhibits the age distribution of deaths during 1908 attributed to the more important causes, numerically speaking. The most noticeable feature is that two-thirds of the deaths attributed to chronic bronchitis occurred between the ages of 15 and 50. Almost certainly the majority of these were due to tuberculosis. The writer believes that 25 deaths per year from pulmonary tuberculosis would be much nearer the truth than 10, which is the number assigned in the records. It is also much more nearly in accord with our estimate of 50 to 60 cases of pulmonary tuberculosis existing in the town at the present time.

TABLE 5.—*Age distribution of deaths in 1908.*

	Less than 1 year.	1 year.	2 years.	3 years.	4 years.	5 to 9 years.	10 to 14 years.	15 to 19 years.	20 to 24 years.	25 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.	70 years and over.	Total.
Chronic bronchitis			1					1	1	3	8	4		3	5	26
Infantile convulsions	33	3	1	2		1										40
Dysentery	2		10	5	2	4					1				1	25
Fever infection						1		1								2
Grippe								1			1					2
Malaria			1			1		1		1						4
Typhoid							2			2	2	1			1	8
Undetermined			2	2						1		1	1	3		10
Gastro enteritis:																
Acute	2	1	1	2		1										7
Chronic	4	2	3	3	1											7
Smallpox	17	7	18	11	12	9	2									76
Pulmonary tuberculosis					1				1	1	4	3				

The deaths attributed to infantile convulsions merit an age distribution in smaller groups, as follows:

Under 30 days	16
Under 1 to 2 months	4
Under 2 to 3 months	3
Under 3 to 4 months	2
Under 4 to 5 months	1
Under 5 to 6 months	1
Under 6 months to 1 year	6
Over 1 year	7

The seven deaths in children over one year of age, and probably most of those between three months and one year, were probably due to other causes.

From the statistics it would appear that smallpox was entirely an affection of childhood. This probably resulted from the fact that the entire existing population of 1905 was vaccinated against smallpox and that this was repeated in March of the present year by representatives of the Bureau of Health; in addition, vaccinations were performed yearly by the local health officer.

The birth register of the town is not so reliable as that of the deaths, the former being merely a copy of the baptismal records of the parish church; therefore, probably a small percentage of the births escape registration. This percentage is, however, small, as practically the entire population is Catholic and religious observances occupy a large place in the daily life of the people. In regard to baptisms, we were told that this rite is customarily performed from thirty to forty days after birth, and is the first occasion on which the mother leaves the house after her confinement.

The registered births are 114 males and 103 females for 1907, and 203 males and 164 females for 1908, the respective rates per thousand being 35.60 for 1907, and 60.22 for 1908.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

IX. GENERAL SANITARY CONDITIONS.

By Paul Clements.[1]
(*From the Bureau of Health.*)

In Taytay the majority of the inhabitants enjoy what would be regarded as modest comfort according to Filipino provincial standards; comparatively few are wealthy and the poorer people do not suffer any hardships. The principal occupations of the inhabitants are agriculture and fishing. Many follow both vocations according to the season. At present, there are no Americans or Europeans and only two Chinese residing in the town, and it would appear that the conditions of life have not been much modified by contact with foreign influence. For this reason, a medical survey of the town should be fairly typical of this section of the Philippine Islands.

The great cholera epidemic of 1882 is said to have started at Taytay, and since that time the town has had a bad reputation from a sanitary point of view. Taytay also suffered severely in the cholera epidemic of 1902, and again in 1905, though perhaps not more than the other provincial towns of central Luzon.

A small portion of the town, including the church, schoolhouse, and municipal building, occupies a low foothill of the Antipolo Range; much the greater part, however, is built on an alluvial plain with a gradual slope toward the south, in the direction of the Laguna de Bay. (Plates X and XI.) Two principal streams run through the town, their beds lying from 6 to 10 feet below the level of the plain. They carry a variable volume of water during the rainy season and early months of the dry season, but during the latter months of the dry season they are without water except for disconnected pools along their courses. Two smaller tributary streams also assist in the drainage of the town. Observations of the level of the water in a number of wells made during the latter part of the dry season indicate that the ground water reaches to within about 12 feet of the surface when it is at its lowest level.

The average dwelling in Taytay is a structure having a frame of which

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the heavier parts are of wood and the lighter parts of bamboo, the roof and sides being of nipa thatch, and the floor of split bamboo-lath, laid with an interval of 3 or 4 millimeters. Ample ventilation is provided by these intervals in the floor, and by generous windows which are closed at night and during storms by blinds of bamboo or of nipa thatch on a bamboo frame. The eaves project usually about half a meter. Direct sunlight rarely penetrates into the house. This structure consists usually of two rooms which are frequently built as separate units. The entrance is at the side of the rear room. A portion of the front room is partitioned off as a closet in which clothing and bedding are kept. Behind the rear room is a small kitchen and a *batalan,* a small roofless porch, where the food is prepared and the water jars are kept. The rooms of such a house are approximately square, the lineal dimensions being $3\frac{1}{2}$ or 4 meters. The floor is from $1\frac{1}{2}$ to $2\frac{1}{2}$ meters off the ground, the entire structure being supported on wooden posts, 15 to 20 centimeters thick, which are set into the ground and reach to the frame of the roof, passing through the corners of the room from floor to roof. The distance from floor to roof is often not more than 2 meters, and sometimes less.

A small percentage of the houses, usually occupied by newly married couples of the poorer class, are smaller and of lighter construction than that described. These consist only of a single room and a kitchen, the frame and supports being entirely of bamboo. There is usually no ceiling and the inside of the roof is begrimed by the smoke of the kitchen fire, chimneys being unknown. From the roof frame is hung a shelf or two, a little higher than one's head, where various articles are put to be out of the way. Strings of garlic, peppers, ears of maize, dried fish, as well as nets or other articles used by the owner in his work, are hung also from the roof frame.

There is usually not much furniture. The bed consists of a mat spread upon the floor at night and a pillow or two. The mosquito net is almost unknown. There are one or two wooden benches, several chests for clothing, and numerous baskets of various shapes and sizes. In the kitchen one or more *calans* (or wooden frames used for holding pots in cooking) are found, and a small portable fireplace of native pottery, on the upper rim of which are three knobs that support the rice pot or the frying pan, the latter being of the same material as the *calan.* A few water jars and a small number of dishes complete the inventory of the household belongings of the average native of Taytay.

FOOD.

The chief component of every meal is boiled rice. This may be accompanied by a stew of fish and vegetables, or of vegetables alone, or by a dish of fried fish. Meat is a rarity for the poor inhabitant of Taytay. Such small amounts as are eaten consist generally of pork or fowl. Ginger, which grows wild in many parts of the Philippines, is much used as a condiment, as are also garlic and peppers. Tuberous and other starchy roots are used to some extent, but principally as a substitute for rice, when the latter is scarce. Almost the only variation in the food from day to day consists in the use of different kinds of vegetables in the seasoning of the stew. The kitchen work is very light, compared with the standards of more highly civilized countries. There is only the washing of the rice and vegetables and the cleaning of the fish or fowl, before the pot goes on the fire, and only a very limited number of dishes to clean afterwards.

When the meal is ready, the rice is turned out upon a large platter, usually of crude porcelain but sometimes of wood, or, occasionally, upon a banana leaf, and the seasoned stew is poured into another dish or perhaps served in the pot in which it was cooked. Both are then placed on the floor or on a low table (about 15 centimeters in height). The family gathers in a squatting position around this table, or around the platter and dish on the floor. Each one takes with his fingers a small portion of rice, which is worked with the finger tips into a bolus, dipped into the stew and then put into the mouth. From time to time a piece of fish or other tidbit is taken from the stew. When the meal is finished, no further toilet is made other than wiping the fingers and mouth on a bit of rag.

The waste from the kitchen such as fish scales, feathers, entrails, vegetable parings, etc., are thrown upon a rubbish heap, and such parts as escape the attentions of the family pig are burned, sometimes daily, sometimes at longer intervals. The slops from the washing of food, dishes, and vessels, are merely poured through the crevices in the kitchen floor; and this practice results in the universal presence of a puddle of foul, stagnant mud underneath the kitchen.

WATER.

There are a number of wells within the town, the water of which is used for various domestic purposes, but not for drinking. Drinking water is usually obtained from springs and wells in the fields, about 200 meters from the outer limits of the town. The only provision for drawing water is an empty petroleum can and a rope. A length of bamboo or a wooden beam is placed across the mouth of the well, and the drawer stands with one foot on this beam and the other on the curb for greater convenience in pulling up the can. Women frequently go for water with an earthen pot, which is carried on the head; but a man will usually carry two petroleum tins swung from a stout piece of bamboo across the shoulder. When the house is reached, the water is emptied into the jars. There are separate jars for drinking water. Each jar, whether the water contained in it is destined for drinking or for other uses, is provided with a wooden cover and with a coconut shell for a dipper, which either lies on the lid, or floats on the surface of the water within. Water is dipped out with this shell, the fingers grasping its edges, and being placed in the water with each dip.

CLOTHING.

Children of both sexes from 1 to 4 years of age or even older, are seen frequently with no clothing whatever, or with merely a thin shirt reaching only to the navel. Older boys add to the shirt a pair of drawers, secured at the waist with a draw string. Girls from 4 or 5 years of age to that of puberty, wear a single garment—a chemise of cotton print reaching to the knees. From puberty onward, the costume of the women consists of the short *camiseta* or chemise, which is sleeveless and low-necked, and reaches to just below the waist line; a skirt, or perhaps two skirts; the *camisa* or waist of *sinamay* material with flaring sleeves which come to the elbow; and the *pañuelo* or neckerchief of the same material. The *camisa* and *pañuelo* are usually starched to the last degree of stiffness, and are taken off at night or when the wearer is engaged in household tasks. Large boys and men wear a shirt and drawers, the latter, and sometimes also the former, being made of cotton cloth. Frequently the shirt is of *sinamay* and then an undershirt of cotton knit goods is usually worn. Both sexes frequently go barefooted, but some wear *chinelas*—loose slippers with a leather sole and a cloth toe-piece—in dry weather, and *suecos* or wooden clogs in wet weather.

When fishing or cultivating rice, the workman is frequently in mud which reaches up to his knee or mid-thigh.

Preparations for retiring are easily made. Mats are unrolled and spread on the floor, pillows put down, the windows and doors closed, and the family lie down wholly or partly dressed. Separate clothing for night wear is not used. With the closing of windows and doors and the covering of the open spaces in the floor with mats, the ventilation of the house at night is materially reduced; however, it is practically impossible in houses of native construction to cut off all ventilation.

BATHING AND WASHING.

The washing of clothing and bathing of the person are frequently performed in conjunction. The site of preference is a shallow spot in the margin of a stream whenever there is one not too distant. The housewife carries the soiled clothing to the edge of the stream in a wide, shallow wooden basin balanced on her head. Arriving at the stream she puts down her load, loosens one of her skirts at the waist and secures it just under the arms and across the upper part of the breasts, from which it reaches to her knees, and then removes the remainder of her clothing. She selects a smooth stone, which reaches just above the surface of the water and squats in front of it. The clothes are soaked for a moment in the water and then piled conveniently at hand. She then selects a piece from the pile, soaps it, and laying it upon the stone, beats it smartly with a piece of wood shaped for the purpose, dipping the latter from time to time into the water, until all the soap is finally removed from the garment. The piece is then wrung out and placed in the basin, and another is taken.

The women usually do their washing in groups and are accompanied by the smaller children of the family of both sexes, who, up to 8 or 9 years of age, play in the water, nude. When all the clothing is washed, the children are also scrubbed, water being poured over the head and shoulders from a coconut shell. The women then proceed to bathe themselves in the same way, rubbing the body with the hands or with a fold of the skirt. A shampoo with *gogo* which much resembles soap-bark, usually accompanies the bath. When the bath is finished, the *camisa* is put on, then a dry skirt, under cover of which the wet one is dropped about the ankles, and the dressing may then be finished at leisure.

If there is no stream convenient to the house, the washing is done near a well, a can of water being drawn and poured into the basin, the clothing piled on a board or stone until the washing is completed, then the soapy water is poured on the ground, and the clean clothes carried home in the basin. Here, too, the woman bathes herself after washing the clothes. From this habit of bathing and the spilling of the water, as it is drawn from the well and poured into the vessels, it results that the ground around the mouth of the well is practically always sloppy and muddy. Men bathe in the same manner, keeping on the drawers or tying a garment around the middle as a loin cloth.

Besides the bath, almost the only care taken of the person is that given to the hair, and a comb of hard wood is almost the only toilet article used. The women comb the hair very carefully and fasten it in a knot at the back of the head or back of the neck. Coconut oil is universally used as a dressing for the hair. Toothbrushes, hairbrushes, mirrors, etc., are not used among the lower classes. Washing the face and hands is considered necessary only when there is a visible soiling. Head lice are evidently common, judging from the frequency with which one woman is seen inspecting another's hair.

NIGHT SOIL.

Of 1,299 houses in Taytay which were inspected and the conditions found noted, 591, or 45.4 per cent, were without provision of any description for the disposition of night soil, while 342 houses, or 26.3 per cent, were provided with outhouses. The latter are small structures of bamboo and nipa, usually raised to the level of the house, and 8 to 10 meters distant from it. Two hundred and sixty-six of these outhouses are connected with the house by a bamboo bridge (Plates XIII & XIV); 76 are without such connection. These privies have no seats; the user squats over a hole in the floor, and the night soil falls through to the ground. The space under the floor is inclosed usually, but a hole large enough for the pig to get through is left invariably at the back of the inclosure. The result is that there is no accumulation—the pig acts as scavenger. On 433 premises, or 33.3 per cent, pits were found which were intended to serve as dry-earth closets. These, however, are of recent introduction, having been dug in January of the present year, by direction of the local health officer, at a time when there was a small outbreak of cholera in the adjoining town of Cainta. More than half of these pits are not used now, the people having resumed their old habits. Sixty of those still in use are provided with a covering, and 8 of these have a shelter in addition. Eleven of the raised outhouses have pits underneath and there are 56 premises where outhouses and pits exist separately. Of the entire number, 81 may be said to fulfill satisfactorily the function of a dry-earth closet.

Those who have neither outhouses nor pits either use a vessel in the house which is emptied early in the morning at any convenient place, or, if they live near the edge of the town, they go into the nearest clump of bushes. Urination at home is frequently performed through the kitchen floor. Away from home, the women will squat, with the skirts arranged in as wide a circle as possible; men simply go up to and face the nearest bush, tree, or wall.

The figures given above with regard to the disposition of fæces may be tabulated as follows:

Number of houses to which the data refer	1,299
Number of houses with no provision for disposal of night soil	591
Number of houses with raised outhouse and pit in connection	11
Number of houses with raised outhouse and separate pit	56
Number of houses with raised outhouse alone	275
Number of houses with simple pit	298
Number of houses with pit with cover	60
Number of houses with pit with cover and roof	8

THE SURROUNDINGS OF THE HOUSE.

The average size of the lots upon which the houses are built may be estimated at 500 square meters, though there are sections of the town in which the lots are much smaller than this. The house is usually built on one corner of the lot, so that in most instances there is ample space between the houses. Occasionally a small number of houses are grouped together, being only about a meter apart. There are no "back alleys." The streets vary from 5 to 8 meters in width. Little work is done on them, and the middle of the street is usually ankle deep in dust in dry weather, and in wet weather still deeper in mud, there being no storm-water drainage except the little provided by the natural slope of the land.

The principal defects within the yard are the mud puddle under the kitchen, already alluded to, and the accumulations of filth due to the keeping of animals. A good deal of litter accumulates, such as fallen leaves, dead weeds, rice hulls, straw, shavings from bamboo work, etc., and this is swept into a heap and burned out of doors daily or whenever the weather permits. Into this fire goes also such solid kitchen waste as escape the attention of the family pig.

Almost every family has one or more dogs, a few chickens, and a pig. The dogs and chickens take care of themselves and contribute comparatively little to unsanitary conditions. The pigs also run loose, except for a month or two before slaughtering, when they are confined in a sty and are well cared for. A small pig, intended to be consumed by the owner and his family and friends, will frequently be kept in a corner of the kitchen. It is, however, the owners of carabaos and horses who live in the most unsanitary surroundings to be found in the town. The carabaos are in the fields by day, either at work, or grazing, but at night the timid owner wishes them under his eye or within hearing. The same may be said of the comparatively small number of horses in the town, which are principally used in traffic with the near-by towns of Pasig and Antipolo. The carabao usually lies in a corner of the yard but a small shed with feed trough and board floor is usually built for the horse. The accumulations of dung, urine, feed waste, etc., are allowed to remain until at times the yard becomes impassable.

MARKET.

The market building is merely a large thatched shed, with a dirt floor. There are no walls, the front opens upon the street, the back upon a vacant space, while the sides are to some extent closed in by the walls of adjoining buildings. Here are to be seen each morning considerable quantities of vegetables, some fruits, eggs, a few fowls, and pork. A few of the regular venders have large tables on which their produce is exhibited. There is always, however, a considerable contingent of occasional venders of small quantities of produce with two or three baskets or a mat spread on the ground. From 6 to 7 o'clock in the evening, when the day's catch of fish comes in, is also a lively hour. Nothing but fish is seen in the market at this time.

There is no abattoir. It is rare that any animal except a hog is slaughtered, and this is usually done on the premises of the owner.

SICKNESS AND INFANCY.

Although there is now a native physician resident in Taytay, the majority of the people when they are sick do not call him, but either do without medicines, or prefer the services of an "herb doctor," of whom there are a number in Taytay. Whether this is due to indifference, or to lack of confidence, or to inability or unwillingness to pay the scale of charges usually exacted by a native physician, I am unable to say. There is some fear of "drug store" medicine, as contrasted with roots, barks, etc., which are obtained in the neighborhood, due to the idea that the former are poisonous and the latter not. Nevertheless, in about two months, more than a thousand persons voluntarily presented themselves at our clinic, and there were numerous requests to see those who were too sick to come.

The houses afford no better accommodations, and no more comfort, for the sick than for the well. The patient lies on a mat on the floor, usually with a cotton blanket over him. He is entirely dependent upon the family and neighbors for attention, and gets plenty of it such as it is, but much of it is misdirected. The prevalent idea that currents of air are not good for the sick causes them to shut up the house as tight as possible. Neither light nor air is admitted. The room, and indeed the entire house, is filled with sympathizing neighbors at all hours of the day and night if the patient is suffering from an acute and dangerous disease. Sick diet consists of rice cooked very soft, or of the broth strained from this. This is fed to the patient as long as he can swallow, and, needless to say, often to his detriment. The "herb doctor" acquires through experience a knowledge of the symptoms of the commoner diseases of the locality, and of some of the properties of medicinal plants of the neighborhood. The latter are known to furnish reliable purgatives, counterirritants, and sedatives, and it is claimed that some of the plants have abortifacient and antiperiodic properties.

Obstetrics is practiced as a separate art by old women who are ignorant of the first principles of cleanliness. Luckily, few abnormal labors occur. A length of cloth is often passed around the body of the parturient and traction made on the ends with the idea of assisting in the expulsion of the child. After birth, the cord is cut and tied, a pad of rags, not always of the cleanest, is secured over the umbilicus by a band, and the child is wrapped in a cloth. The mother does not get up for a week, and leaves the house for the first time when the child is baptized; that is, thirty to forty days after confinement.

The mother practically always nurses her infant. The latter is usually not weaned until it is 2 years old, and sometimes not until it is 3. It is not uncommon to see two children of different ages nursing from the same mother. On the other hand, the infant's diet is not breast milk alone. Rice feeding is usually begun at three or four months of age and perhaps causes the enlargement of the abdomen which is so strikingly noticeable in the children.

Funerals usually take place either in the early forenoon or late afternoon and within twenty-four hours of the death. Delay only occurs when some member of the family is absent, and there is hope of his being able to be present in a few hours or a day more. All the details of the burial are attended to by relatives or friends of the deceased. The body is washed, dressed in its best clothing, and wrapped in a mat which serves as coffin or winding sheet. The body is carried to the grave upon a sort of hammock constructed of bamboo slats and slung from a bamboo pole on the shoulders of two men, who are relieved in relays. After the funeral, those present return to the house of the deceased where a funeral feast is prepared.

THE BETTER CLASS OF INHABITANTS.

Such are the conditions under which the greater part of the population of Taytay undergo their daily existence. The changes which take place as we climb the rounds of the social ladder are much more in the direction of better material possessions than in that of improved habits and genuine comfort. Improvement is first shown in the construction of the house, in the proportion between the amount of wood and lighter materials employed, the height of doors, etc. While in the more ordinary houses the supports are the sole portions that are of wood, each advance in material well-being is marked by the additional use of wood in construction: first the floor joints and principal members of the roof frame, next the steps and the door and window frames, then the sides, until the entire house, except the thatched roof and the floor of bamboo lath, is constructed of wood. The final dignity of stone foundation, floors of wide smooth boards, and roof of galvanized iron, is attained by only one house in Taytay.

So it is also with regard to furniture. The possessor of a few chairs, a table, and a small mirror has climbed a step or two in the social scale, and when the principal room is lined with chairs, and there is a bed (reserved for distinguished visitors), a clothes press of hardwood, and sufficient dishes to set a table, the owner is likely to be one of the *principales*.

An individual's social station is indicated also fairly accurately by his clothing. On Sundays and gala occasions, the well-to-do man will appear in public in just such clothing as is worn by his white acquaintances, the ordinary clothing serving for underwear. However, just as soon as he is at home and in private, he removes the outside clothing and again appears in shirt and drawers. The ladies of the family do not change the style of their clothing, but use much handsomer material. The younger ones appear in gay colors, the older ones in more sober ones.

Among these more well-to-do natives in Taytay very little change will be found in the kitchen, perhaps nothing more than an increase in the number of fireplaces. The ordinary diet remains the same except that fish occupies a more prominent place, and meat appears oftener. The hygienic conditions outside of the house are likely to be worse, due to the ability of the occupant to purchase and keep a larger number of animals.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

X. ANIMAL PARASITES OF THE INTESTINE.

By Philip E. Garrison,[1] Ricardo Leynes, and Rosendo Llamas.

Table 1.—*Summary of findings.*

Examinations and infections.	Number.	Per cent.	Examinations and infections.	Number.	Per cent.
Persons examined	1,000		Persons infected with—		
Persons infected	959	95.9	*Amœba*	27	2.7
Persons infected with—			Ciliates	2	0.2
Ascaris	829	82.9	Flagellates	55	5.5
Trichuris	770	77.0	Encysted protozoa	11	1.1
Hookworms	116	11.6	Total infections	1,821	182.1
Strongyloides	7	0.7	Intestinal worms alone[a]	1,726	172.6
Oxyuris	4	0.4			

[a] Microscopic examination of the fresh sputum of 110 persons and of the centrifuged urine of 26 persons respectively failed to show ova of *Paragonimus* and of *Schistosoma*. There was no clinical evidence of these infections.

INTRODUCTION.

The inauguration of the work at Taytay offered an opportunity for the first time to determine the frequency of infection with intestinal parasites in a normal and fairly typical Filipino community. Practically all of our previous knowledge of this subject in the Philippines has been based upon the results of work done at Bilibid Prison, in the hospitals of Manila, and in military organizations. From these results certain tentative deductions have been made with regard to the rates of infection with the various parasites in question which might be expected in the Philippine population as a whole. It is our purpose in presenting the results found at Taytay to consider in conjunction with them these earlier figures and to draw such conclusions as may be warranted regarding the true significance of these infections in the Philippines in the light of our additional knowledge concerning them.

[1] Assistant surgeon, United States Navy; detailed medical zoölogist to the Biological Laboratory, Bureau of Science.

We believe that the real importance of intestinal infections with animal parasites, and especially with hookworms, as a factor in Philippine hygienic and industrial conditions is still far from being satisfactorily determined and that it will not be determined with a precision and definiteness in harmony with the present standards of medical science until much more work has been done in the provincial districts themselves where the people can be studied under representative conditions. We believe that already deductions have been made with regard to the medical importance of certain parasites which go far beyond what the actual known facts will warrant and in presenting this latest contribution to our knowledge of these infections we shall limit ourselves to such conclusions as appear justifiable upon grounds positively ascertained by the results of work actually done in the Islands.

In the studies performed at Taytay as in the work done at Bilibid Prison, only one cover-glass preparation of the stool was examined in the great majority of cases and it is realized that light infections were probably missed frequently. Most of the stools were passed after a dose of epsom salts though many were collected from people without such previous treatment. The great majority of the specimens were examined the same morning they were passed, usually within two or three hours, but frequently a specimen would be kept over night before being brought to us, necessitating care in order to avoid confusing the embryos of hookworms and *Strongyloides* and undoubtedly reducing somewhat the number of infections found with intestinal protozoa. The number of such old specimens examined was not sufficiently great however to account in any great measure for the marked disparity between our findings at Taytay and those of ourselves and of other workers elsewhere with regard to the frequency of intestinal *amœbæ* and flagellates in the Philippines.

In addition to the usual clinical record kept of all cases, patients infected with hookworms and with *amœbæ* were specially studied and notes made of the presence or absence of symptoms arising from these infections.

The distribution of the various infections in different ages and in the two sexes offers some points of interest.

AGE AND SEX DISTRIBUTION.

The prevalence of infections in males and in females and in various age groups is shown in Tables 2, 3, 4, and 5.

In general the age and sex distribution agrees with that which has been found in other localities.

Any significant differences in the frequency of infection in the sexes or in the different age groups will be considered under the head of each parasite separately.

SEX DISTRIBUTION.

TABLE 2.

	Number examined.	Infected.		Ascaris.		Trichuris.		Hookworms.		Strongyloides.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Males	[a]488	465	95.3	390	79.9	369	75.6	84	17.2	4	0.8
Females	[a]507	489	96.4	435	85.8	394	77.7	32	6.6	3	0.16

	Oxyuris.		Amœba.		Ciliates.		Flagellates.		Encysted protozoa.		Total infections.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Males	1	0.2	14	2.9	1	0.2	19	3.9	3	0.6	881	180.5
Females	3	0.6	13	2.6	1	0.2	24	4.7	6	1.2	909	179.3

[a] Five examinations not included; specimens sent to laboratory without giving sex of patient.

The figures in males differ materially in several instances from those obtained from prisoners at Bilibid Prison [2] as follows: Infected with *ascaris* at Bilibid, 26 per cent; with *trichuris,* 59 per cent; with hookworms, 52 per cent; with *amœba,* 23 per cent; with ciliates and flagellates, 21 per cent.

TABLE 3.—*Age distribution of infections.*

Age (years).	Total number examined.	Total infected.		Ascaris.		Trichuris.		Hookworms.		Strongyloides.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Under 2	73	46	63.0	39	53.4	22	30.1	0	------	0	------
2 to 4	100	96	96.0	87	87.0	75	75.0	1	1.0	2	2.0
5 to 9	127	126	99.2	119	93.7	108	85.0	4	3.2	1	0.8
10 to 14	53	53	100.0	50	94.3	44	83.0	11	20.8	0	------
15 to 29	227	221	97.4	194	85.5	177	78.0	37	16.3	1	0.4
30 to 49	250	248	99.0	203	81.0	204	81.6	42	17.0	1	0.4
50 and over	137	137	100.0	110	80.3	112	81.7	17	12.4	2	1.5
Under 15	[a]353	321	90.9	295	83.6	249	70.5	16	4.5	3	0.8
15 and over	[a]614	606	98.7	507	82.6	493	80.3	96	15.6	4	0.7

[a] Thirty-three examinations not included; age of patients not determined.

[2] *This Journal, Sec. B* (1908), 3, No. 3.

TABLE 3.—*Age distribution of infections*—Continued.

Age (years).	Oxyuris.		Amœba.		Ciliates.		Flagellates.		Encysted protozoa.		Total infections.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Under 2	1	1.4	0	------	0	------	3	4.1	0	------	65	89.0
2 to 4	1	1.0	2	2.0	0	------	8	8.0	1	1.0	177	177.0
5 to 9	1	0.8	3	2.4	0	------	7	5.5	1	0.8	244	192.1
10 to 14	0	------	0	------	1	1.9	4	7.5	0	------	110	207.5
15 to 29	1	0.4	9	4.0	0	------	10	4.4	2	0.9	431	189.9
30 to 49	0	------	7	2.8	1	0.4	10	4.0	1	0.4	469	187.6
50 and over	0	------	6	4.4	0	------	8	5.8	1	0.7	258	188.3
Under 15	3	0.8	5	1.4	1	0.3	22	6.2	2	0.6	596	168.8
15 and over	1	0.2	22	3.6	1	0.2	28	4.6	4	0.7	1,158	188.6

TABLE 4.—*Age distribution of infections, males.*

Age (years).	Total number examined.	Total infected.		Ascaris.		Trichuris.		Hookworms.		Strongyloides.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Under 2	37	21	56.8	17	45.9	10	27.0	0	------	0	------
2 to 4	53	51	96.2	44	83.0	41	77.4	1	1.9	1	1.9
5 to 9	56	56	100.0	54	98.8	47	83.9	3	5.4	0	------
10 to 14	19	19	100.0	19	100.0	15	78.9	5	26.3	0	------
15 to 29	120	117	97.5	100	83.3	92	76.7	28	23.3	1	0.8
30 to 49	120	118	98.3	92	76.7	96	80.0	30	25.0	1	0.8
50 and over	71	71	100.0	55	77.5	57	80.0	13	18.4	2	2.8
Under 15	165	147	89.1	134	81.2	113	68.5	9	5.5	1	0.6
15 and over	311	306	98.4	247	79.4	245	78.8	71	22.8	4	1.3

Age (years).	Oxyuris.		Amœba.		Ciliates.		Flagellates.		Encysted protozoa.		Total infections.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Under 2	0	------	0	------	0	------	1	2.7	0	------	28	75.7
2 to 4	0	------	1	1.9	0	------	0	------	0	------	88	166.0
5 to 9	0	------	0	------	0	------	4	1.7	0	------	108	192.8
10 to 14	0	------	0	------	1	5.3	0	------	0	------	40	210.5
15 to 29	1	0.8	4	3.3	0	------	4	3.3	2	1.7	232	193.3
30 to 49	0	------	4	3.3	0	------	4	3.3	1	0.8	228	190.0
50 and over	0	------	4	5.6	0	------	6	8.5	0	------	137	192.9
Under 15	0	------	1	0.6	1	0.6	5	3.0	------	------	264	160.0
15 and over	1	0.3	12	3.9	------	------	14	4.5	3	0.9	597	192.0

TABLE 5.—*Age distribution of infections, females.*

Age (years).	Total number examined.	Total infected.		Ascaris.		Trichuris.		Hookworms.		Strongyloides.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Under 2	36	25	69.4	22	61.1	12	33.3	0	------	0	------
2 to 4	47	45	95.7	43	91.5	34	72.3	0	------	1	2.1
5 to 9	71	70	98.6	65	91.5	61	85.9	1	1.4	1	1.4
10 to 14	34	34	100.0	31	91.2	29	85.3	6	17.6	0	------
15 to 29	107	104	97.2	94	87.9	85	79.4	9	8.4	0	------
30 to 49	130	130	100.0	111	85.4	108	83.1	12	9.2	0	------
50 and over	66	66	100.0	55	83.3	55	83.3	4	6.1	0	------
Under 15	188	174	92.6	161	85.6	136	71.8	7	3.7	2	1.1
15 and over	303	300	99.0	260	85.8	248	81.5	25	8.3	0	------

Age (years).	Oxyuris.		Amœba.		Ciliates.		Flagellates.		Encysted protozoa.		Total infections.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Under 2	1	2.8	0	------	0	------	2	5.5	0	------	37	102.8
2 to 4	1	2.1	1	2.1	0	------	0	------	1	2.1	81	172.3
5 to 9	1	1.4	3	4.2	0	------	3	4.2	1	1.4	136	191.6
10 to 14	0	------	0	------	0	------	4	11.8	0	------	70	205.9
15 to 29	0	------	5	4.7	0	------	6	5.6	0	------	199	186.0
30 to 49	0	------	3	2.3	1	0.8	6	4.6	0	------	241	185.3
50 and over	0	------	1	1.5	0	------	2	3.0	1	1.5	118	163.6
Under 15	3	1.6	4	2.1	0	------	9	5.3	2	1.1	324	172.3
15 and over	0	------	9	3.0	1	0.3	14	4.6	1	0.3	558	184.2

INTESTINAL WORMS.

The results of the examinations at Taytay agree with those of the other series in showing the Filipinos almost universally infected with intestinal worms. Of the 4,106 prisoners examined at Bilibid about 84 per cent were infected; of the 385 women and children in Manila, 89 per cent. At Taytay, infections with intestinal worms were found in 96 (95.9) per cent.

The average number of infections with intestinal worms for each 100 persons examined (indicating multiplicity of infection) was 172.6 at Taytay, 138.7 among Manila women and children, and 142 among Bilibid prisoners.

Referring to Table 2, it will be noted that there is practically no difference between the sexes with regard to the percentage infected or to the average number of infections per 100, though the prevalence of certain individual parasites differs materially.

With regard to the prevalence of worms in the various age groups, (Tables 3, 4, 5) little difference is noted in the total proportion infected and the average number of infections, excepting that the figures are lower for those less than 2 years old (nursing children). Still, over 60 per cent of these were infected and they averaged nearly ninety infections to a hundred. Here again the rate of infection with the individual parasites varies considerably in the different groups.

ASCARIS INFECTIONS.

82.9 per cent.

Roundworms were the parasities most frequently encountered, and they were much more prevalent in the Taytay population than among either the Bilibid prisoners (26 per cent) or the Manila women and children (53 per cent). They were somewhat more common among females (85.8 per cent) than among males (79.9 per cent), and among children between 2 and 14 years of age than in other ages. Female children between 2 and 14 years gave over 91 per cent of Ascaris infections.

Among older age groups *Ascaris* and *Trichuris* are about equally prevalent.

TRICHURIS.

In the results at Bilibid and for the women and children in Manila whipworms were the most prevalent of intestinal parasites (59 and 86 per cent respectively.) At Taytay, *Trichuris* was found in 77 per cent of the people, being second in frequency to *Ascaris* alone; and these two worms together gave 1599 of the total 1726 infections with intestinal worms.

The whipworm infections at Taytay were very evenly distributed proportionately in the two sexes and among the various age groups (see Tables 2 to 5), only the children under 2 years of age showing any marked difference from other groups.

HOOKWORM INFECTIONS.

Only 116 infections with hookworms were found among the 1,000 persons examined at Taytay, an average of only 11.6 per cent, and this has occasioned considerable surprise. An infection of 60 per cent has been reported from Philippine Scouts, 50 per cent from Bilibid prisoners, and Stiles and Garrison reported 10 per cent in American soldiers two years after they had left the Philippines.

It must be noted that all the figures are based upon the examination of adult males, and when the results at Taytay are considered for different sexes and ages (see Tables 4, 5, 6) the disparity is not so remarkable, though still great.

All males examined at Taytay gave 17.2 per cent infected with hookworms; females, 6.6 per cent. Adults (over 15 years) gave 15.6 per cent, children 4.5 per cent. The 311 adult males gave 71 infections or 22.8 per cent, and of these 71 cases, 58 were between the ages of 15 and 50 years. In other words, of the 116 hookworms infections, 58 or exactly half were among the 240 males between the ages of 15 and 50, giving a rate of 24.2 per cent.

IDENTITY OF PARASITES.

Specimens were secured from about one-fifth of the cases and were all of the "new world" hookworm, *Necator americanus*.

SEVERITY OF INFECTIONS.

Of the 116 infections, there was no one which showed more than from one to five ova to the average cover-glass preparation and the greatest number of worms recovered after treatment in any one case was fourteen.

CLINICAL MANIFESTATIONS.

In view of the small number of worms present in the cases of infection with hookworms, any severe clinical manifestations would not be expected.

However, in view of the interest taken in hookworm infections in the Philippines the past two or three years, it was thought highly desirable to investigate thoroughly and to demonstrate as clearly as possible the actual medical importance of hookworms in the conditions as found at Taytay.

A Tallquist hæmoglobin test was made of the blood of 712 persons who presented themselves at the clinic. Of this number 20 or 2.8 per cent were recorded with less than 50 per cent of normal hæmoglobin. Most of these were just under 50 per cent. Two hundred and seventy-five of the 712 patients tested for hæmoglobin, or a fraction over 38 per cent, were recorded with between 50 and 80 per cent. Here again by far the greater number approached the higher figure. Four hundred and seventeen, or about 58 per cent, gave a hæmoglobin test of over 80 per cent. These figures indicate roughly that there was severe anæmia present in something less than 3 per cent of the people examined, a mild anæmia in about 38 per cent, and normal hæmoglobin in about 60 per cent.

That the hookworm infections can not be held accountable for the anæmia found at Taytay is apparent from the facts that only 3 of the 20 patients in whom the hæmoglobin registered below 50 per cent and only 21 of the 275 patients in whom it was between 50 and 80 per cent, were infected with hookworms, while 61 of the 356 patients giving roughly a normal hæmoglobin estimate were infected with hookworms. In other words, the percentage of hæmoglobin in the hookworm cases was rather higher on the whole than in the cases not so infected. This is graphically shown in the following table.

Comparative hæmoglobin tests of hookworm and other cases.

Percentage of hæmoglobin.	Number of patients not infected with hookworms.		Number of patients infected with hookworms.	
	Number.	Per cent.	Number.	Per cent.
Under 50	17	2.7	3	3.5
50 to 79	254	40.5	21	24.7
80 to 84	176	28.0	21	24.7
85 to 90	150	23.9	27	31.8
Over 90	30	4.8	13	15.3
Under 80	271	43.3	24	28.2
Over 80	356	56.7	61	71.8

Of the three hookworm cases having less than 50 per cent hæmoglobin, one complained of gastric pain and vomiting and gave a history of malaria; the second, was afflicted with nephritis and mitral regurgitation; in the third no cause for the anæmia was found; very few hookworm ova were present and no worms could be found in the stool saved after the first treatment with thymol.

GENERAL CONSIDERATIONS.

The absence of clinical manifestations, the small number of worms found in the infected cases, and the low percentage of persons infected, indicate that hookworms play a very small part in the sanitary conditions encountered at Taytay.

Practically all medical workers in the Philippines since American occupation are in accord regarding the rarity of the severe forms of hookworm disease and also as to the mildness of the average infection. Nearly all investigators, on the other hand have reported a much higher percentage of the people infected. These investigations, however, have been almost exclusively among adult males in military organizations or in Bilibid Prison, the work at Taytay being the first to be conducted among a normal population living under natural conditions.

The fact that the adult males who do most of the work in the fields gave nearly 25 per cent infected with hookworms while women and children gave only 8.3 and 4.5 per cent, respectively, would indicate that the infections are acquired for the most part out in the fields away from the dwellings and the possibility naturally suggests itself that soldiers, especially in the early days in the Islands, were more exposed to infection in that they were more or less constantly wading streams, tramping through swamps and marshes and camping on wet ground.

The soil at Taytay is a heavy alluvium and, according to some observers, the nature of the soil is an important factor in the incidence of hookworm infections. What part this may play in the Philippines remains to be investigated, but the rarity of clinical evidence of hookworm disease in sandy as well as in clay districts would seem to make it improbable that any great difference will be found in this respect.

STRONGYLOIDES AND OXYURIS.

0.7 per cent. 0.4 per cent.

The presence of these parasites has been noted frequently by various workers in the Philippines but never in a high percentage of cases. Among the Bilibid prisoners 3 per cent were infected with *Strongyloides* and 0.8 per cent with *Oxyuris*. Manila children gave 2 infections with pinworms among 158, or 1.26 per cent. Strong in 1901 reported 13 cases of *Strongyloides* (0.6 per cent) among 2,179 persons examined in the Philippines.

Adult specimens of pinworms were obtained from two of the Taytay cases and were determined as *Oxyuris vermicularis* (Linnæus), 1767. No adult *Strongyloides* were secured, only the embryos being found.

INTESTINAL PROTOZOA.

AMŒBA.

2.7 per cent.

In various series of examinations of stools in the Philippines, the percentage of intestinal *amœbæ* reported has varied from something over 20 per cent to as high as 50 and even 70 per cent. In one hundred autopsies at the Philippine Medical School, Gilman reported typical, active, amœbic ulceration of the large intestine present in 32 cases. In examinations at Bilibid Prison 26 per cent (Musgrave and Clegg) and 23 per cent (Garrison) of the prisoners have been reported to have motile *amœbæ* in their stools.

At Taytay, the stools of only 27 persons in the thousand examined showed motile *amœbæ*. Eleven other cases showed encysted bodies which we felt were probably *amœbæ* but the diagnosis could not be made with certainty.

About one hundred specimens of fæces included in our figures were a day old when brought to us and had these shown amœbic infections proportionately as did the others our total figures would be raised to about 30 infections, or 3 per cent.

It was a matter of no little surprise to those engaged in this work that the number of amœbic infections should fall so far short of what both others and we ourselves had found in previous examinations of Filipinos, but throughout the course of the work and with special care in searching for these infections the figures remained proportionately the same.

No attempt was made to differentiate between *Entamœba coli* and *E. histolytica*.

There was no preponderance of amœbic infections in either sex or in any age group. No infections appeared in children under 2 years old.

CLINICAL MANIFESTATIONS.

Of 1,122 patients attending the clinic during the three months it was in progress, 60 had intestinal disorders. Of these 35 were diagnosed as cases of dysentery. Of the 35 cases of dysentery, 12 had *amœbæ* in their stools, leaving 23 cases of dysentery in which *amœbæ* could not be found and 15 patients with *amœbæ* in their stools who showed no symptoms of amœbic enteritis. In other words, a definite diagnosis of amœbic dysentery was made in only 12 (about 1 per cent) of the total 1,122 persons attending the clinic. Of these 12 cases, 5 had flagellates in their stools as well as *amœbæ*.

One other case with dysenteric symptoms had encysted organisms in his stool which were probably *amœbæ*. The remaining cases with encysted organisms had no symptoms of dysentery.

There was one questionable case of liver abcess with no history of previous dysentery. The patient died in April but consent for an autopsy could not be obtained.

To summarize, there were 27 patients of the 1,000 examined, or 2.7 per cent. who showed motile *amœbæ* in their stools. There were 35 cases, or 3 per cent, of 1,122 patients examined which were clinically diagnosed as dysentery. There were 12 patients (13 including the one with encysted forms) with *amœbæ* in their stools and with dysenteric symptoms, or about 1 per cent of those examined. Fifteen had *amœbæ* in their stools without dysenteric symptoms. Twenty-three had dysentery without *amœbæ*.

FLAGELLATES AND CILIATES.

5.5 per cent. 0.2 per cent.

The figures for these infections are not considered to be of much statistical value. Both flagellates and ciliates appeared much less frequently than we have been accustomed to find them in other series of examinations in the Philippines. At Bilibid Prison we found 23 per cent of the prisoners to have these organisms in their stools.

Of the two cases with ciliates, the organism in one appeared to be *Balantidium coli*, in the other it more closely resembled the saprophytic *Paramœcium* commonly found in water and may have been a contamination. In both cases the ciliates had disappeared after treatment for *Ascaris*.

The identity of the flagellates was not determined in the majority of the cases. Most of those studied appeared to be *Cercomonas hominis* and it is probable that most of the infections were with this organism.

APPLICATION OF RESULTS.

It is necessary to know how fairly and how adequately the group of persons examined for any given infection represented the normal population of the town of Taytay before the percentage of infection found can be interpreted for the general community. In other words, it is essential that the presence and amount of any selection among the persons examined, either by sex, age, occupation, condition of health, or otherwise, be carefully determined.

The results of the examination of 1,000 persons, or nearly one-fifth of the population, should be a fairly satisfactory basis provided they fairly represent the community.

The amount of selection present with regard to sex and age is shown in Table 5, wherein is set forth the proportion of the total population of Taytay examined for intestinal parasites in the two sexes and in each age group.

Seventeen per cent of the total population were examined. The amount of selection by age or sex is represented, therefore, by the difference between 17 and the percentage examined in any age or sex group. In the results for all males and all females the figures are 17.0 and 17.2, indicating practically no sex selection. Likewise the total figures for those under 15 years (16.5 per cent) and those of 15 years and over (17.5 per cent) show little difference in the proportion of children and adults examined. Among males alone and among females alone, the difference between the proportion of adults and children examined is still less than 3 per cent and less than 2 per cent, respectively. So far, therefore, it is apparent that there was practically no age or sex selection. As we go up the male and female columns, however, taking the smaller age groups separately we find certain groups represented in considerably higher or lower proportion than the average. Among the males, all the age groups are well within 3 per cent of the average proportion excepting the 10 to 17 years group which, with only 7.8 per cent of the population within those ages examined, falls nearly 10 per cent below its fair representation. Among the females, the various age groups are less evenly represented than among the males, though no group varies so far from the average as the male 10 to 14 year group. The female 10 to 14 year group gives only 13.7 per cent and the 15 to 29 year group only 12 per cent examined. The 30 to 49 year group, on the other hand, shows an excess of over 5 per cent and the 5 to 9 year group an excess of 3.5 per cent. These results for the sexes separately find expression in the total column for each age group in that the 10 to 14 year group falls short of the average representation (17 per cent) by 6.2 per cent and the 30 to 49 year group shows an excess proportion by 4.1 per cent.

TABLE 5.—*Proportion of the population examined for intestinal parasites in each sex and age group.*

Age groups (years).	Males.			Females.			Total.		
	In population.	Examined.	Per cent examined.	In population.	Examined.	Per cent examined.	In population.	Examined.	Per cent examined.
Under 2	198	37	18.7	213	36	16.9	411	73	17.8
2 to 4	312	53	17.0	278	47	16.9	590	100	16.9
5 to 9	300	56	18.7	347	71	20.5	647	127	19.6
10 to 14	245	19	7.8	247	34	13.7	492	53	10.8
15 to 29	735	120	16.3	889	107	12.0	1,624	227	14.0
30 to 49	611	120	19.6	572	130	22.7	1,183	250	21.1
50 and over	367	71	19.3	343	66	19.2	710	137	19.3
Under 15	1,055	165	15.6	1,085	188	17.3	2,140	353	16.5
15 and over	1,713	311	18.2	1,804	303	16.8	3,517	614	17.5
Total population	2,768	476	17.2	2,889	491	17.0	5,657	967	17.0

In order to determine approximately what changes would occur by substituting in our tables hypothetical figures obtained by raising or lowering these disproportionately represented groups so that each group examined represented 17 per cent of that group in the general population, assuming the same rate of infection to be maintained, a hypothetical table was prepared and it was found that the number of persons infected, the number of infections per 100 persons, and the rate of infection with each parasite separately was changed by less than 1 per cent in each case.

With regard to sex and age therefore, there was no selection among the persons examined which materially influences the results obtained.

Division of labor in the community was so incompletely developed that no classification by occupation is of much value. Rice farming and fishing are the industries almost exclusively followed, and though a man might pronounce himself a carpenter, or a musician, as frequently was the case, upon inquiry it would nearly always be found that a certain amount of his time would be spent as a fisherman or in the rice paddies. Neither was it possible to definitely separate fishermen from farmers as many were both. Occupation, therefore, was for the most part a question of age or sex and any material selection by occupation would appear under those heads.

A very large percentage of the persons who attended the clinic came with no complaint or with some indefinite or imaginary one. Many came in company with sick friends. From as many as possible of these healthy persons, as well as from the sick, specimens of fæces were examined. In addition, receptacles for specimens of stools were distributed promiscuously through the town either by the town officials or by members of the expedition as the census was taken. In other words, from the beginning, our endeavor was to make our examinations for parasites upon persons representative of the entire community, and it is believed that with the care taken there could be no material selection of persons on the ground of the condition of health.

We have gone into this matter of selection of cases rather at length for the obvious reason that as such selection is eliminated, the validity of the results obtained is strengthened and the possibilities of their application as an index to infection in the general population are broadened.

We have no hesitation in saying, therefore, that the results obtained by the examination of 1,000 persons in Taytay, as set forth in Table 1, may safely be taken as an index to the amount of infection in the entire community. It is obvious that the percentages based upon a large number of infections are more reliable than those upon a few infections, since the latter would be changed materially by finding but a few additional infections.

The applicability of the amount of infection with the various intestinal parasites found at Taytay to the population in other parts of the Islands can be dealt with only in general terms, and the disparity between the Taytay results and the results of other series of examinations made in Manila indicate the necessity of caution in making a general application of results.

However, Taytay was selected for the work with a view to obtaining a community which would be representative of a large section of the country, namely, the greater part of central and southern Luzon inhabited by the Tagalogs. In much of this section the conditions of soil, and climate, the occupation, and habits of the people are practically identical with those in Taytay and for these parts it is reasonable to suppose that the incidence of infection with the parasites in question would be about the same as that found at Taytay. In other regions, where the country is mountainous, or the soil sandy, or in towns situated on the coast, the amount of probable infection can be predicted much less confidently and we believe that only the actual examination of people living under these different conditions will give as satisfactory information on the subject.

In view of the figures obtained at Taytay, those which resulted from the examinations of soldiers and of prisoners at Bilibid were evidently misleading when taken as an index to the frequency of infection in the general population, in that they indicated an excessively high frequency of infection with hookworms and *amœba* and too low a frequency with *Ascaris*. Knowledge of the real incidence of these infections throughout the Islands must depend upon a continuance of such work as was done at Taytay in various localities representing various existing conditions.

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MEDICAL SURVEY OF THE TOWN OF TAYTAY.

XI. TABLE OF PHYSICAL EXAMINATIONS.

By FRED B. BOWMAN, LEONCIO LOPEZ, VICENTE E. MANAPAT and VICENTE RIVERA.

The following table gives the results of 789 physical examinations which for the most part were made by Doctor Bowman, of the Biological Laboratory, Bureau of Science, and Doctors Lopez, Manapat and Rivera, recent graduates of the Philippine Medical School, with the assistance of various members of the expedition.

Clinical histories were taken of all cases and the cards containing them have been carefully reviewed. In a number of cases in which a diagnosis had been made tentatively it was changed in the present table to "indefinite," in view of the fact that it was frequently difficult to make an accurate diagnosis of obscure conditions in the short time available for the examination of many of the cases.

Of the 789 examined, 558 complained of some form of disease; the remainder were apparently healthy. The 9 cases of cholera are not included in this table.

Nervous system:	
Neuritis peripheral	12
Hemiplegia	3
Epilepsy	2
Insanity	1
Facial palsy	1
Indefinite	14
Genito-urinary system:	
Gonorrhoea	1
Cystitis	2
Stricture	1
Nephritis	4
Hydrocele	1
Indefinite	
Males	14
Females	14
Tumors:	
Abdomen (1 sarcoma, 2 fibromata)	6
Leg (sarcoma)	1
Breast (sarcoma)	1
Lip (epithelioma)	1
Thyroid (goitre)	11
Fevers:	
Malaria	18
Typhoid	4
Varicella	1
Measles	1
Whooping cough	1
Dengue	2
Indefinite	33
Puerperal sepsis	1
Special organs:	
Otitis media	8
Mastoiditis	1
Disease of teeth	4
Harelip	1
Eye disease	14
Skin:	
Infections and abscess	30
Ulcers	5
Yaws	21
Circulatory system:	
Endocarditis	6
Indefinite	7
Anæmia	7
Hæmorrhoids	7

General diseases:	
Rickets	3
Rheumatism, indefinite	17
Alimentary system:	
Stomach—	
Gastritis	7
Gastralgia	7
Indefinite	52
Liver—	
Cirrhosis	1
Abscess	1
Gall-bladder disease	2
Indefinite	2
Alimentary system—Continued.	
Intestines—	
Amebic dysentery	12
Dysentery	23
Diarrhoea	10
Enteritis	15
Hernia	2
Respiratory system:	
Tuberculosis	30
Pleurisy	2
Pneumonia	6
Asthma	3
Bronchitis	47
Indefinite	77

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

XII. EXAMINATIONS OF THE BLOOD WITH SPECIAL REFERENCE TO MALARIA.

By LUIS GUERRERO and VICTOR SEVILLA.

Malaria is endemic in the Philippines and is present throughout the whole year, though the number of cases varies at different seasons. During the months of March to June, the amount is small, later in the year it begins to increase in a remarkable manner, and in the months of November, December, January, and February—that is, after the rainy season is over—it becomes much more prevalent. During this last period a large number of cases occur in the infected districts, especially among the country people, and there have been occasions when the harvesting of rice had to be suspended on account of the number of people afflicted with this disease. As the epidemics frequently coincide with the rice harvest, the natives usually ascribe the cause of the disease to the ingestion of green rice, that is, to rice newly mown.

According to the investigations of Craig[1] at Camp Stotsenberg, the recrudescence of malaria coincides with the abundance of *Anopheles,* and undoubtedly such must be also the case with the other infected areas of the Archipelago, for at the end of the rainy season, when the fields become dry, pools and other natural receptacles for water are left, which are used for breeding places by mosquitoes.

The investigations at Taytay upon malaria were conducted during the months of March, April and May, in the midst of the hot season, when the fields were entirely dry and many of the sources of water supply almost exhausted. Only after prolonged search was a breeding place of *Anopheles* found: this was in the neighborhood of a well from which part of the inhabitants obtained their water supply. Among the 1,131 persons who visited the dispensary, only 16 cases were found to be infected with malaria. This number agrees very well with the scarcity of *Anopheles.* As to the type of the parasite, 12 were infected with the tertian

[1] *This Journal* (1906), 1, 523.

and 4 with the æstivo-autumnal parasite, as may be seen from the following table:

Persons infected—	Number.	Variety. Tertian.	Quartan.	Æstivo-autumnal.	With splenomegaly.
With fever	15	12	----------	3	7
Without fever (latent malaria)	1	----------	----------	1	----------
Total	16	12	----------	4	7

The most frequent type of infection was that of mild tertian fever. All of the patients but one, at the time of the examination, complained of fever, more or less intense. One case had no febrile symptoms and may be considered as a case of latent infection. No cases of quartan infection were found, and no case of marked malarial cachexia. As to the character of the infection, it may be said that excepting in three patients who had suffered from relapses the attacks were probably all primary.

For the purpose of determining the number of latent cases of malaria in the town, an investigation of the blood of all cases of splenomegaly encountered was also made. It has been suggested by a number of observers that the amount of malaria in a locality may be roughly judged by observing the percentage of cases of splenomegaly among the people; that is, that the enlargement of the spleen is an index of the amount of malaria present.

Among 1,131 people, we found only 13, or 1.14 per cent. with an enlarged spleen. However, it must also be taken into account that there are in the Philippines cases of splenomegaly due to other causes than malaria.

The blood of all those who had an enlarged spleen and came to the clinic for physical examination was subjected to a special investigation, and in only 7 of them was the parasite of malaria encountered; the remainder always gave negative results although repeated examinations of the blood were made. The blood of 742 persons was examined for malarial parasites, and as has been stated, in only 16, or 2.16 per cent, was the presence of the parasite demonstrated.

Special attention was also devoted to the examination of the blood of children, who, according to the researches of Koch, Stephens, Christophers, and Sargent in Africa, James in India, and Craig in the Philippines, seem to suffer more than adults from latent infection. The blood of 278 children was examined, of whom only 5, or 1.8 per cent, were found infected. The following table will show the relation existing between malarial infection and the age of the children, as found in Taytay and at Camp Stotsenberg by Craig.

Relation of malarial infection and age of children at Taytay and Camp Stotsenberg.

TAYTAY.

Age.	Number.	Number infected.	Per cent.	Variety.		
				Tertian.	Quartan.	Æstivo-autumnal.
1 to 5 years	129	2	1.5	2		
5 to 10 years	95	2	2.1	2		
10 to 15 years	54	1	1.8	1		
Total	278	5		5		

CAMP STOTSENBERG (CRAIG).

Age.	Number.	Number infected.	Per cent.	Tertian.	Quartan.	Æstivo-autumnal.
1 to 5 years	40	30	75.5	10	4	16
5 to 10 years	54	20	37.0	8	1	10
10 to 15 years	53	13	24.5	5	1	7
Total	147	63		23	6	33

The number of children examined by us was much larger than that studied by Craig, though the number of infected cases observed by us was very much lower than that which he found. By comparing the two preceding tables no decrease in our figures in the percentage of infection can be noticed proportionate to the increase in age of the individuals such as has been observed by other investigators. This may be explained perhaps by the very small number of infections found among the number of children examined.

All the cases of malaria discovered in Taytay seemed to be isolated sporadic cases. All the other members of the families of two individuals found infected with malaria and of six with splenomegaly, were completely free from malaria as is shown by the following table:

Family.	Number of its members.	Number of infections.	Number of splenomegalies.	Variety.		
				Tertian.	Quartan.	Æstivo-autumnal.
1	3		1			
2	3		1			
3	2		1			
4	3		1			
5	3		1			
6	3		1			
7	4	1	1	1		
8	2	1	1	1		

It is true that the cases with splenomegaly showed at the time of examination only a slight enlargement of the spleen. The blood from these cases was examined on two different occasions with negative results.

It is not strange that this small town, situated in the Mariquina Valley and near the shores of Lake Bay, in a decidedly marshy region, should be so sparsely infected with malaria, for the disease is rather a local one and is apt to appear in various local foci within a certain limited area. There are many towns in the Philippines similar to Taytay which, though exhibiting the same topography, show, nevertheless, a higher degree of infection.

In view of the conditions of the soil and the meagre number of infections found during the period when we made the investigations, we conclude that an antimalaria campaign here would be carried out more successfully during the dry season (February, March, and April) when the number of cases of malaria and the number of breeding places of mosquitoes are at a minimum.

As to the method which would seem to be most advisable for the extermination of malaria here, we believe that the systematic administration of quinine to all cases found carrying the malarial parasite and the destruction of the larvæ of *Anopheles* by the sprinkling of kerosene oil in all water holders and receptacles, are the principal measures which may be used with success. The natives are well acquainted with the efficiency of quinine in combating malaria, and even those most ignorant and prejudiced against any but native medicines are willing to take quinine without serious objection.

The free distribution of quinine by the Government or the regulation of the sale of the drug so as to render it cheaper, are other measures which might also be adopted for the benefit of the people.

OTHER STUDIES OF THE BLOOD.

Systematic analyses of the blood of the majority of the people who called at the dispensary, were also made with the idea of discovering what parasitic diseases of the blood were prevalent in the locality as well as with the idea of throwing light upon other diseases and aiding in establishing an accurate diagnosis.

The specimens were collected from persons of both sexes and of all ages, some of whom were actually sick, though the majority did not show any indication of illness.

The percentage of hæmoglobin was first determined. The Tallquist method was employed on account of its simplicity and because it was considered sufficiently accurate for clinical purposes. The lowest average of hæmoglobin registered was 15 per cent and the highest 95 per cent. In the majority of the cases the hæmoglobin oscillated between 70 and 85 per cent with a total average percentage among 616 persons who were examined of 56.4 per cent. Only two persons showed such low averages as 15 and 20 per cent; the first one was in a child 2 years old, suffering from a heavy infection of *Ascaris;* and the second in a girl of 19 years, suffering with chlorosis.

Among the 11 cases of malaria an average of 75.9 per cent of hæmoglobin was found, the lowest registering 60 per cent and the highest 90. Among 572 persons in whom the percentage of hæmoglobin fluctuated between 60 and 90 per cent, we found an average of 56.4 per cent. The relatively high percentage of hæmoglobin found among the malaria cases was probably due to the fact that the majority of them were primary infections in whom olygochromemia was not marked.

To our great regret counts of the red blood corpuscles and of the leucocytes, owing to lack of time, were performed only in very few cases. In our opinion the number of red blood corpuscles in the majority of the Filipinos of Taytay is undoubtedly below the number considered normal for the inhabitants of temperate climates.

Fresh blood smears from 742 individuals were examined, but no other parasite was found in these specimens, excepting the parasite of malaria which was encountered in 16 cases.

The spirochæta of relapsing fever was sought for in the blood of all the fever patients who came to our dispensary and in many others who were confined to their homes, but was not found.

A differential count of the leucocytes was made in 129 persons, as shown in the following table.

[Figures indicate percentages.]

	Lymphocytes.	Large mononuclears.	Polymorphonuclears neutrophiles.	Eosinophiles.	Mast cells.
Leucocytes obtained at Taytay	34.5	4.1	51.6	11.2	0.16
Leucocytes in normal blood after Cabot and Da Costa:					
Cabot	20–30	4–8	62–70	0.5–4	0.025–0.50
Da Costa	20–30	4–8	60–75	0.5–5	0.025–0.50

From this table it may be seen that if we adopt as a standard the figures given by Cabot and Da Costa, a small increase will be noticed among the number of the lymphocytes and a decrease in the polymorphonuclear cells, while the large mononuclears and the mastcells remained normal. The percentage of eosinophiles is also increased in the majority of cases above normal, and in some cases it rose as high as 36.6 per cent; this marked eosinophilia is ascribable to the fact that 94 per cent of the population are affected with intestinal parasites and a large percentage suffer from various skin diseases.

Wickline,[2] in the investigations made by him at Camp McGrath, Philippine Islands, for the purpose of determining the effects of the tropical climate on the white race, also arrived at very similar results. In three examinations conducted by him at intervals of six months in 104 American men, he found a diminution of hæmoglobin, an increase of the red blood corpuscles, a steady decrease in the polymorphonuclear cells and a relative augmentation of the lymphocytes, and especially of the eosinophiles.

In the differential counting of the leucocytes we followed the technique recommended by Rogers, counting backward and forward across the slide, and eliminating the borders and edges of the blood smear. The results were obtained from a count of 250 leucocytes in each instance.

As to the classification of the leucocytes we also followed the method adopted by Da Costa and by Rogers.

[2] The Military Surgeon (1908), **23**, No. 4, 282.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

XIII. FILARIASIS, MALARIA, TUBERCULOSIS, TYPHOID FEVER, GOITRE, BERIBERI, VENEREAL AND SKIN DISEASES.

By Henry J. Nichols.[1]

Microfilaria bancrofti was searched for in the blood taken at night of 400 persons and was found in one case. This was in a man 28 years old who was born in Taytay and had always lived there except for two years spent recently in towns on the lake within a radius of 20 miles of Taytay. He had no signs of elephantoid disease. The embryos had a nocturnal periodicity but there were very few present even at midnight. The blood of the man's father contained no embryos; his wife and mother declined to be examined. A number of examinations of other people residing in the neighborhood were made, but were also negative. *Culex fatigans* Wied. was found by Banks in only one locality on the opposite side of the town.

Of the 400 persons examined about one-half were adult males, about one-quarter adult females and about one-quarter children and old people. The specimens were secured by going to *tiendas* in each part of the town between 8 and 10 p. m. with a lantern and depending on the natural curiosity of the natives, a few coppers and the diplomacy of the medical students to attract a small crowd. Usually there was little difficulty in obtaining the consent of the individual to allow the specimen of blood to be taken after several of the inhabitants were shown the parasite.

A woman 33 years old, suffering with elephantiasis (Plate No. XV, fig. 1) came to the clinic from Napindan, a town four miles distant, where she was born and had always lived. Ten years ago her left leg began to swell, this symptom being accompanied with fever. Eight years ago the swelling ruptured near the ankle, discharged blood and a white fluid, and then healed, leaving the markedly depressed scars seen in the picture. No microfilariae were found in the serum from the leg or in the blood collected at night.

[1] Lieutenant, Medical Corps, United States Army, serving on United States Army Board for the Study of Tropical Diseases as they occur in the Philippine Islands.

According to Phalen and Nichols, who studied the distribution of filariasis among the Philippine scouts, 0.5 per cent of Tagalogs outside of Manila are affected. The finding during the present survey of one case in a little over 200 adult males confirms the former figure for this group, but the percentage would be considerably less if the whole population were considered. Evidently filariasis with its consequences, although it is to be found here, if sought for, plays but an insignificant part in the health of the people and does not call for active prophylactic measures. The only question of interest is, why in the presence of occasional cases and the filaria-bearing mosquito, the disease is so rare here and so prevalent elsewhere on the same island. It is to be noted in this connection however, that *Culex fatigans* Wied. is present only in small numbers.

Malaria.—An examination of the blood of about 600 dispensary patients revealed the presence of malarial parasites in 19 cases or in 3 per cent. The spleen was examined in 233 children at the dispensary, and in 5, or 2.1 per cent, was found to be enlarged. Among 556 adults, enlargement of the spleen occurred eight times, or in 1.4 per cent. About 5 per cent of all the persons infected with malaria exhibited no symptoms of illness. The disease affected chiefly the adult males and children, very few cases being seen in adult females. Most of the cases gave a history of repeated disability from attacks of fever.

The tertian parasite was found in 14 cases, the æstivo-autumnal in 4, and the quartan in 1. The enlargement of the spleen in all the cases was slight except in one case, a boy of 14 years infected with the quartan parasite, where it was marked.

The most interesting feature is the distribution of the cases of malaria along the banks of the streams shown in the map (Plate IV), in which Mr. Banks found *Myzomyia rossii* breeding. No cases of malaria were found more than two or three blocks away from these streams. In one house, father and son were found with enlarged spleens. The other cases were found isolated and examinations of the blood made of the rest of the family were negative.

Although Taytay is not a highly malarious town, something of a prophylactic nature could be done, in view of the distribution of the cases, by cleaning the banks of the esteros and by draining the stagnant pools.

Tuberculosis.—A special study of tuberculosis was made according to which it was estimated that there were about 60 cases of this disease in the town, or that 1 per cent of the population were affected; 35 of the cases were adult males over 20 years of age (2 per cent); about 15 of the cases were females (1 per cent); and 10 were children (3 per cent). About 800 persons were examined physically and 114 sputum examinations made. In 20 cases tubercle bacilli were found: 3 children had joint lesions and 7 adults had unmistakable clinical signs of tuberculosis without showing tubercle bacilli in the sputum. A great many of the people complained of some trouble with the lungs, and 51 of these, considered possibly tubercular, were examined a month or two later, 11 or about one-fifth were then found to be affected, 5 showed tubercle bacilli in the sputum and 6 definite clinical signs of the disease. The rest had either asthma or heart disease or had entirely recovered from what had evidently been attacks of bronchitis.

No focus of tuberculosis was found. The disease was distributed evenly over the town. (Plate No. V.) No special family infection could be observed. Very few patients had been sick over two years and it would appear that they generally do not live much longer than two or three years after having been infected. The death rate is about 4 per thousand, or 25 per year.

Pulmonary tuberculosis was most frequently observed; one case of spinal tuberculosis, 2 cases of tuberculosis of the skin and 3 cases of joint involvement were encountered. The larynx was involved in 3 cases. In young adults the disease ran a relatively rapid course.

It is our belief that something could be done here in combating tuberculosis by segregation of the patients in a sanitarium and by the disinfection of their sputum. The chief need of those affected is nourishing food.

Typhoid fever.—Four cases of typhoid fever were seen among the natives of Taytay and one in a resident of Manila who was taken sick five days after arrival in Taytay. The location of these cases is shown in the map. (Plate V.) Two of the cases were typical from a clinical standpoint, the fever continuing for four weeks. One of these, a male aged 24 years, gave a Widal reaction on the 19th day of the disease and a positive one on the 36th day. The other case, a girl of 14 years, gave a positive Widal on the 16th day; typhoid bacilli, a blue strain, was recovered in plate cultures from her fæces. The other two cases were in girls, aged 6 and 7 years respectively, who had fever of ten and fourteen days, and in which the blood showed a Widal reaction after the subsidence of the fever. None of the patients had been out of Taytay for one month before becoming sick. No connection between the cases could be traced. The wife of the first case gave a Widal reaction and an indefinite history of fever, but no bacilli were found in her fæces. The blood from the members of the family in which the cases occurred and of people who had been in contact with the sick ones was examined by the Widal reaction but none gave a positive reaction.

Some of the early reports of the Surgeon General's Office and of the Bureau of Health give the impression that typhoid fever is a comparatively rare disease in the Philippines and that those cases which are found have been imported. The same idea was formerly held in India but recently it has been shown by Rogers and others to be erroneous and does not appear to hold good for the Philippines. Typhoid fever has been found to be endemic in Samar, Leyte and Iloilo, where it was especially frequent among children. If the disease had been recently introduced here into an entirely nonimmune population, its severity and mortality ought to be much greater than it is.

It would seem that the blue variety of the typhoid bacillus is the common one in the Philipines, whereas the ordinary or "lilac" variety is the common one in the United States.

Goitre.—Eleven cases of goitre were found; as a special search was made for this disease, and since it is so easy of detection, it is safe to say that practically all the cases in the town were observed. All were in women. The average age at the time of onset of the goitre was 28 years; the average duration at present is 15 years, and the average age of the individual affected, 43 years. The onset in each case was after the age of 20. As the number of females over 20 in the town is about 1,500, the proportion of females affected is about 7 per cent. The largest goitre is shown in Plate No. XVI, fig. 2; it is cystic and of over thirty years' duration. The others varied in size and location, some being just perceptible, one case had marked exophthalmos and deviation, with palpitation, extreme nervousness and a history of variation in the size of the tumor. (Plate XVI, fig. 1.) Two other cases had milder exophthalmos and some palpitation.

It will be seen from the geologist's report that Taytay is on a non-Cretaceous soil so that these cases can not be associated with the ingestion of an excess of lime salts.

Beriberi.—No definite case of beriberi was seen, with œdema, loss of knee jerk, pain in the calf muscles, weakness and heart disturbance. On the other hand several cases were found with symptoms resembling those of beriberi. They were all women, after childbirth, who complained of numbness and tingling of the legs and arms and exhibited diminished or lost knee jerk. One case presented a general weakness of the muscles and palpitation. These cases exhibited a mild peripheral neuritis but whether this was due to pressure, anæmia, or to some specific disease, such as beriberi, it was difficult to say.

The small amount of beriberi found in Taytay is in marked contrast to the amount seen among bodies of laboring men such as railroad gangs, Philippine Scouts and Constabulary, all of whom suffered considerably. The evidence, as far as it goes, is in accord with the polished rice theory of the cause of beriberi, as the natives use but little milled rice, while soldiers and laborers are given Saigon or polished rice.

Venereal disease.—Venereal disease is decidedly rare in the town. One case of acute urethritis, 1 case of stricture of the urethra, 2 cases of cystitis, and 1 case of ophthalmia neonatorum all of gonorrhœal origin were observed. Evidences of syphilis were also rare. One case with loss of palate and septum, possibly syphilitic, 1 case of gumata of the frontal bone, 2 cases of hemiplegia with a suggestive history of previous lesions of syphilis, 1 case of parenchymatous keratitis and 3 cases of Hutchinson's teeth in small children were seen.

Our experience at Taytay and elsewhere does not support the conventional statement that the natives of the Philippines are "riddled with venereal disease." This statement may be partly true in the larger cities and among the camp followers of the white troops; but among the rural population which makes up the bulk of the Filipinos, prostitution is not a recognized institution and venereal disease can not be considered as a noteworthy feature from the standpoint of health. Among the native soldiers venereal disease is very rare.

Skin diseases.—Five hundred individuals were thoroughly examined for skin diseases and 192, or 38.4 per cent, were found to be affected with some disturbance of the skin. Since but very few persons complaining of skin diseases alone, came to the clinic, this percentage may be taken as fairly representative of the general population. For convenience, those examined were divided into three groups—children (under 15 years), adult males, and adult females (15 years and over). These groups were affected as follows:

TABLE I.

	Number examined.	Number affected.	Per cent affected.
Children	180	71	39.4
Adult males	125	55	44
Adult females	195	66	33.8
Total	500	192	38.4

The commonest skin diseases are tabulated as follows:

TABLE II.

	Children.		Males.		Females.		Total.	
	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.
Tinea versicolor	8	4.4	20	16	18	9.2	46	9.2
Tinea circinata	2	1.1	9	7.2	4	2	15	3
Scabies	20	11.1	11	8.8	13	6.6	44	8.8
Impetigo contagiosa	33	18.3	1	.8	4	2	38	7.6
Total	63	34.9	41	32.8	39	19.8	143	28.6

The following table gives the number of less common and special skin diseases.

TABLE III.

	Males.	Females.	Children.	Total.
Acne	2	3		5
Blastomycosis	1		1	2
Advetitious bursæ	2			2
Bunion		3		3
Callosity	1	2	1	4
Epithelioma of lip		1		1
Furunculosis	2	1	1	4
Fibromata	3	7		10
Keloid	2			2
Leprosy	1			1
Measles			1	1
Miliaria	1			1
Pompholyx		1		1
Pigmentation		3		3
Seborrhœa	1	1		2
Tuberculosis cutis	1		1	2
Urticaria		1		1
Verrucosity	3	2		5
Vitiligo	2	1		3
Yaws	4	1	16	21

Tinea versicolor infections made up about one-fourth of the skin diseases observed. The affection (see Plate XVII, fig. 2) is noteworthy only on account of its slight disfigurement. In this connection it should be stated that in one-half of the cases the lesions were situated on the face and were thus exposed to light in contradistinction to the usual location in temperate climates. The frequent occurrence of the lesion on the face of natives of the tropics has been noted in Assam by Powell and others. The disease is especially noticeable in the young of both sexes (16 per cent of males and 9 per cent of females being affected). In many cases the lesions were extensive. The best antiseptic treatment seems to be sulphurous acid generated directly upon the skin by applying first a 10 per cent solution of sodium hyposulphite and then a second solution of 5 per cent tartaric acid.

Tinea circinata was less prevalent in Taytay than in Manila. The region around the groin is seldom attacked probably on account of the loose clothes worn. Most of the cases seen in Taytay showed only small patches on the wrists and waist.

Scabies (Plate XVII, fig. 1) was found to be very common, affecting 8 per cent of the population. However, no special attention is paid to it by the natives. They know the organism which causes the infection and frequently extract it on a needle for the sake of curiosity. Nothing particular was noticed about the disease except that it seemed to be the starting point for impetigo contagiosa in children and sometimes it was difficult to separate the lesions in a mixed case.

Impetigo contagiosa was very common among young children and gave many of them a repulsive appearance by producing crusts over the head and face and often over the entire body. *Staphylococus pyogenes aureus* in pure culture was isolated from 3 cases. Several cases of infected glands were found at the base of infected scalps. The lesions or scars of this disease, together with those of smallpox and yaws are so common that it was difficult to find a child with an entirely normal smooth skin.

The following diseases were looked for but were not found: *Tinea imbricata, Tinea nigra* (*Castellani*), *Pinta,* and *Tinea tonsurans.* Two cases which clinically resembled blastomycetic infection were seen but sections of the skin could not be obtained.

Puente.—In examining the adults, especially the women, one frequently meets with circular scars about one inch in diameter, on the arms, legs and thighs which might be mistaken for vaccination marks. These scars result from the healing of running sores called by the natives "Puente" (corruption of the Spanish word *fuente*=spring) which have been produced for the purpose of causing counterirritation. The method of their production is as follows: In a small area of inflammation, which has been set up by the application of lime to the skin, an abrasion is made, and upon this a small piece of betel-nut or wax is bound. Plate XVIII fig. 2, shows the binder in place and fig. 1 shows a resulting ulcer with a piece of wax in place. *Puente* is produced as a counterirritant to any sort of pain or altered sensation and is most frequently used on the legs during pregnancy. Only one case was seen in a man, he having a pad covering an ulcer on his abdomen.

Fibromata.—Symmetrical fibromata were seen a number of times in persons over 30, most frequently in females. The distribution of these fibromata is shown in Plate XIX. Two were excised and on section found to be fibroma dura; several felt partly calcified. The tumors spring, apparently, from the subcutaneous tissue and are not painful nor adherent to any particular structure. About one in every thirty women over 30 years of age was found to have them either on one or on both ankles and elbows.

Yaws.—This disease is known in Taytay as *"galis pateros," galis* being the Tagalog name for scabies, and *pateros* (Spanish name for duck farm) the name of a town near by where yaws is supposed to be particularly prevalent and is thought to be contracted from a scaly lesion on the head of the ducks. Twenty-one cases were found after a special search and it is believed that nearly all the cases in the town were seen. (Plate XX.) Sixteen cases were found in children under 10 years of age, and, as the number of such children in the town is about 1,650, hence about 1 per cent were infected. *Treponema pertenuis* was found in three cases examined with the use of Giemsa's stain but the clinical appearance is so characteristic that further microscopical examination was considered unnecessary. The circinate, tubercular, ulcerative, and desquamative forms occurred, but no lesions of yaws were seen on the soles of the feet.

In almost every case the disease was attributed to contact with some other case and in all but one, in spite of very common glandular enlargement the yaws seemed to develop gradually by autoinoculation from previous lesions. One case showed an extensive eruption of yaws of similar size. In order to get the good will of the patients, silver nitrate was applied to the lesions but was considered only a palliative measure and potassium iodide was given if the patient, as was frequently the case, showed any interest in becoming permanently cured. The lesions, if left alone, seemed to run a chronic course.

The distribution of the cases is seen in the map. (Plate VI.) They usually occurred in groups. Near the station were three adjoining households infected as follows: *First house,* child aged 3; grandfather aged 70; child aged 8 had yaws one year ago; *second house,* child aged 2; *third house,* child aged 2; mother aged 25.

In another part of the town there were four cases in one house, two children, the father and grandfather, and one case across the street. In each neighborhood a history of previous cases could be obtained.

While yaws is principally a disease of childhood, 5 of the cases were in adults; one mother had an ulcerative yaw on one breast near the nipple from nursing a child whose lips were completely covered with lesions; 3 male grandparents had yaws on the side of the neck and head from carrying children, and one father had a general eruption.

Evidently both treatment and some sort of isolation is advisable to eliminate this disease. An infected child of a school-teacher was made to use separate dishes and care was taken to isolate and disinfect its clothing; no further cases occurred in the family.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

XIV. THE DISPOSAL OF HUMAN EXCRETA.

By Philip E. Garrison.[1]

The importance of this subject in the Philippine Islands has been emphasized recently by resolutions passed at the Philippine Islands Medical Association and by the Manila Medical Society, recommending the appointment of a commission to study this problem and stating that other measures to prevent cholera, etc., must necessarily fail if some adequate provisions be not made for the disposal of excreta. While the party at Taytay was in no sense a commission to investigate this question, advantage was taken of the opportunities to look into the subject. During the taking of the census, an examination was made of each house and premises to see what provisions were made by the inmates for the disposal of excreta. The results of this inspection are given in Doctor Clements' paper, Part IX, The general sanitary conditions of the town. In brief, it may be said that by over 50 per cent of the inhabitants there is no conscious disposal of fæces; around one-half of the houses in the town there were no provisions for such disposal and the excreta were deposited on the surface of the ground almost anywhere in the neighborhood and left exposed to the rain, or the sun, or to pigs and chickens to dispose of. In the vicinity of the remainder of the houses there was some kind of outhouse or place devoted to the reception of excreta, but aside from an entrance made in one place for the pigs, no provision had been made for the disposal of the fæces. Only 8 per cent of the houses had pits in connection with them. Some of these were sufficiently satisfactory. These were large, fairly deep pits, provided with a floor, an inclosure and a roof; either earth, ashes or rice husks were provided to cover the depositions.

Such being the actual situation what can be done to improve it? A water carriage sewer system is, of course, wholly out of the question, on account of the expense. The earth system is also not feasible, partly

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on account of the expense but chiefly on account of the lack of supervision that would exist were it put in operation. The privy or pit system, which has served in civilized countries so long, seems to be practicable under present conditions. Its success would depend, first, upon proper construction and, second, upon proper supervision.

The pit should be dug 1 meter square and 2 meters deep; if possible, it should be walled with bamboo, the earth from the pit should be banked around the edges and the pit should have a bamboo cover, fitting as tightly as possible; there should be a roof over the pit and a screen on the sides. Earth, ashes or rice husks should be used to cover the fæces. When the pit is three-quarters full, another should be dug near by and the structure moved over it, the old pit being filled in. Frequent inspections, one at least every month, should be made by the municipal physician and the police to insure the success of these pits and, occasionally, disinfectants should be added, particularly when flies are excessive.

Several objections have been made to the pit system: First, that the pits fill up in the rainy season; second, that they pollute the soil and wells; third, that they increase the flies; fourth, that they are not as advantageous for the disposal of excreta as are the natural agents such as the sun and animals.

In answer to the first objection, it may be said that several pits like those described above were made at Taytay and were inspected by the writer at the end of the first quarter of the rainy season. No water was found in the pits dug in the earth and arranged as described above. If there is no roof or covering, some water will collect undoubtedly.

As to the second objection, pollution of the soil and wells does occur with the present arrangements in Taytay; and the pollution of the soil would be less with a pit system while pollution of the wells would probably not be much greater than at present. However, the people usually get their drinking water away from their habitations and will probably have an artesian water supply shortly.

As to the increase of flies: Unless the fæces are covered, flies will undoubtedly breed in them. However, flies abound under the present conditions in Taytay.

Further information on the fly question and the employment of pigs for the disposal of fæces are necessary, but I am satisfied that the pit system is feasible and would be an improvement on the present conditions in Taytay. The pit system can not be used in rocky or swampy soil. A dike system may be feasible under such conditions, but this also would require further investigation.

MEDICAL SURVEY OF THE TOWN OF TAYTAY.

XV. SUMMARY AND CONCLUSIONS.

By Richard P. Strong.

(*From the Biological Laboratory, Bureau of Science, Manila, P. I.*)

In considering these reports one should bear in mind the original purpose of the expedition, which was to obtain exact and comprehensive knowledge of conditions as they actually existed in a typical Filipino town. The primary idea of the survey was not to develop any special line of research, although it was hoped that new conditions might be discovered. The difficulties in carrying out the investigations were not as great in some respects as had been anticipated; the people throughout the town took considerable interest in the work, and there was comparatively little difficulty encountered in obtaining their consent to submit to a physical examination or to one of their blood, or in securing specimens of sputum, fæces or urine when such were desired.

From a consideration of the data at hand, it is believed that a satisfactory knowledge has been gained of the diseases prevalent in the community of Taytay and of the conditions under which the people live there.

As might have been expected, the inhabitants, in building their homes in the lowlands, considered chiefly the conveniences of location in pursuing the agricultural and fishing industries, thus sacrificing the advantages of a healthy location on the hill-lands at the east of the town. (Plate XI, fig. 1.)

The town of Taytay, because of its proximity to the cities of Manila, Pasig and Cainta, where Spanish, Chinese and Indians are present in great numbers, probably contains a more mixed population than the average Filipino village situated along the littoral highlands. It is near Lake Bay and as it also lies at the foot of hills and mountains, therefore, both the fisherfolk and the hill people are found in the town.

From the examination of about 500 men, women and children among the visitors at the dispensary who were carefully measured, the physical types and the ear types associated with them which have been previously described by Doctor Bean, were established and the diseases common to some of the types were mentioned. From these studies no absolute conclusions would be justified, but the inference is strong that the blend of European and Filipino which most resembles the Iberian, or Mediterranean race of Sergi, is more susceptible to all diseases—and more especially to tuberculosis—than the primitive type. This may indicate that the European-Filipino type, or its resulting offspring, the Filipino-Iberian type, is less resistant to disease in the tropics than is the aboriginal type on its own soil and in its natural environment. In a number of children and adults a dorsal flattening in the brachycephalic region was observed, which was accompanied by projection in the parietal region, prominence in the region of the bregma and bulging in the temporal region. This condition it is believed has been brought about in young children owing to the custom of placing them on hard bamboo floors with only a *petáte*, or thin mat, between the head and the floor when they sleep. A soft pillow, being hot and oppressive for the children, is not used in the Philippines. The child usually lies flat on its back and during sleep or while resting, the head is either straight or turned to one side. After a few months a flat place is frequently formed on that part of the head resting on the floor, and the child then continues to lie on this flat place until the head bcomes misshapen and badly deformed. For this reason Doctor Bean believes that the dorsal flattening may occur in many adults and thus the cephalic index is not the best differential factor in racial anatomy. The ear form has been established beyond doubt as a differential factor in racial anatomy, and among Filipinos of the littoral regions it should be placed above the cephalic index in importance, because of the apparent distortion of the head in many individuals. By the ear alone the derivation of the majority of the people may be determined.

The principal occupations of the people are agriculture and fishing. At present their life is not modified to any degree by contact with foreign influence. A slight gain in the population of the town has apparently taken place since 1903, at which time the census showed a population of 5,840 whereas the present census shows one of 6,094.

The water supply is largely from wells which are generally exposed to surface contamination and to contamination from the hands and feet of those drawing water. (Plate XII, fig. 2.) A bacteriological examination of the water from these wells, thirteen in number, showed in six of them, over 5,000 microörganisms per cubic centimeter. *Bacillus coli communis* was isolated from seven, and *Bacillus pyocyaneus* from three. Hence the majority have been contaminated by sewage. The chemical examination of these waters showed that in the majority the amount of chlorine and of albuminoid ammonia and nitrites was so high as to also condemn them from a chemical sanitary standpoint. *Amœbæ* were found in all but one and *flagellata* in all. However, since the general water supply of Manila usually contains *amœbæ*, the discovery of these protozoa in the water of the wells of Taytay might have been expected. The natives of the town, of course, drink the water unboiled. From the character of the drinking-water supply in the town and its constant exposure to surface contamination and to contamination from the hands and feet of those drawing the water, it is evident that the population, under the present conditions, must be exposed from time to time to epidemics of cholera and of dysentery.

It is particularly surprising that more cases of dysentery were not observed during the time that the expedition carried on its work. Only 23 of the 789 individuals examined (2.9 per cent) were suffering from any form of dysentery and but 12 with amœbic dysentery. In view of the fact that practically all the drinking water in Taytay was found to be infected with *amœbæ,* we must conclude that either most of the species of *amœbæ* found in the water of the wells are not pathogenic for man or that the great majority of the inhabitants of Taytay are relatively immune to the effects of these *amœbæ* present in the water. Only one case of abscess of the liver was observed in the town. Although epidemic bacillary dysentery has occurred in several parts of the Islands during the present year, and has been more frequent than at any other time since 1901, no cases were observed in Taytay. However, epidemics of this form of the disease in the Philippines rarely occur before the beginning of the rainy season in June, and are most usual in July, August and September. The remaining eleven cases of dysentery found in the town were of the catarrhal form and were perhaps caused by intestinal infection with *Bacillus pyocyaneus* since this organism was isolated from the water of three of the wells in the town.

Of the protozoal forms of dysentery now recognized, amœbic, malarial and balantidial dysentery are all found and are endemic in the Philippine Islands. However, *Kala-azar* dysentery does not exist here. Of the remaining forms of dysentery (the verminous ones), that one caused by *Schistosoma japonicum* has alone been observed here. *Schistosoma hæmatobinum* has only been found in Manila in cases in which the infection originated in foreign countries, and *Œsophagostomum brumpti* has not yet been discovered in the Philippines. With the exception of the amœbic and catarrhal dysenteries, none of these forms were encountered in Taytay.

The cholera spirillum which was sought for carefully was not found in the water from any of the wells, although several species of vibrios were isolated from some of them. Had one of the wells been infected with the cholera spirillum, there would almost certainly have been an epidemic of this disease in the town, whereas during the three months but nine cases of cholera occurred. The stools of 80 individuals who had been in contact with these cholera cases were examined for the cholera spirillum, but in no case was this organism found. The result was somewhat different from that obtained in Manila and in the vicinity where this disease had been endemic for some time; in these latter places the stools of 376 apparently healthy people who had come in contact with cholera cases were examined bacteriologically, and the cholera vibrio found in 27 (7.02 per cent). After the disappearance of cholera from Manila, a large number of stools from various individuals were examined over an extended period of time but no typical cholera vibrios were isolated from any of them. The stools of 264 apparently healthy individuals in Bilibid Prison in Manila were also examined for the cholera vibrio during the epidemic, and this organism isolated from 17 (6.44 per cent). It seems probable that the appearance of cholera in Bilibid Prison from time to time, may sometimes be due to these cholera spirillum carriers. It is interesting to note in this connection that all nine of the cases of cholera in Taytay occurred within a period of ten days and during the middle of the hot and dry season. Perhaps for this latter reason the fæces from these cases were rapidly dried by the sun and the cholera spirilla therein thus killed and not disseminated, hence no widespread epidemic occurred and no cholera "spirillum carriers" were discovered. Had these cases of cholera occurred during the rainy season, judging from our past experience, and owing to the conditions of surface drainage in this town, at least a small epidemic of cholera would probably have resulted.

Only four cases of typhoid fever occurred during the three months that the examinations were carried on. There can be no serious ground for the idea that typhoid fever is a comparatively rare disease in the Philippines and that those cases which are found in the Islands have been imported. In the year 1900, I reported to the Surgeon-General of the United States Army fifty-four autopsies upon cases of typhoid fever occurring in Manila. During the same year there were 328 positive Widal serum reactions for typhoid fever observed in the laboratory. Typhoid fever is not nearly so prevalent in Manila and the vicinity as it was during 1900, but since that year the disease has not been at all uncommon, and there is no question but that it is endemic in the Islands and that the large majority of the cases are certainly not imported.

In regard to the improvement of the drinking water supply of Taytay, it is fortunate that the geological strata is favorable to drilling; Doctor Adams has reported it is possible that in the southwestern part of the town sufficient hydrostatic head might be encountered to produce an artesian flow. It is recommended that a deep well be drilled at this place with the hope of obtaining artesian water. In case artesian water is not obtained, the remaining wells which might be drilled in the town should be made only sufficiently deep to prevent surface filtration.

The food of the inhabitants of Taytay was found to be of limited variety and almost entirely of local production; some dried fish is imported from Manila. The staple diet consists largely of fish and rice with some fruits and vegetables, and occasionally carabao milk, butter and eggs

From a physiological standpoint, the diet of the average person represented 90 grams of protein and 2,700 calories, and for a laboring man 100 grams of protein and 3,100 calories. Practically all of the rice used in the town belonged to the class of cured rice, which it is claimed by the adherents of the rice theory in regard to the etiology of beriberi, never causes this disease even when it forms the greater portion of the nutriment consumed over a long period of time. It is interesting to note in this connection that no case of acute beriberi was discovered in the town. Whatever little evidence there is, therefore, supports the theory that beriberi is caused by the ingestion of uncured rice. It must be admitted, however, that this evidence is probably not of sufficient importance to be used as an argument in favor of this view. Beriberi might be prevalent in a town or district during one season of the year and entirely absent during another.

The cost of the food consumed by the inhabitants usually amounted to between 9 and 16 centavos daily, with an average of 12½ centavos per person. However, it is not believed that the daily ration consumed by these people is the most desirable one for them or that the most beneficial food can be purchased by them for this amount. Experience in the Philippines has shown that whenever a large number of Filipino men are required to perform under American direction the duties of laborers, in the construction of roads, streets, railroads, etc., a more liberal diet becomes necessary for them. In Bilibid Prison where the prisoners are required to perform a much greater amount of manual labor than the men at Taytay carry on, the cost of the food for each individual averages 21 centavos per day. When, however, a number of these prisoners were transferred outside of the prison and placed upon even harder work, consisting of the construction of fortifications, it was found advisable to increase the amount and cost of the daily ration to 30 centavos per day. Twelve centavos is a sufficient amount to purchase the ration for the average individual in Taytay only because he performs there very little work. When the average Filipino undertakes to carry on the work expected of a laborer he requires a more liberal diet, and one which includes meat in addition to fish. Under such circumstances his physical condition usually becomes greatly improved.

In relation to the entomological study of the town, two new species of mosquitoes were met with, both belonging to the genus *Culex*. A description of these will appear in another number of the General Science section of this JOURNAL.[1] Mosquitoes of the subfamily *anophelinæ* (*Myzomyia rossii* Giles) were found breeding, particularly in the districts of the town along the banks of streams and in all bodies of stagnant water around the wells; they were most numerous along the stream running through the town. It is interesting to note that the distribution of the *anophelinæ*,

[1] *This Journal* (1909), *Sec. A*, 4, No. 6.

as found by the entomologist, corresponded very well with the districts in which the cases of malaria were discovered by the clinicians. It is not surprising that only about 2 or 3 per cent [2] of those examined in Taytay were found to be harboring the malarial parasite, since the investigations were carried on in the midst of the dry season, which is the time of year in which malaria in Taytay is at a minimum. While the *anophelinæ*, were moderately abundant, they were not nearly so numerous as they were found to be in Olongapo and Cervantes, both very malarial districts. As far as the conditions for the propagation of malaria are concerned, Taytay is not very unfavorably situated. Mosquito nets were used practically not at all in the town, only about one-half dozen having been seen by members of the expedition.

Culex fatigans Wied. was also found breeding in the town. It is interesting to note in this connection that 0.5 per cent of the inhabitants harbored filaria. No evidence was found of the existence of any case of severe infection and this is evidently one reason why filariasis is not more prevalent in the town. The cases of filariasis with numerous embryos in the circulating blood are undoubtedly more dangerous to a community than are those in which but few embryos are present.

It has been suggested by several authors that the amount of malaria present in a community can be estimated roughly by determining the number of cases of enlarged spleen that are encountered. However, in many districts in the Philippines this method would yield very inaccurate results in estimating the amount of malaria present. Chronic enlargement of the spleen is a very common affection among natives of the Philippine Islands. In a large percentage the enlargement is certainly not of malarial origin. In these, aspiration or examination at autopsy reveals no malarial pigment and no malarial parasites. A series of these cases are receiving careful study and a report from this laboratory will soon be made upon them. As is well known, in certain parts of India also enlargement of the spleen is not an index of the amount of malaria present in the locality, since in *Kala-azar* this condition is almost invariably present. It is interesting to note that only in two instances was *Cimex lectularius* L. (the common bedbug) found in Taytay, and that *Cimex rotundatus* Sig., which, according to the researches of Patton, is supposed to convey to man the parasite of *Kala-azar*, was not encountered at all.

Enlargement of the spleen was found in 2.1 per cent of the children examined and in about 1.4 per cent of the adults. No case of *Kala-azar* was found. Indeed, up to the present time this disease is not known to exist in the Philippine Islands.

[2] According to the series of examinations reported by Nichols parasites were found in 3 per cent of the people examined; in the series examined by Guerrero and Sevilla 2.16 per cent were found infected. Latent malaria was found to exist in 5 per cent of the cases by Nichols.

No species of the genus *Glossina* (comprising the tsetse flies) has yet been found in the Philippine Islands. In this connection, it may be mentioned that during the year 1908, a report became circulated in Manila that a case of human sleeping sickness, with trypanosoma infection, had been discovered in the Islands. The report gained credence, probably chiefly owing to the fact that the following title of a paper, "Human Trypanosomiasis in the Philippine Islands. First Reported Case," was printed in the programme of the annual meeting of the Philippine Islands Medical Association held in February, 1908. The paper, however, was not read at this meeting and has not since been published; but the statement was made later in a Government report from the Philippines that one case of sleeping sickness had been detected through the year and news had been received of another suspected case in the Province of Albay.

The evidence in regard to this matter is as follows: Mr. Willyoung, of this Laboratory, was sent on a trip to some of the southern islands to perform microscopical examinations of a number of lepers. Specimens of the blood of these cases, some 60 or 70, were taken, and, upon the return of Mr. Willyoung to Manila, these were stained in the Laboratory by an assistant. Upon examination of these specimens microscopically, Mr. Willyoung found in one of them several trypanosomata. He therefore made a second visit to the locality where the specimens had been collected and visited the people from which these specimens were supposedly taken. However, he was unable to locate the particular patient from whom he thought the specimen might have been taken. The question then arose, was the specimen one of human blood, or was it one from a horse infected with surra, or one from some laboratory animal infected experimentally, which the assistant accidentally mixed with the other specimens.

The writer was absent from the Philippines at the time this slide with the trypanosomata was encountered, but upon his return he was shown the specimen in question. As the preparation was already hardened, and stained and mounted in balsam, there seemed little chance of being able to differentiate the nature of the blood by means of the precipitin or complement deflection test. Measurements of the red corpuscles showed the average diameter to be very slightly under that of human red corpuscles. However, by means of these measurements, it was obviously not possible to determine definitely that the specimen was not one of human blood though from the character of the leucocytes it was evidently not horse blood. It is also impossible to differentiate certainly the human trypanosoma from the trypanosoma of surra by microscopical examination alone.

The report of this case, therefore, must remain in doubt. Up to the present time no definite case of sleeping sickness has apparently been discovered in the Philippines.

Infections with animal parasites.—An examination of the fæces of

1,000 persons in the town showed that 95 per cent of the people were infected with some form of intestinal worm. The results of these examinations are in accord with those which have been carried out by Doctor Garrison and his assistants in the city of Manila, which have showed that the Filipinos are almost universally infected with these parasites.

No evidence was found of infection with cestodes or trematodes in Taytay. In Manila cases of cestode infection are not uncommon, *tænia* having been found in 0.7 per cent of the cases examined in Bilibid Prison and in 0.66 per cent in children. The fact that the diet of the people of Taytay so seldom contains any meat evidently accounts largely for the absence of *Tænia saginata* and *Tænia solium* infection among them.

With respect to trematodes it may be mentioned that few cases of paragonimus infection have been found in the Philippines in which the infection was probably acquired as far north as Manila. The majority of the cases have been discovered in the southern provinces or in the Islands south of Luzon. This affection is endemic in portions of Samar. Infections with *Schistosomum japonicum* and *Opisthorcis sinensis* also appear more common in the southern islands than in Luzon. From reports that have reached Manila it seems not improbable that infection with *Filaria medinensis* (the guinea worm) occurs among the Moros in some of the southern islands of the Archipelago. No authentic case, however, has yet been reported from the Philippines.

An attempt to discover any localization in groups of the cases infected with *Ascaris*, hookworms, *Trichuris*, *Strongyloides*, *Oxyuris* or *Amœba* in any part of the town of Taytay, in proximity to certain wells or streams, by families or occupations, gave negative results.

It was perhaps surprising that only 2.7 per cent of the persons examined were found to be harboring *amœbæ*, since in Bilibid Prison, where the water supply of the prisoners is carefully sterilized, 23 per cent of the prisoners had been found to have *amœbæ* in their stools. However, it is needless to emphasize that the examinations at Taytay were performed with very great care. It was thought that encysted forms of *amœbæ* were discovered in eleven individuals, but no reliance can be placed upon observations relating to the presence of encysted forms of *amœbæ* in the stools. Only in cultures of *amœbæ* and certainly not in the fæces, can one be certain of recognizing encysted forms. The 27 cases discovered with *amœbæ* were evenly divided between the two sexes, and showed no excessive frequency of infection in any single age group.

Only 11.6 per cent of those examined were found to harbor hookworms, and none of them presented any symptoms of disease which could be attributed definitely to this parasite. Eighty-two and nine-tenths per cent were found to harbor *Ascaris*, and about 77 per cent *Trichuris*. It is interesting in this respect to compare the studies of a similar nature carried on in individuals in Manila by Doctor Garrison and his assistants. In the neighborhood of 3,000 examinations were made in Bilibid

Prison and here 84 per cent of the natives were found to be infected with animal parasites—59 per cent with *Trichuris,* 26 per cent with *Ascaris,* and 52 per cent with hookworms. Of 385 women and children examined in Manila, 89 per cent were found infected with *Trichuris,* 53 per cent with *Ascaris* and but 13 per cent with hookworms.

The question has arisen as to what really is the rôle that these infections play in regard to the public health. In my opinion, reasoning from the examinations that have been made, too much stress has been laid on the action which the intestinal worms exert in Luzon in relation to the health of the people. There is probably no evidence which shows that moderate infections with whipworms and roundworms exercise a deleterious effect on the health of the individual. The cases of hookworm infection which we have observed in these Islands have been as a rule mild ones, and this parasite is not as important a factor in Luzon in the production of disease as it is in Porto Rico, Egypt, Japan and several other countries in which the individuals infected frequently exhibit a grave anæmia. In the early days of American occupation of the Islands, when our American troops were frequently encamped in the field near swampy districts, severe cases of uncinariasis with advanced anæmia were occasionally, though rarely, observed among them. Such cases are now almost unheard of among our troops. In Taytay, and in by far the great majority of the cases of infection found in Luzon, the individuals infected exhibited no visible anæmia or other symptoms of disease. Indeed, in the Taytay examinations, while in none of the cases infected with hookworms did the hæmoglobin register 100 per cent, nevertheless in the hookworm cases the hæmoglobin estimations were somewhat higher on the whole, than those in individuals which showed no infection with hookworms. No case in Taytay gave a reading above 95 per cent. It may be stated in general that in the natives of Taytay the hæmoglobin, as determined by the Tallquist test, registered over 80 per cent in only about 60 per cent of the inhabitants. The natives therefore generally show a reduction in the amount of hæmoglobin, below that amount usually observed in healthy individuals in temperate climates.

About 1 per cent of the inhabitants were found to be infected with tuberculosis; no focus of this disease was discovered, the cases being distributed evenly throughout the town. Pulmonary tuberculosis was the common form. No case of relapsing fever was discovered; indeed, no authentic report of infection with the recurrent spirochætæ has yet been made in the Philippine Islands. About 1 per cent of the inhabitants were found to be suffering from goitre. It is interesting to note the very small amount of venereal disease which was observed in the town. On the other hand, yaws was found to be fairly prevalent, 1 per cent of the children being infected. An interesting custom among the natures is the artificial production of sores and ulcers for the purpose of producing counterirritation on the skin, known by the natives as *puente;* the scars which later result, are apt to puzzle the uninitiated in regard to their origin. These ulcers are sometimes mistaken for syphilitic lesions. Their method of production by the application of lime and later by binding on a piece of betel-nut is described in detail by Doctor Nichols in Part XIII, page 285, and is illustrated in Plate XVIII.

From this brief summary of the studies performed at Taytay, it may be seen that while the conditions in this town are generally unsanitary, the death rate varying in different years from 27.91 per 1,000 to 45.42 per 1,000, they at times may become most unsanitary. Under the present conditions, epidemic diseases such as cholera, typhoid and bacillary dysentery are likely to occur from time to time. The history of the town shows this to be the case in regard to cholera. The great epidemic of 1882 is said to have gained a foothold first in Taytay. In 1902, and again in 1905, cholera was also epidemic there. If the introduction of cholera at Taytay during the present year had taken place in the rainy season instead of in the midst of the dry one, another epidemic of this disease would likely have occurred.

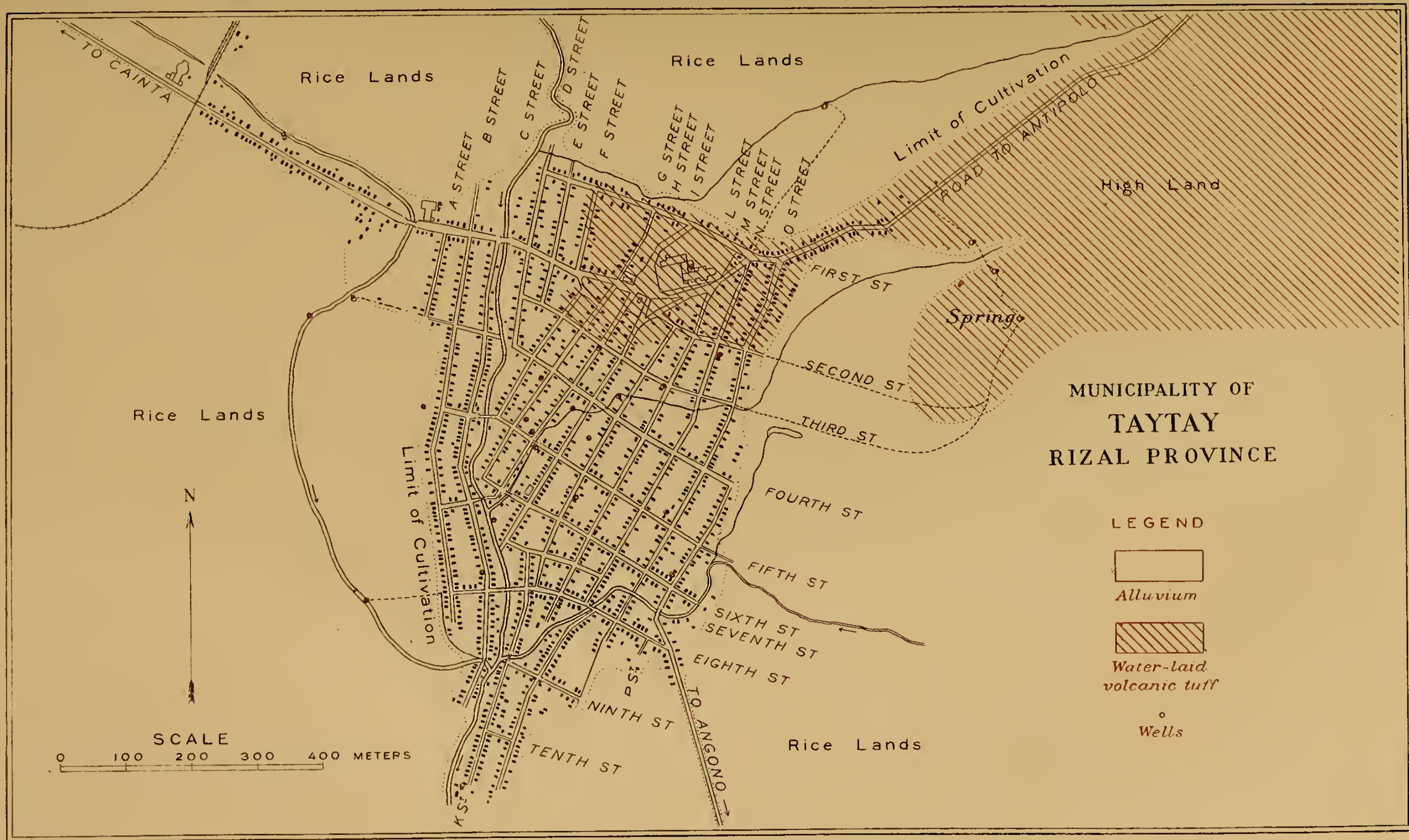
In regard to smallpox, general vaccination against this malady was carried out in 1905 and in March 1909. It is interesting to note in this connection that smallpox was present in 1908 and 1 per cent of the inhabitants died with it. The entire mortality of the year was 45.42 per 1,000. In 1907, when there was no smallpox, the death rate was 27.91 per 1,000. Practically all of the deaths from smallpox were among children under 9 years of age; indeed, nearly 90 per cent were among children under 5 years of age; that is, the majority of the children who died from the disease were born after the general vaccination performed in 1905. Therefore, there should be no difficulty in controlling smallpox by means of vaccination.

There can be no question of the advisability of protecting the inhabitants of Taytay against cholera and perhaps against typhoid fever, also by vaccination. All the evidence that we have from the provinces relative to cholera has shown the practicability and the efficiency of vaccination against this disease as a method of protection. The most striking experience was that obtained in the town of Angat, where one-sixth of the population—that is, all those who volunteered, 1,078 in number—were vaccinated against cholera; a few months later, cholera appeared in the village, 122 persons were stricken with the disease, 121 of whom were among the noninoculated. The vaccination against cholera performed throughout the Islands during the past few years have shown that proportionately six times as many cases of cholera have occurred among those unvaccinated as in those vaccinated. Work in the Philippines in vaccination against smallpox has been very active recently; and it is difficult to understand why so little attention has been paid here recently to vaccination against cholera and typhoid fever, particularly since vaccination against typhoid fever is being employed in our Army in the United States. Vaccinations for obtaining immunity in the treatment of furunculosis and gonorrhea are at present much in vogue in Manila; but in these instances we have not been able yet to demonstrate that any immunity is obtained by this procedure. In the case of cholera, however, the question has been demonstrated not only by experiment but from a practical standpoint. It is believed that if a large epidemic were imminent the sanitary authorities would not hestitate to employ vaccination against cholera. It would seem, however, that in the case of towns with sanitary conditions similar to those which exist in Taytay, general vaccination against cholera should be performed in order to protect the inhabitants from a general epidemic of this disease which otherwise might occur were the disease introduced at a favorable season. It is true that the sanitary conditions in Taytay can be improved greatly if artesian water can be supplied to the people, but so long as they pursue their present habits in regard to sanitation—particularly those of eating with their fingers from a common dish, drinking water from a jar which is constantly soiled by the hands, and bathing, washing and even drinking from the same stream; and so long as fæces are exposed to flies and other insects in the vicinity of the dwelling houses—so long will they be liable to epidemics of cholera.

In conclusion, it would appear that the sanitary measures to be particularly recommended in Taytay at the present time are supplying the town with an artesian water supply, vaccination against cholera and perhaps against typhoid fever, and an improvement in the present method of disposing of the fæces so that the human excrement is not exposed to flies and other insects and not allowed to lie in close proximity to wells or to houses where food is partaken of. During certain periods of the year something might be done in the way of distributing quinine among those suffering from fever. More extensive prophylaxis against malaria in Taytay is not recommended at the present time.

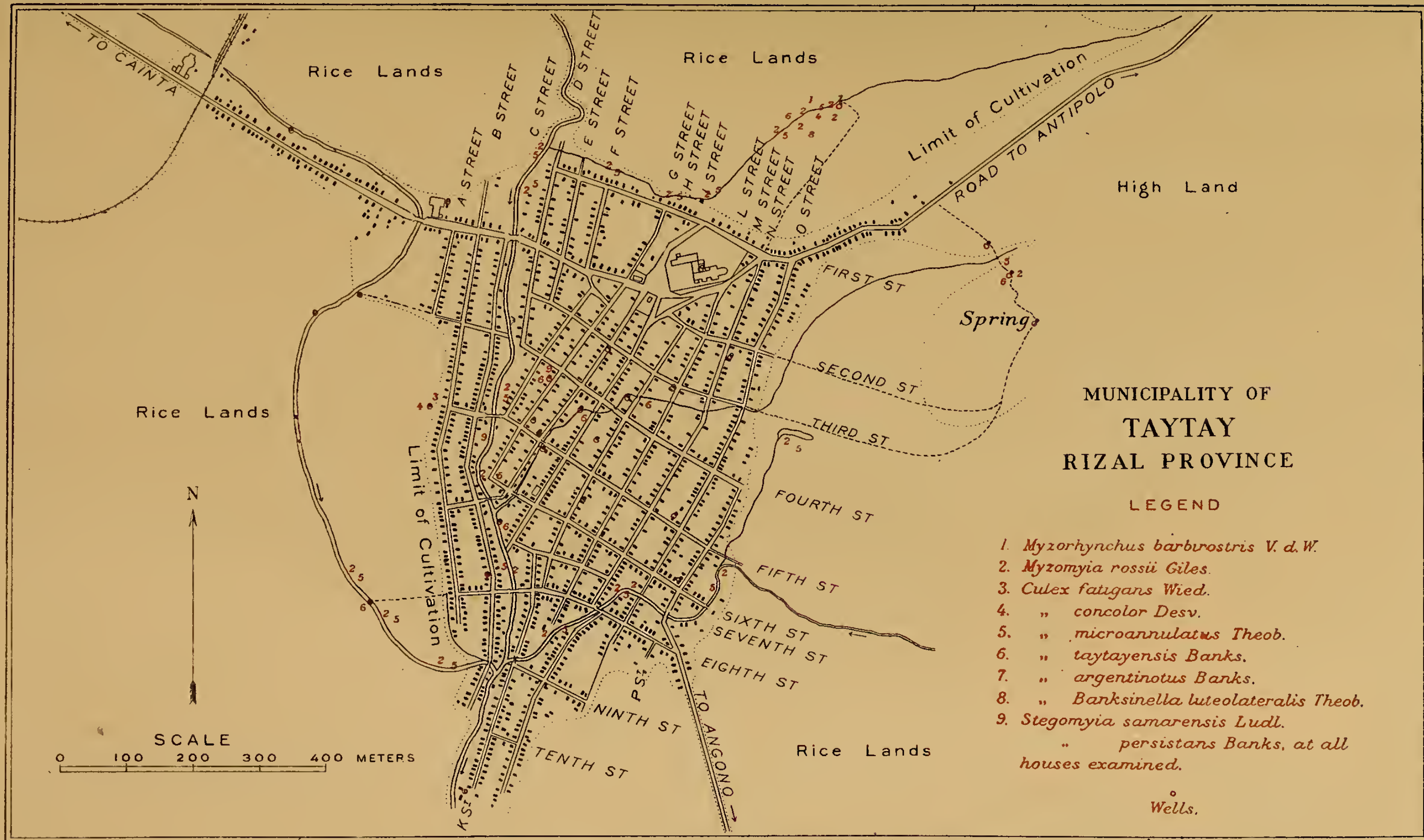
LIST OF ILLUSTRATIONS.

TEXT FIGURE.



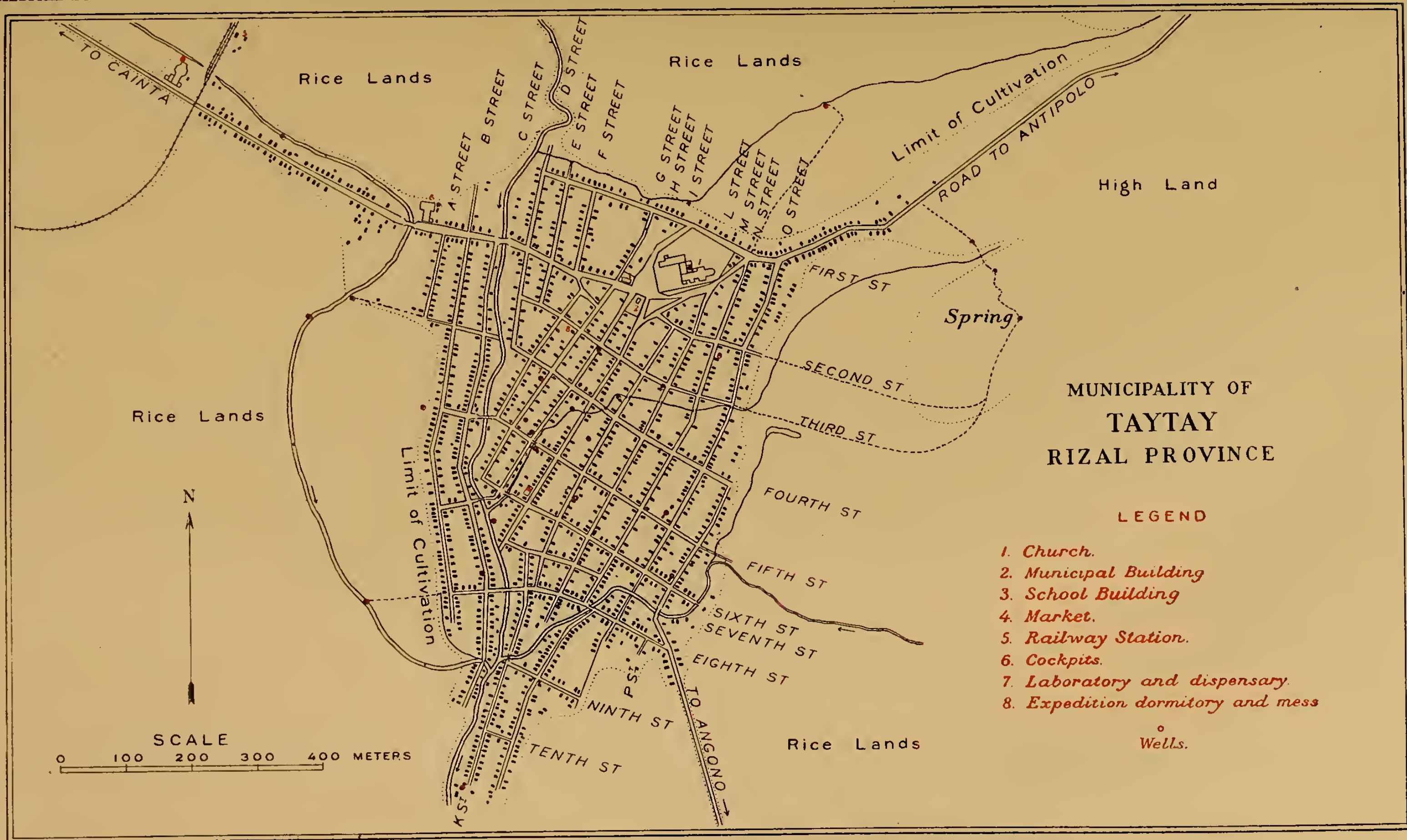
GEOLOGY AND WATER SUPPLY OF TAYTAY. (ADAMS.)

PLATE I.



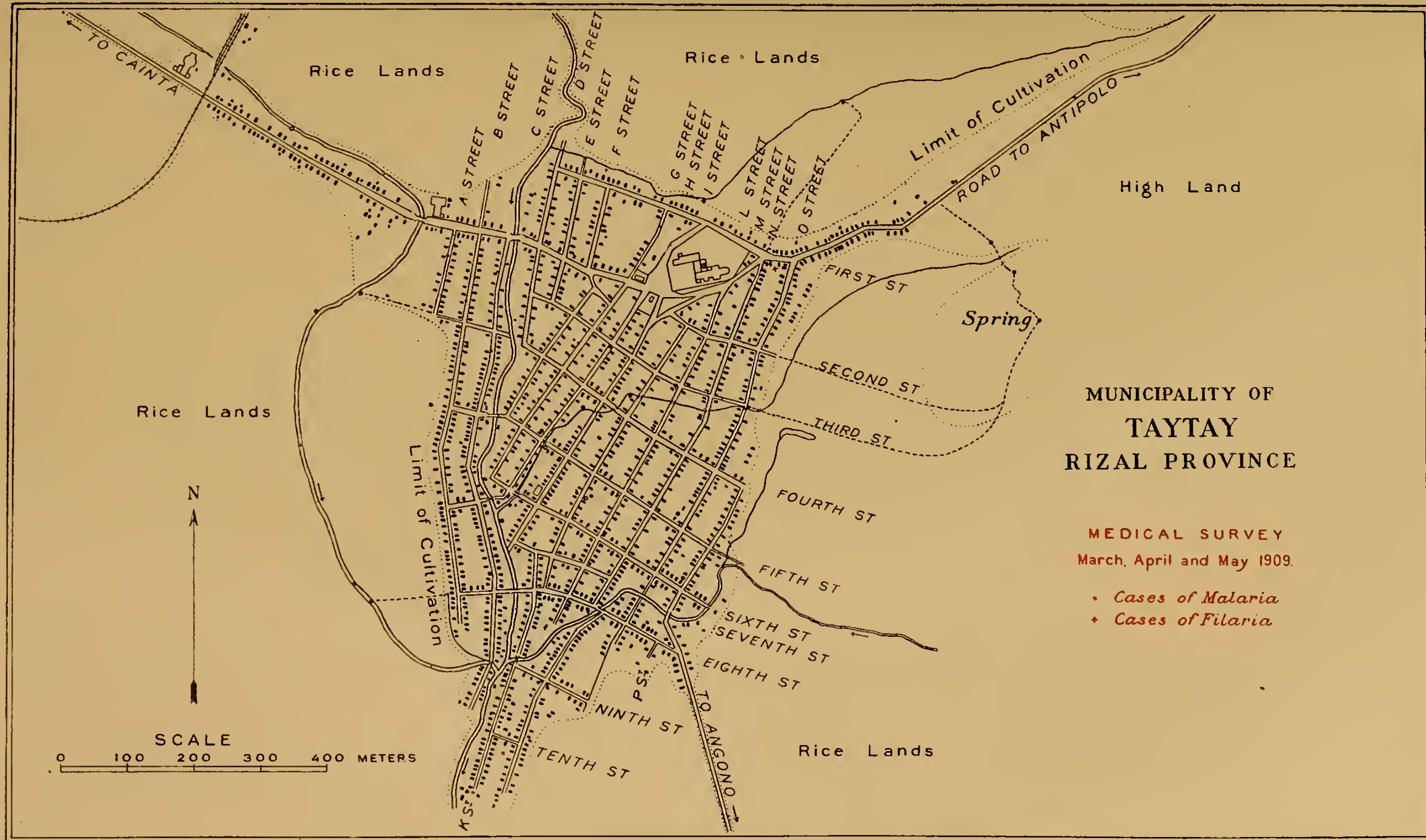
TYPE AND DISTRIBUTION OF MOSQUITOES OF TAYTAY. (BANKS.)

PLATE II.



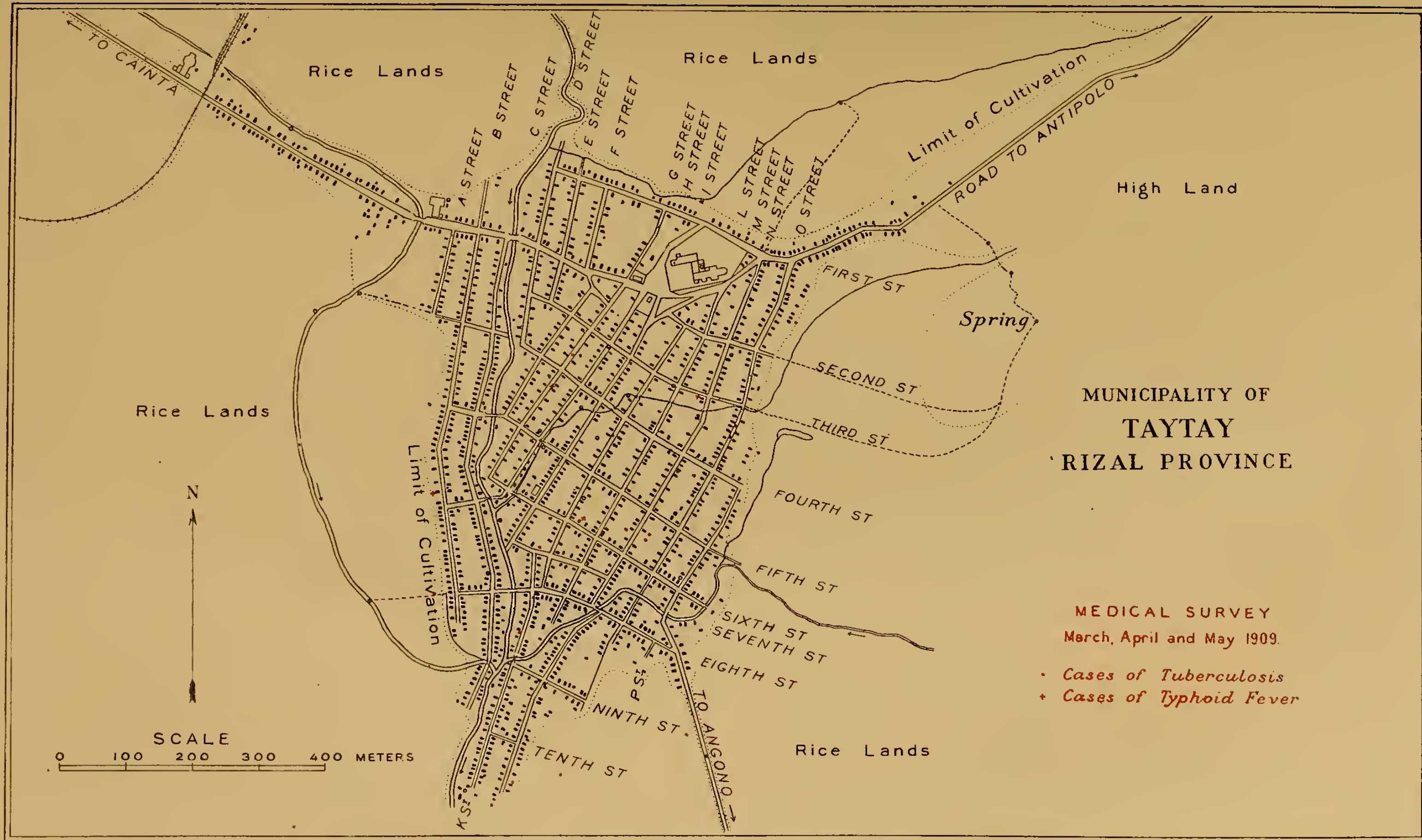
REFERENCE MAP OF TAYTAY SHOWING LOCATIONS OF PRINCIPAL BUILDINGS. (CLEMENTS.)

PLATE III.



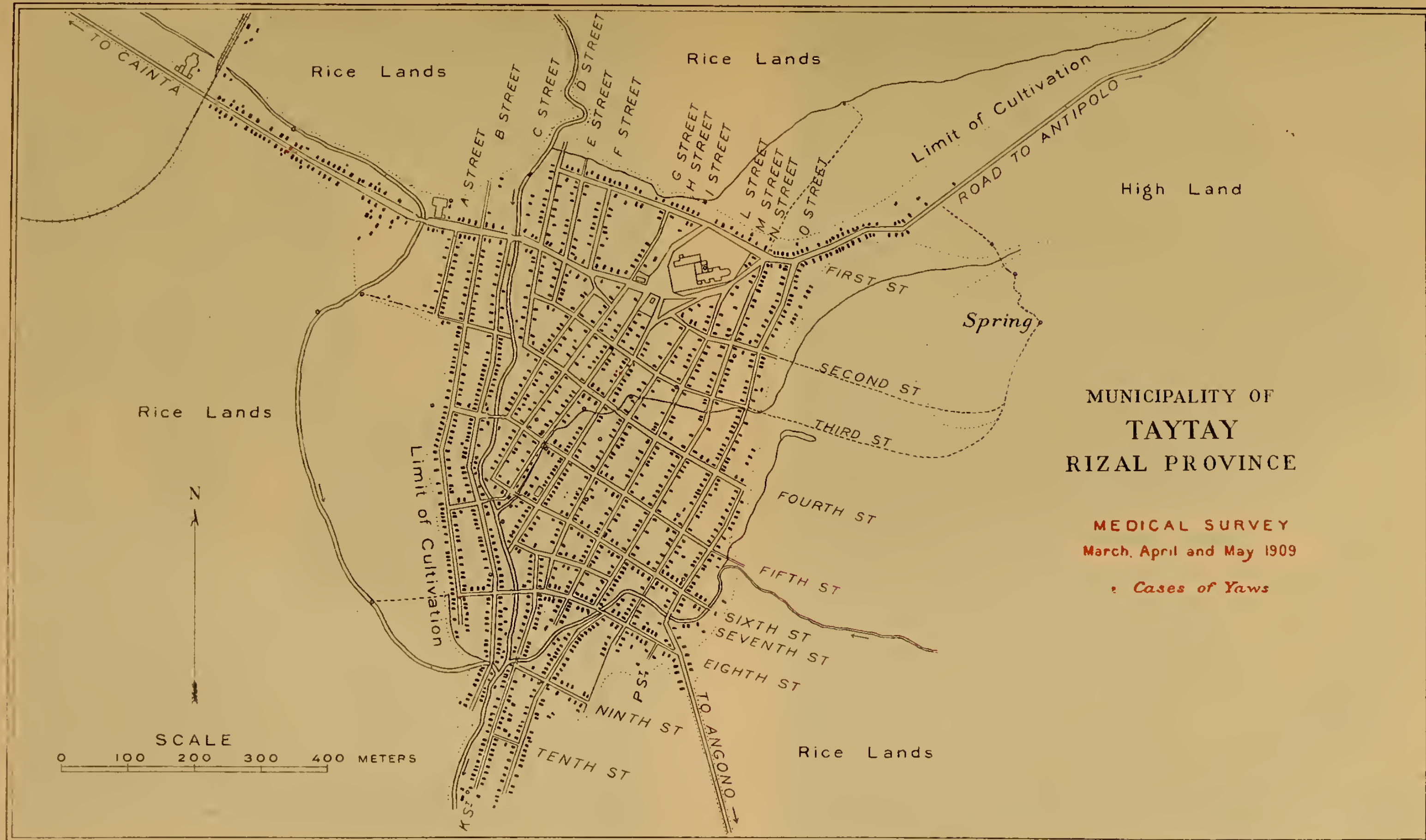
CASES OF MALARIAL AND FILARIAL INFECTION IN TAYTAY. (NICHOLS.)

PLATE IV.



DISTRIBUTION OF CASES OF TUBERCULOSIS AND TYPHOID FEVER IN TAYTAY. (NICHOLS.)

PLATE V.



CASES OF YAWS IN TAYTAY. (NICHOLS.)

PLATE VI.

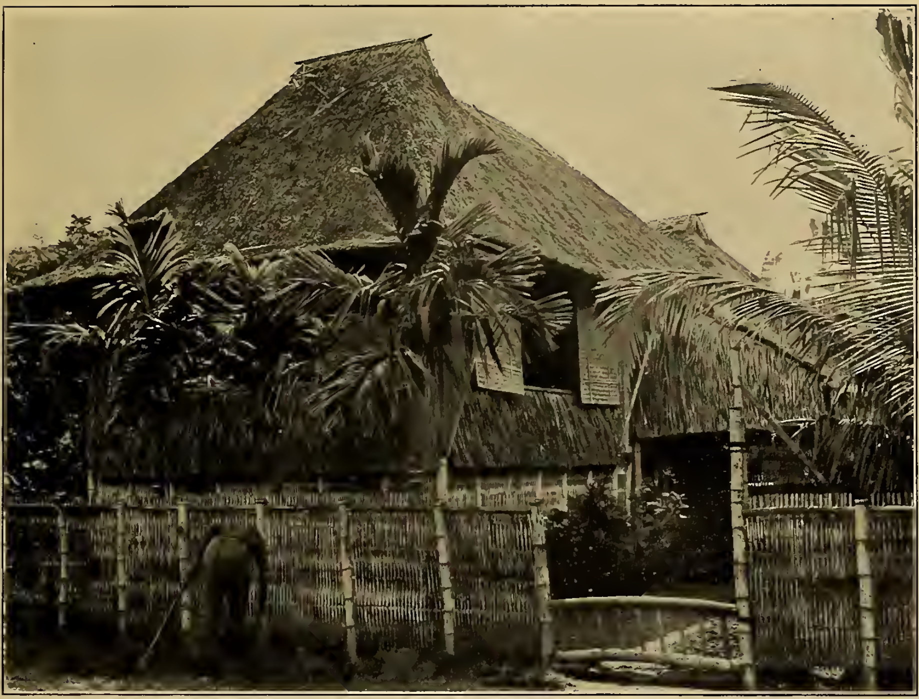


FIG. 1. LABORATORY AND DISPENSARY BUILDING.

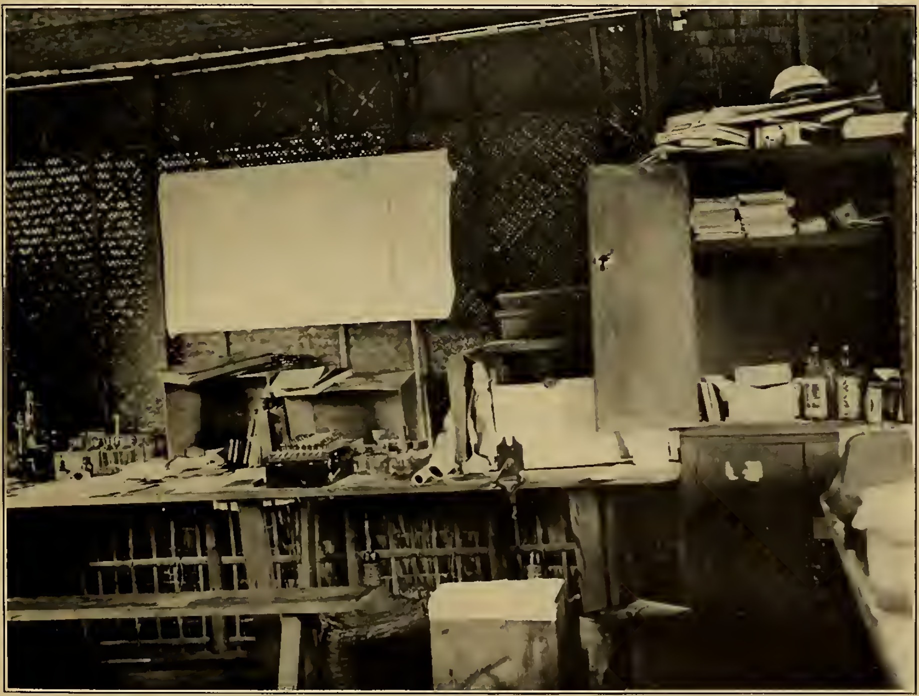


FIG. 2. INTERIOR OF LABORATORY.

PLATE VII.

FIG. 1. TAYTAY FROM THE EAST.

FIG. 2. ROAD TO ANTIPOLO IN TUFF FORMATION.

PLATE VIII.

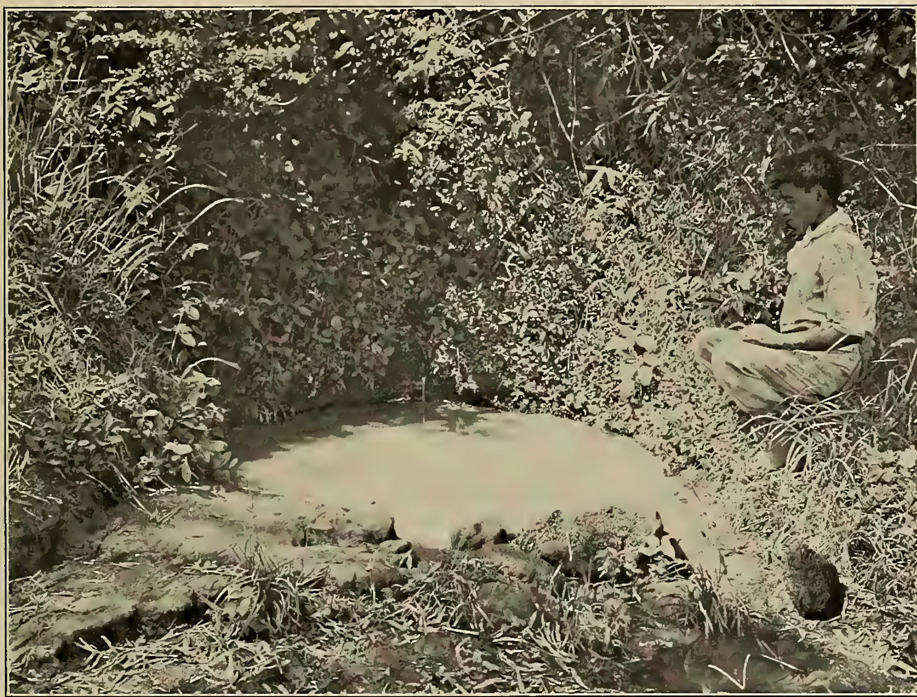


FIG. 1. SPRING DURING RAINY SEASON.

FIG. 2. BIG WELL NEAR MUNICIPAL BUILDING.

PLATE IX.

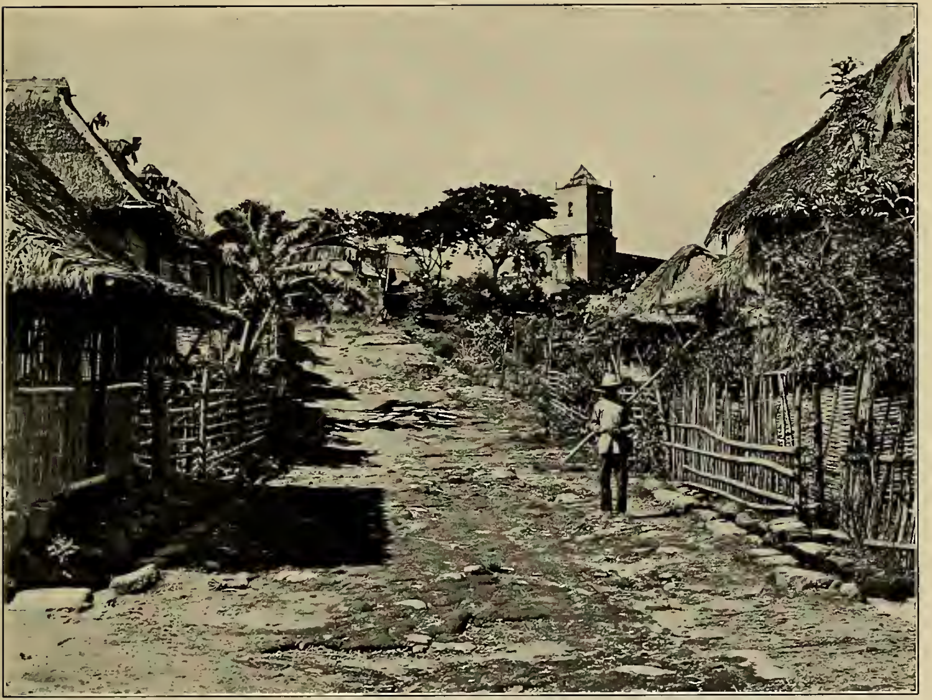


Fig. 1. STREET SCENE, LOOKING NORTH TOWARD THE CHURCH.

Fig. 2. STREET SCENE, LOOKING SOUTH FROM THE CHURCH.

PLATE X.

FIG. 1. LOOKING TOWARD TAYTAY ACROSS THE RICE PADDIES.

FIG. 2. THE LARGEST CREEK IN AUGUST AFTER THE RAINS.

PLATE XI.

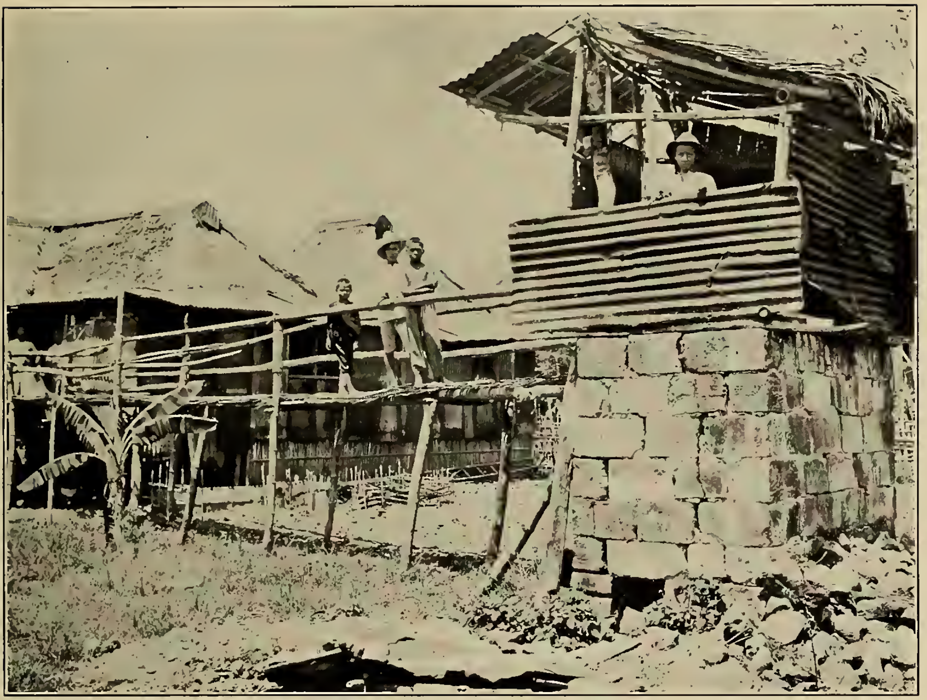


FIG. 1. OUTHOUSE WITH BRIDGE FROM HOUSE.

FIG. 2. OUTHOUSE IN PROXIMITY TO WELL.

PLATE XII.

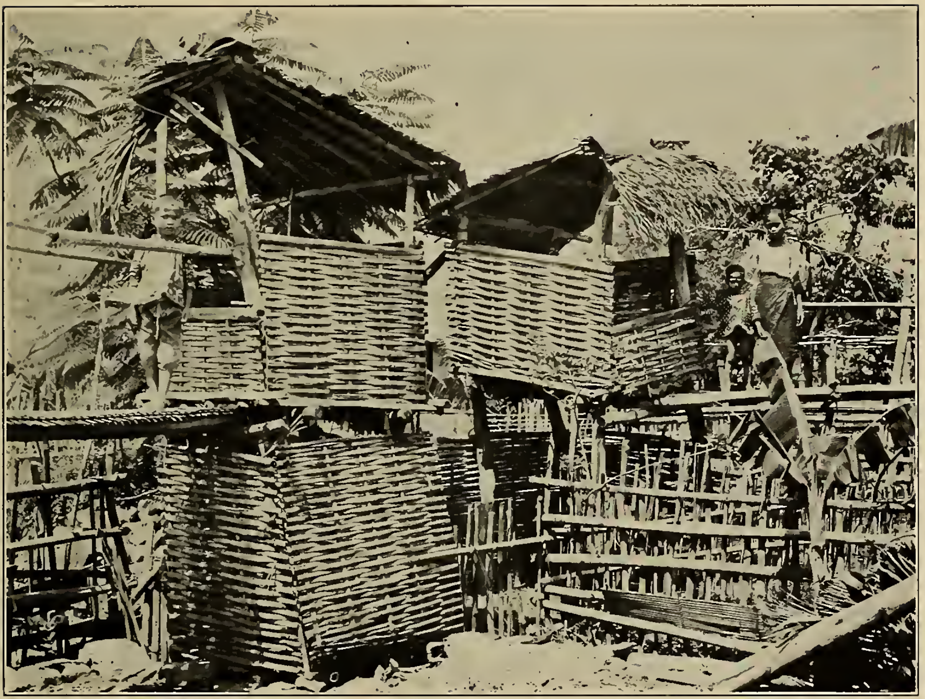


Fig. 1. TYPICAL OUTHOUSES.

Fig. 2. OUTHOUSE WITH PROTECTED PIT.

PLATE XIII.

FIG. 1. REAR OF HOUSE BESIDE THE MARKET.

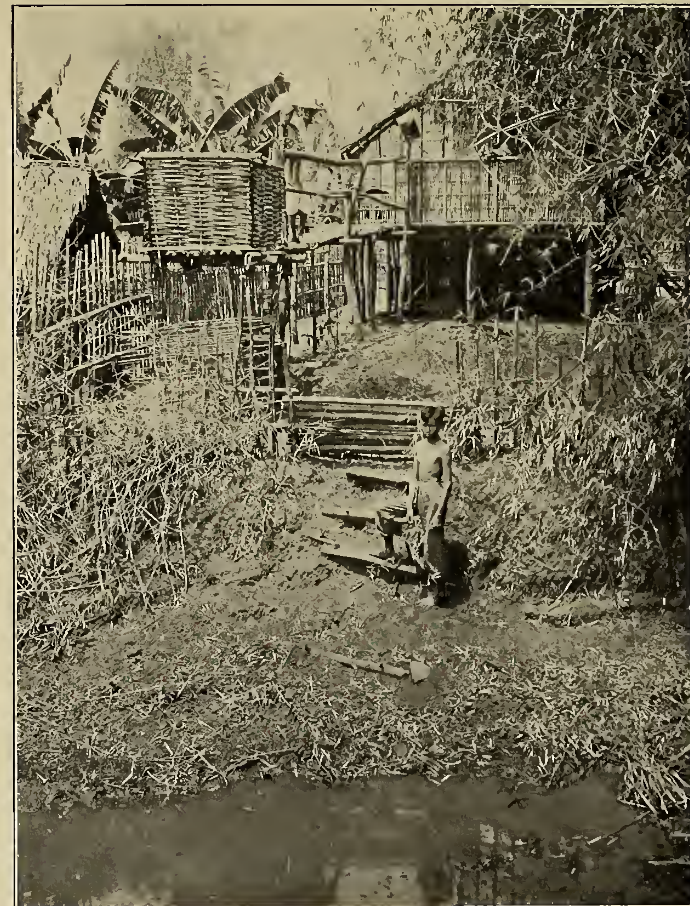


FIG. 2. THE LARGEST CREEK IN MAY BEFORE THE RAINS.

PLATE XIV.

FIG. 1. ELEPHANTIASIS.

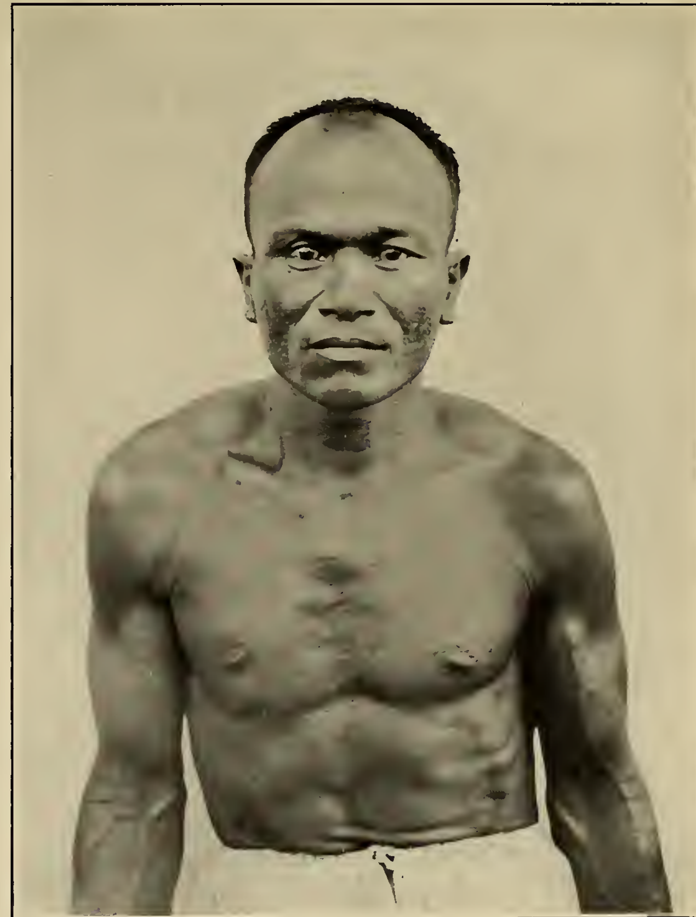


FIG. 2. BURSÆ ON SHOULDERS FROM USING A CARRYING-POLE OR "PINGA."

PLATE XV.

FIG. 1. GOITRE, WITH EXOPHTHALMOS.

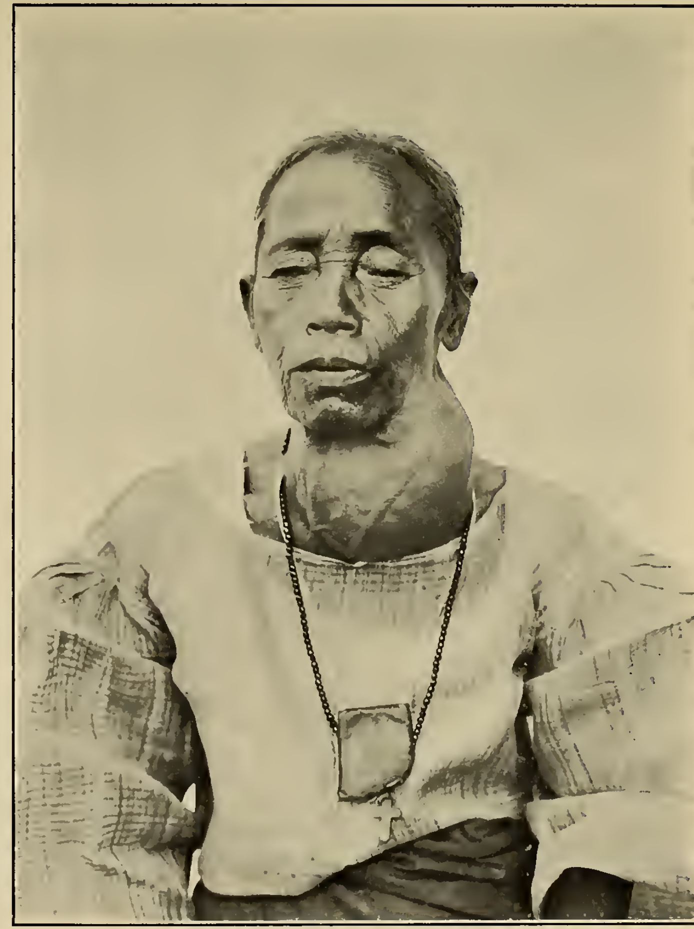


FIG. 2. SIMPLE GOITRE.

PLATE XVI.

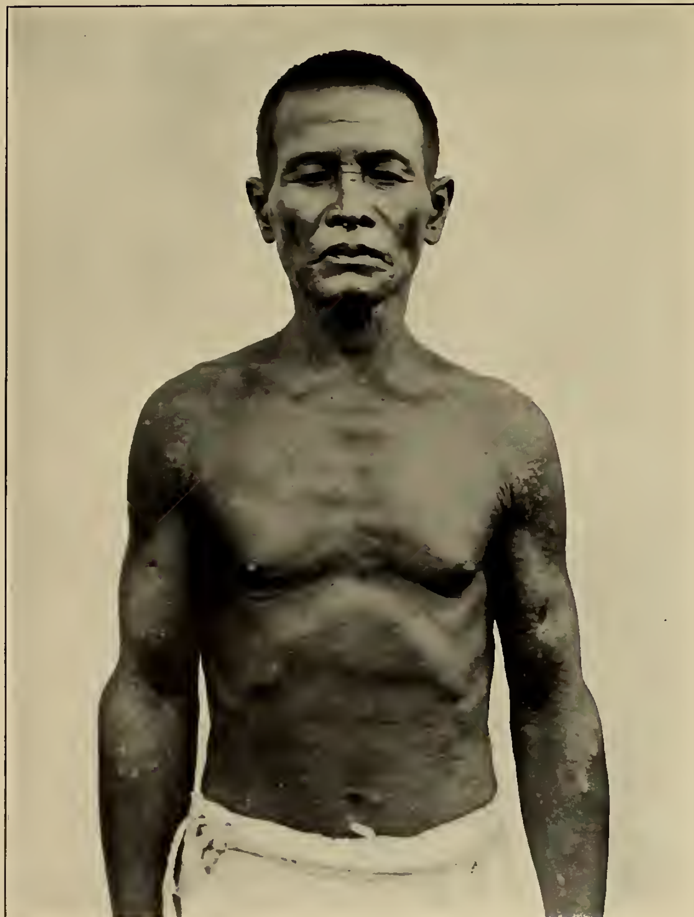


FIG. 1. SCABIES.

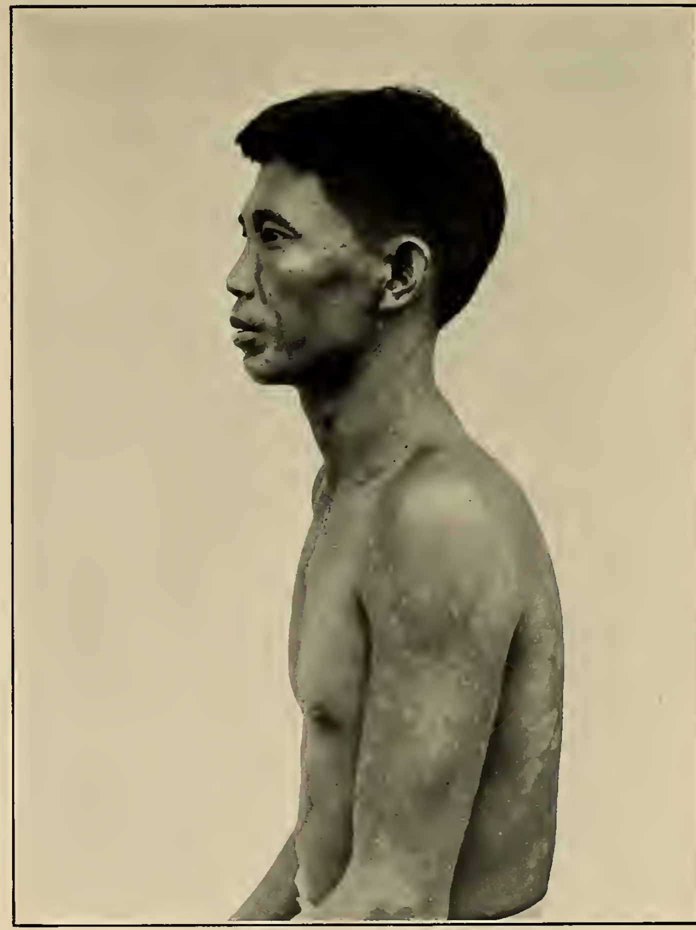


FIG. 2. TINEA VERSICOLOR.

PLATE XVII.

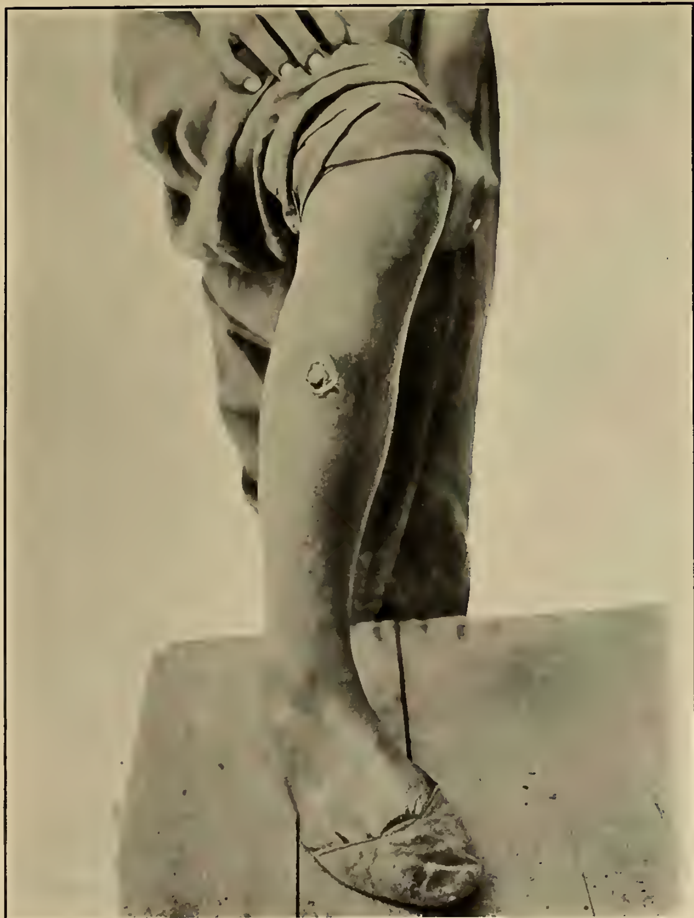


FIG. 1. PUENTE, SHOWING PIECE OF WAX IN ULCER.

FIG. 2. PUENTE, WITH BINDER APPLIED.

PLATE XVIII.

FIG. 1. SYMMETRICAL FIBROMATA ON FOREARMS AND ANKLES.

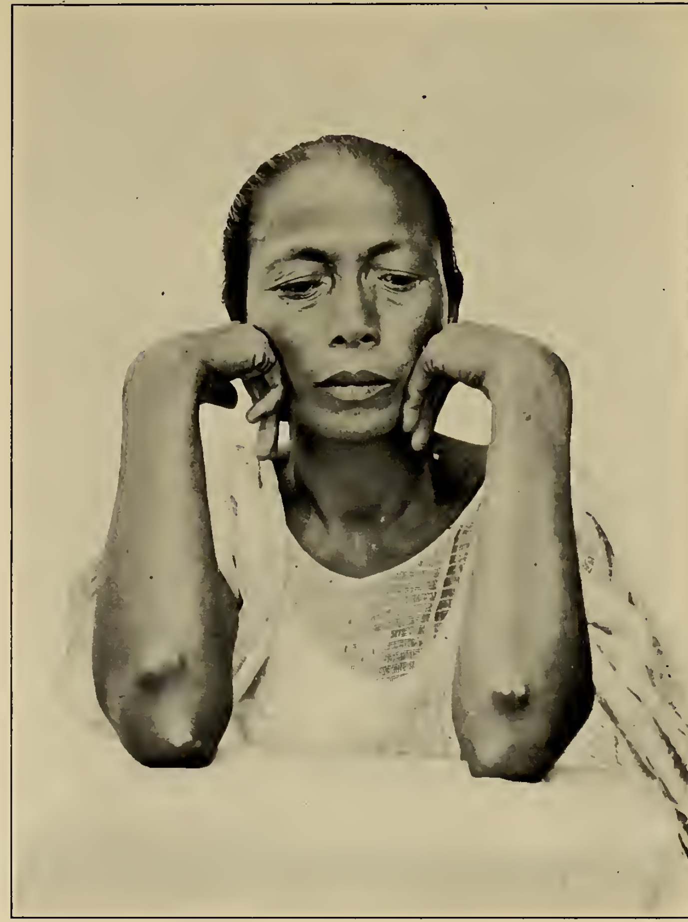


FIG. 2. SYMMETRICAL FIBROMATA.

PLATE XIX.

FIG. 1. YAWS IN GRANDFATHER.

FIG. 2. YAWS IN GRANDDAUGHTER.

PLATE XX.

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THE PHILIPPINE

JOURNAL OF SCIENCE

B. MEDICAL SCIENCES

VOL. IV OCTOBER, 1909 No. 5

AN UNUSUAL CASE OF AMŒBIC DYSENTERY.[1]

By HARRY T. MARSHALL,

(*Professor of Pathology, University of Virginia.*)

In descriptions of amœbic dysentery emphasis is always laid upon the occurrence of irregular, undermined ulcers as the most characteristic change in the large intestine. This form of ulceration is the only one exhibited in the two pathological museums which I have had an opportunity to visit. Furthermore, it is not common to meet with a case of amœbic dysentery, running an acutely fatal course, accompanied by profuse hæmorrhage. Such a course, together with unusually acute lesions of the large intestine, distinguished the following case which I examined while connected with the Biological Laboratory of the Bureau of Science in Manila.

M., a native Filipino, a patient in the Civil Hospital of Manila, had a severe and acute type of amœbic dysentery with abundant hæmorrhages from the bowels. He died, apparently from loss of blood, and came to autopsy December 28, 1906.

AUTOPSY NOTES.

Body of an adult male Filipino about 25 years old, sparely built; moderately well nourished; mucous membranes extremely pale; a few ecchymoses in the skin of arms and legs.

Subcutaneous fat.—Moderately abundant, very yellow.

Peritoneal cavity.—Clear, no adhesions; mesenteric glands large, pale, soft; on section pale, gray; structure visible.

[1] Read before the American Association of Pathologists and Bacteriologists, Boston, April 9, 1909.

Thorax.—Clear; lungs occupied less than one-half of thoracic cavity; were very pale and cushiony; uniform in appearance; normal on section; bronchi and pulmonary vessels clear.

Heart.—Pericardium clear; a number of pin-point ecchymoses around the auriculo-ventricular groove; muscle pale, firm, uniform; valves and endocardium normal; aorta clear.

Abdominal cavity.—Spleen moderately enlarged and firm; surface normal; on section trabeculæ prominent; the color distinctly pale. Liver of normal size, pale and firm; on the anterior surface of right lobe directly over gall bladder and 10 cubic centimeters from the anterior margin of the liver, a puckered scar was situated with adhesions to the anterior wall of chest. On section, the scar of an old sinus was found leading for 6 cubic centimeters to a firm, yellow-white scar near the center of the lobe. Right and left kidneys were alike, both large; the capsule stripped readily, leaving an extremely pale, soft cortex. On section, the cortex was extremely pale; the structure cloudy but otherwise normal; the pyramids were also very pale. The suprarenals, pancreas and stomach appeared normal. In the small intestine numerous *uncinaria* were found in the upper part where red points studding the mucosa were observed. In the lower portion several specimens of ascaris occurred; otherwise the small intestine was normal.

The large intestine contained a large amount of dark red, almost black, pasty material in which *amœbæ* were numerous. From the ileocæcal valve to the lower part of the rectum the mucosa was studded with nodular elevations which varied from about 6 millimeters to 12 millimeters in diameter and which rose about an equal distance above the level of the mucosa. In most cases the elevation was surmounted by a mass of necrotic tissue which could be scraped off, leaving a deep crater-like ulcer extending well down through the mucosa. Only one or two small, typical, irregular amœbic ulcers were observed. Many active amœbæ were found in the detritus taken from the crater-like ulcers. On section through such a nodule a red, dirty looking mass was seen extending into the submucosa and radiating for 1 cubic centimeter or more in this layer.

Microscopic examination, hæmatoxylin and eosin stain.—Lungs, alveolar septa delicate, tissue normal, very little pigment. Spleen, capsule of normal thickness; section was very cellular so that the Malpighian bodies did not stand out conspicuously. The sinuses were for the most part flattened and collapsed. The cells lining them were usually small with clear cytoplasm. There was little evidence of destruction of red blood corpuscles. The vessels, stroma and Malpighian bodies appeared normal. A few cells were found with small, dark nuclei and cytoplasm staining a coppery-red. The section of the liver showed a diffuse cloudiness and numerous areas of focal necrosis. These areas were quite extensive and often were seen to be located around the sublobular veins. In these areas the liver tissue had lost the normal staining power and the cells were opaque, red, swollen, devoid of nuclear material and either homogeneous or vacuolated. There was no evidence of reaction around the areas of focal necrosis.

Sections of the large intestines were made through several of the nodular elevations from various parts of the large intestine. The appearances were nearly uniform in all of the cases. The mucosa between the nodules showed many crypts in which the epithelial lining was entirely converted into goblet cells. In a large number of cases the epithelium was lost entirely, leaving only the interstitial tissue. Here and there an entire crypt was converted into a granular mass, taking a deep nuclear stain. In no case were *amœbæ* found in the crypts, however. Here and there one or two adjoining crypts had become converted into granular masses and were surrounded by masses of small round cells, with numerous red blood corpuscles among them. Along either the side or the top of the elevations it was common to find that the tips of the tissue projections between the crypts were densely packed with extravasated red blood corpuscles. Close to these areas of hæmorrhage there often occurred a small bright red mass of thready fibrin mixed with detritus containing tissue cells, blood and other débris, continuous with necrotic epithelium. The necrotic mass extended as a core into the center of the nodule, in some cases reaching no further but in other cases spreading in the submucosa. Surrounding the central core of necrotic material was a dense mass of cells and red blood corpuscles, the corpuscles being often so abundant as completely to fill the tissue. Passing away from the necrotic area along the submucosa the red blood corpuscles rapidly diminished in numbers, while the cellular infiltration extended further, gradually giving way to œdema. In several places the infiltration from one nodule extended directly into that from an adjoining one. The muscular layers were practically free from involvement except along the course of the vessels where there was usually some evidence of small round-cell infiltration. A few small collections were also found in the subserosa. The cells around the necrotic mass and extending through the submucosa were for the most part lymphocytes. In many cases cells with small, densely staining nuclei were found possessing a greater amount of cytoplasm which took a slightly basic stain. Considerable numbers of cells occurred with a slightly vesicular nucleus and clear cytoplasm about two or three times the diameter of a red corpuscle in size. A moderate number of mononuclear eosinophiles were also found. These were more numerous along the outer margins of the areas of infiltration than toward the center. Great numbers of large, pale grayish, cloudy cells, evidently *amœbæ*, were found in the spaces and occasionally in the veins, especially in the advancing margin of necrosis. Often these *amœbæ* contained either blood pigment or fragments of corpuscles. In addition to the changes above noted, the connective tissue cells in the walls of some of the ulcers were swollen, with large vesicular nuclei, and there was swelling and vacuolization of the endothelial cells lining the tissue spaces and veins. In one section there was apparently a new growth of capillaries beginning near the edge of the ulcer.

In sections stained with thionin, the amœbæ failed to take the distinctive stain, but the tissue was old at the time of staining. In sections stained by Gram's method, no bacteria were found in the necrotic areas. The *amœbæ* were conspicuous in these sections. The mesenteric lymph glands showed little change in the cell nests and cell columns, except that the structure was less dense. The sinuses were moderately distended and contained many cells, (small and large mononuclears) and a few red blood corpuscles.

Anatomical diagnosis.—Amœbic dysentery; hæmorrhage into large bowel; acute anæmia; focal necrosis of liver; cloudy swelling of kidneys; ecchymoses in skin and epicardium; scar from old liver abscess. *Uncinaria and Ascaris* infection.

In this case the acute course of the disease with the abundant hæmorrhages and the peculiar nodular form of ulceration shown in the accompanying illustrations were unusual. On looking through the literature I find, however, that this lesion has been described as characteristic of the earlier stage of amœbic dysentery. Councilman and Lafleur [2] note in one case, in addition to irregular undermined ulcers, "numerous round elevations often communicating with the lesions of the bowels by a small opening. Others apparently have no opening." In their summary they speak of "sharply circumscribed projecting nodular thickenings, in which were small cavities filled with gelatinous looking pus."

The most detailed description is given by Dopter,[3] who cites an illustration of a nodule similar to one of these, and describes its development from the first stage of œdema and congestion with minute superficial erosions through a stage with elevations which he speaks of as "verrucosities" which vary from the size of a millet seed to that of a pea. He describes the false membrane and the necrosis; the destruction of entire glands and the reaction in the submucous tissues. The amount of hæmorrhage in his case was much less than in the one under discussion. He also describes the fusion of adjacent areas and a subsequent sloughing off of areas of mucosa leading to the characteristic sinus form of ulceration.

Kartulis [4] makes very little mention of such a form as the one under consideration. He describes one stage as follows: "In the case of still incomplete ulceration the plug (of necrotic tissue) is wedged in the tissue and the picture is like a furuncle with a small opening in the mucosa and the base in the submucosa." Davidson [5] refers to the occurrence of such nodules at an early stage of amœbic dysentery, and apparently a

[2] *Johns Hopkins Hosp. Rep.* (1891), II, 451.

[3] Anat. Path. Dysenterie Amibienne *Arch. de Méd. exp. et d'Anat.* Path. Paris (1907), 19, 505–541.

[4] Kolle u. Wassermann: Handbuch der pathogenen Mikroorganism, Ergänzungsband. 1907.

[5] Allbutt and Rolleston: A System of Medicine by Many Writers. London. (1907) II, Part 2, 527–542.

similar condition is briefly mentioned by Osler.[6] To those of us who saw the tissue from this case in Manila, it appeared unique but Doctor Strong believed that he had seen a similar condition before, although he does not allude to it in his article in Osler's System.[7] Jürgens [8] does not speak of finding this lesion in his experimental cats, neither is it mentioned by Ruge in Mense's Handbuch, by Manson or by Scheude. The condition in this case is certainly different from ulceration of the solitary follicles described by Jürgens and others, and in none of my sections was there evidence of special changes in the follicles.

A word as to the scar in the liver. There was no evidence of a chronic form of dysentery, neither was there evidence of peritoneal adhesions nor other evidence of previous peritonitis, yet we found the sinus leading from the puckered scar in the center of the liver to the surface. It would lead too far to speculate upon the possible relation of this scar to a previous amœbic infection, or upon the possibility of an abscess having ruptured into the peritoneal cavity without having led to the formation of adhesions.

[6] William Osler: The Principles and Practice of Medicine. New York and London. 6th ed., (1906), 2–7.

[7] Osler's system of Modern Medicine (1907), 1, 488–524.

[8] *Zrschr. f. exp. Path. u. Ther.* (1907), 4, 769–816.

ILLUSTRATION.

PLATE I.

1. Early ulcer with necrotic cap.
2. Ulcer with necrotic tissue removed.
3. Confluent ulcer.

1. EARLY ULCER WITH NECROTIC CAP.
2. ULCER WITH NECROTIC TISSUE REMOVED.
3. CONFLUENT ULCER.

PLATE I.

SIXTH INTERNATIONAL CONGRESS ON TUBERCULOSIS (HELD AT WASHINGTON, D. C., SEPTEMBER 21 TO OCTOBER 12, 1908).[1]

By FERNANDO CALDERON and VICTOR G. HEISER.[2]

It was the good fortune of one of the writers to attend, as the official delegate of the United States, the First International Congress on Tuberculosis which was held at Naples, Italy, in the year 1900. The United States at that time ranked as one of the countries that had accomplished least in the combating of tuberculosis. In the eight years that have intervened between the First Congress and this, the Sixth Congress, great strides have been made along this line and the United States now ranks among the first countries that are accomplishing the most toward reducing the ravages of this disease, notwithstanding the fact that all the leading civilized countries of the world have made tremendous progress in this work from year to year.

The plan of organizing the Sixth International Congress differed from that which ordinarily prevails in Europe. The work of the different sections was characterized by a large attendance and by the earnest enthusiasm and interest which was manifest at all times. The scientific work took precedence over the social features. The latter were always arranged so as not to interfere with the real object of the congress, yet there was ample opportunity for diversion, and the wives and friends of the delegates were taken care of in a most excellent manner.

The leading authorities on tuberculosis from nearly every civilized country in the world were present, among whom might be mentioned Koch of Germany, Landouzy of France, Woodhead of England, Vladimiroff of Russia, Tendeloo of Holland, Bang of Denmark, Ishigami of Japan, Adami of Canada, von Schrotter of Austria, Calleja of Spain, and many others. Twenty-seven foreign countries were represented and the governors of many States were present in person. The daily attandance upon the scientific sessions was about 2,000, and upon popular sessions probably 5,000. A total of over 4,000 physicians registered;

[1] Read at Sixth Annual Meeting of the Philippine Islands Medical Association, February 12, 1909.

[2] Official delegates from the Philippine Islands.

some States having 200 physicians present. These figures demonstrate that this was the largest congress which has yet been held and that active interest in combating tuberculosis is rapidly increasing.

The first session was opened by the honorable the Secretary of the Treasury of the United States, and the closing session was presided over by His Excellency the President of the United States. Among other business transacted the following resolutions were passed:

Resolved, That the attention of State and central governments be called to the importance of proper laws for the obligatory notification by medical attendants, to the proper health authorities, of all cases of tuberculosis coming to their notice, and for the registration of such cases in order to enable the health authorities to put in operation adequate measures for the prevention of the disease.

Resolved, That the utmost efforts should be continued in the struggle against tuberculosis to prevent the conveyance from man to man of tuberculous infection as the most important source of the disease.

That preventive measures be continued against bovine tuberculosis, and that the possibility of the propagation of this to man be recognized.

Resolved, That we urge upon the public and upon all governments the establishment of hospitals for the treatment of advanced cases of tuberculosis.

The establishment of sanatoria for curable cases of tuberculosis.

The establishment of dispensaries and day and night camps for ambulant cases of tuberculosis which can not enter hospitals and sanatoria.

Resolved, That this Congress indorses such well-considered legislation for the regulation of factories and workshops, the abolition of premature and injurious labor of women and children, and the obtaining of sanitary dwellings as will increase the resisting power of the community to tuberculosis and other diseases.

That instruction in personal and school hygiene should be given in all schools for the professional training of teachers.

That, whenever possible, such instruction in elementary hygiene should be intrusted to properly qualified medical instructors.

That colleges and universities should be urged to establish courses in hygiene and sanitation, and also to include these subjects among their entrance requirements, in order to stimulate useful elementary instruction in the lower schools.

That this congress indorses and recommends the establishment of playgrounds as an important means of preventing tuberculosis through their influence upon health and resistance to disease.

A most noteworthy feature was the interest exhibited by those who attended the congress, and that of the press of the United States, which was characterized by its earnestness and enthusiasm.

FIRST WEEK.

The tuberculosis exhibit was pronounced by those in a position to judge to have been the most complete that has yet been assembled anywhere. Since the closing of the congress the exhibit has been transferred to New York and later it will be sent to Boston and other places. An idea of its size may be obtained when it is stated that it occupied a floor and wall space over forty times greater than that of the Marble Hall at the Ayuntamiento, Manila. The exhibit consisted mainly of models of properly constructed dwelling houses and of small and individual shacks or tents, both in actual size and models, for the treatment of tuberculosis in different climates. These varied in style and equipment from those that cost thousands of dollars down to some which could be constructed for $25. Statistics were presented in every conceivable form. One chart showed that there had been three times as many deaths from tuberculosis in the past four years as the total number of deaths among Federals and confederates in all the battles of the Civil War. The United States Census Bureau had a red light which flashed every two minutes, each flash representing a death from tuberculosis, or 720 deaths every day in the United States alone. Cuspidors, sputum cups, and pocket flasks were shown in endless variety, together with various methods for disinfecting the same, such as burning the contents or cleansing by the use of hot water or disinfecting fluids. The exhibit from the Government Printing Office in Washington attracted much favorable comment, particularly the method by which cuspidors are carried to a special room, cleansed and disinfected without being touched by the hands. Full-sized models of dispensaries were shown by Pennsylvania and other States, illustrating the out-patient method of treating the disease. The good that may be accomplished by nurses appointed to visit the poor in their homes was well shown by the improved appearance of the houses and the disposal of the sputum of the afflicted ones in such manner as to avoid danger therefrom to others. The windows in the model houses were so arranged as to admit of perfect ventilation, painted floors were substituted for carpets, iron beds for wooden ones, and light-weight washable curtains for the heavy variety. In brief, every effort was made to show that the house should be light and well ventilated, and should contain but few things in the way of furnishing, instead of being dark and littered up with useless belongings.

The city of New York showed a series of models of city blocks. In the first series, almost the entire ground space was built over and the tuberculosis death rate was very high. The amount of unobstructed space has been increased from time to time, and a corresponding lowered death rate from tuberculosis has resulted.

The evil effects of sweeping with an ordinary broom, without first wetting the surfaces or using a special form of brush, was demonstrated by charts showing that tubercle germs have frequently been found in clouds of dust raised by the ordinary method. Many hundreds of other things too numerous to mention were also shown. The United States Department of Agriculture exhibited daily a large quantity of fresh meat which had many tuberculous lesions, which served as excellent material for demonstration. Models of traveling libraries on tuberculosis, railway cars equipped with steriopticon lantern slides, charts, etc., were shown in endless profusion.

SECOND WEEK.

The work of the second week of the congress was divided into seven sections, at which over 600 papers were read. Each section was presided over by a chairman who had an international reputation in the special field of work over which he presided, viz:

Section 1.—Pathology and bacteriology, Dr. William Welch.

Section 2.—Clinical study and therapy of tuberculosis, Dr. Vincent Bowditch.

Section 3.—Surgery and orthopedics, Dr. Charles H. Mayo.

Section 4.—Tuberculosis in children, Dr. Abraham Jacobi.

Section 5.—Hygiene, social, industrial, and economic aspects of tuberculosis, Edward T. Devine.

Section 6.—State and municipal control of tuberculosis, Dr. Walter Wyman.

Section 7.—Tuberculosis in animals and its relation to man, Dr. Leonard Pearson.

All sections met daily from 9 to 12 and from 2 to 5, and at times two sections held combined meetings to discuss questions of common interest; a general meeting of all sections was also held every night, beginning at 8 p. m.

Under the section entitled "The State and municipal control of tuberculosis," the papers were read which were deemed to be of the most practical interest to the Philippine Islands, and, consequently, the greater portion of our time was devoted to this section.

On September 29, Doctor Heiser read a paper entitled "The tuberculosis problem in the Philippines and the elimination of intestinal parasites as the first step in its solution." On October 1, Doctor Calderon read a paper entitled "Notes on tuberculosis in the Philippines."

The scientific work of the congress showed clearly that remarkable unanimity prevailed among the delegates upon the following points:

1. That tuberculosis in its early stages is a curable disease.

2. That it is a house disease; that is to say, that people who live an outdoor life are not afflicted with tuberculosis, and the more confined the living quarters are the more prevalent is the disease.

3. That it is a simple and practicable matter to avoid contracting tuberculosis by introducing large volumes of air into the house, night and day, winter and summer, or, better, by sleeping out of doors altogether.

4. That among the best ways to cure tuberculosis is to live an outdoor life, regardless of what the climate may be, with only such exercise as a physician prescribes and a good, simple diet which should consist mainly of eggs and milk.

6. That the successful treatment of the disease is not necessarily confined to specially favored localities, but that many cures may be effected in almost any climate or locality.

THIRD WEEK.

The third week of the congress was devoted to a continuation of the exhibition, lantern demonstration, lectures, and visits to Baltimore and the near-by places at which tubercular sanatoria are located.

OFFICIAL VISITS.

Philadelphia, White Haven, Saranac, Boston, and New York were visited for the purpose of observing the dispensary and hospital work in large cities as well as the manner in which the different kind of sanatoria are conducted. After carefully inquiring into and seeing the foregoing, it is again plainly evident that the authorities are practically unanimous in their methods of combating tuberculosis, the principal difference being to suit them to the financial abilities of the different communities in which they were in force.

The measures readily divide themselves into the following:

1. Registration and classification of cases.
2. Popular lectures on tuberculosis and popular articles in the press.
3. Treatment of tuberculosis by the dispensary system.
4. Confining the hopeless cases in separate hospitals located in the city.
5. Sending early cases to a sanatorium in the country.

TUBERCULOSIS WORK IN PENNSYLVANIA.

As practically all the States are endeavoring to adopt the systems in use in Pennsylvania, Maryland, New York, and Massachusetts, the one now used in Pennsylvania is hereby briefly outlined:

1. The collection and tabulation of statistics relating to tuberculosis, through official morbidity and mortality reports of each individual case.

2. The establishment of one or more sanatoria for the treatment of incipient cases, including infirmaries for advanced and hopeless cases.

3. The establishment of dispensaries in each county of the State for the care of cases which can not avail themselves of sanatorium treatment, including home visitations and the study of occupational conditions.

4. The maintenance of pathological laboratories for the free examination of sputum and tuberculous lesions, and biological laboratories for the possible development of immunitive and curative products.

5. The restriction of tuberculosis by the disinfection of rooms, buildings (private and public), conveyances, and carriers, and by supervision and regulation over the general avenues of infection.

6. The dissemination of knowledge relative to the communicability, care, and prevention of tuberculosis.

The last session of the Pennsylvania legislature appropriated $1,000,000, United States currency, for the continuation of the fight against tuberculosis in that State. The sums raised from private effort probably amounted to as much again. Dr. Lawrence Flick, the eminent authority on tuberculosis, estimates that as a result of this appropriation at least 5,000 lives are already saved annually in Pennsylvania alone.

DISPENSARIES.

One of the principal weapons with which to combat tuberculosis in large cities is the use of the outdoor dispensary, at which no other disease except tuberculosis is treated. Pennsylvania has established such a dispensary in every county seat in the State and in some of the principal cities. These, as well as those being built by the munificence of Mr. Phipps, are perhaps typical of their class. They consist usually of two rooms, one a waiting room where the patients are received by the nurse, who records the history and makes a most complete card index record of the case; temperatures are taken, and in general the patient is in every way prepared for the doctor's visit. The latter usually arrives after the patients have been prepared for him, makes the diagnosis and prescribes the treatment.

These dispensaries are usually open from 8 until 1 each day and have, as a rule, one nurse and two physicians on duty. In addition to the nurse who is on duty in the dispensary, there are usually two who make visits to homes of tuberculosis patients, and give them practical demonstration in hygienic living. They also recommend as to whether fresh eggs and milk should be supplied gratis.

SANATORIUMS AND CAMPS.

White Haven.—This institution differs from all of the others visited in that a systematic trial is being made on a large scale to put the sanatorium on a self-supporting basis by means of the labor of the patients. So far as our own observations went, it can not be said that this plan has proved successful up to this time.

Trudeau's.—As is well known, the oldest advocate of the outdoor treatment of tuberculosis is Doctor Trudeau, and it is here that it is most interesting to observe the gradual development of small buildings suitable for the treatment of tuberculosis. The first primitive shack still stands and each structure built since is an improvement on its predecessor. The accompanying illustrations (figs. 1 and 2) show what he regards to be the most modern type of building for the outdoor treatment of tuberculosis. Doctor Trudeau's place is situated in the Adirondacks at Saranac Lake.

Ray Brook.—The State of New York has erected at Ray Brook a large brick structure much on the order of a modern hospital building, where patients are treated in wards of the two-story type, with enormous air space allowance for each patient. In addition, a few tents or shacks are built near by for the treatment of such cases as are considered more favorable for the hardy outdoor life.

Beelitz, Germany.—At Beelitz, Germany, there is probably one of the most modern tuberculosis sanatoriums in the world. This was built by a German Life Insurance Company for the use of their policy holders. The institution is built upon the same general lines as the Ray Brook institution mentioned above, but on account of the greater amount of funds available, the institution presents a more finished character.

NIGHT AND DAY CAMPS.

At Pittsburg, Pa., and Boston, Mass., there exist on the outskirts of the city large day camps where persons suffering with incipient tuberculosis are encouraged to go during the day time, and are given lessons in hygiene and furnished with wholesome diet, free of charge. It is now proposed to change these camps to night camps so that persons may sleep there, and, in suitable instances, go to their business during the day time.

TREATMENT.

It was the overwhelming opinion of those actively engaged in the treatment of tuberculosis that the use of tuberculin and serums is largely in the experimental stage, that its general use at the present time is not justified, and that the subject has scarcely passed out of the laboratory stage. There was a unanimous opinion, however, that the best method of combating tuberculosis was by the free administration of eggs and milk, and, occasionally, a tonic. Practically no other treatment is given. All persons interviewed also emphatically expressed the opinion that the success depended upon the early diagnosis of the disease. In this connection, it might be well to mention that beds in sanatoriums for incipient cases were scarcely ever found to be filled. Statistics show that 55 per cent of the early cases recover, while only 11 per cent of the more advanced cases recover. It is also generally believed that cold weather has the most beneficial influence. This is based on the fact that cases invariably do better in the winter time than in the summer. Considerable stress was also laid upon the fact that in the past it has been customary to allow too much exercise, and there seems to be little question but that harm has often followed overexertion.

COST OF TUBERCULOSIS.

Professor Fisher, of Yale University, estimates the death rate from tuberculosis in all its forms in the United States to be 164 per 100,000 of population, and the number of deaths in 1906 at 138,000. At this rate, 5,000,000 people now living in the United States will die of tuberculosis. The average age at death for males is 37.6 years; for females, 33.4 years. The "expectation of life" lost (though estimated on a specially high mortality rate) is at least 24 years, of which at least 17 fall in the working period. The average period of disability preceding death from tuberculosis exceeds three years, of which the latter half is a period of total disability.

The money cost of tuberculosis, including capitalized earning power lost by deaths, exceeds $8,000 per death. The total cost in the United States exceeds $1,000,000,000 per annum. Of this cost about two-fifths, or over $440,000,000 per annum, falls on others than the consumptive.

An effort to reduce the mortality by one-fourth would be worth, if necessary, an investment of $5,500,000,000. The cost of treating patients at sanatoria is repaid many times over in lengthened working lives. The erection of isolation hospitals for tuberculosis is probably the most profitable method at present of reducing the cost of tuberculosis.

Upon the above bases there are 25,000 deaths or more per year in the Philippines.

RECOMMENDATIONS.

1. That the compulsory registration of cases of pulmonary tuberculosis be put into effect immediately, at least in the city of Manila.

2. That one or more dispensaries solely for the outpatient treatment of tuberculosis be opened in Manila, to which one or more nurses be attached for the purpose of visiting patients in their homes. Also that provision be made for the microscopical examination of sputa.

3. That the necessary funds be provided for a trial of the "open-air method" in Benguet or some other place where an equally low temperature may be had, for the treatment of not to exceed twelve tubercular patients.

4. That provision be made on an elevated site near Manila for treating a limited number of incipient cases of tuberculosis, for a period of not to exceed three months each, by requiring their presence only during the night in order that the advantages of the open air method, the disposal of sputa, and the precautions to be taken to avoid transmitting the infection to others may be demonstrated.

5. That in order to furnish a practical object lesson, sanitary cuspidors be provided and used in all public buildings, including public schools, and that the sweeping or cleaning of such buildings be done in such manner as to prevent the formation of clouds of dust.

6. That the public streets be swept only when in a wet condition, so as to avoid the unnecessary blowing about of dust. In this connection, it is suggested that the cleansing of streets by flushing, as is now done in Cincinati and other cities of the United States, be thoroughly investigated with the view of discontinuing street sprinkling and sweeping in Manila.

7. That arrangements be made for supplying the public press with information relative to tuberculosis.

8. That instruction on tuberculosis be continued in the public schools and begun in all other schools where it is not taught at present.

9. That in communities where hookworms prevail, steps be taken to eradicate them, because the lowered vitality which they induce predisposes strongly to tuberculosis.

10. That as many of the above recommendations as possible be put in force in the provinces.

ILLUSTRATIONS.

FIG. 1.—FRONT ELEVATION.

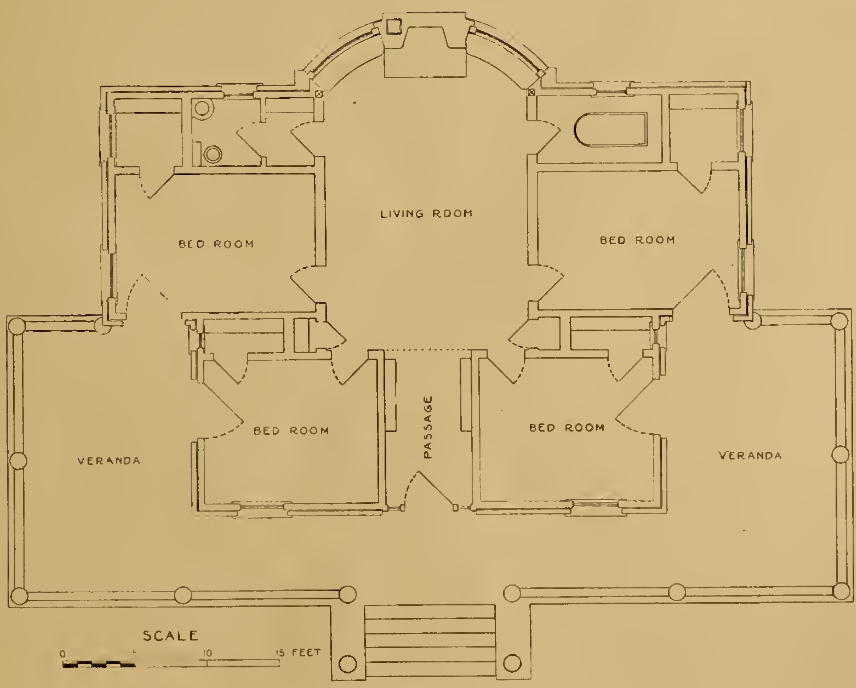

FIG. 2.—FLOOR PLAN.

COTTAGE FOR THE ADIRONDACK COTTAGE SANATORIUM, SARANAC LAKE, NEW YORK.

THE CUTANEOUS REACTION IN LEPROSY. PRELIMINARY REPORT.[1]

By Oscar Teague.

(*From the Biological Laboratory, Bureau of Science, Manila, P. I.*)

One of the greatest advances made in the study of immunity during the past two years has been the recognition and investigation of a condition which is in a sense the opposite of immunity, namely a condition of hypersensitiveness. It has been known for a long time that when an animal is injected with certain toxic substances, it may react and produce antibodies which render it more resistant to the toxin in question; but it is only recently that marked attention has been given the fact that under certain circumstances an animal may react and become more suspectible to the substance injected. The hypersentitivenes of the guinea pig to injections of horse serum has been carefully studied and will illustrate the point in question A normal guinea pig may be given 5 or 6 cubic centimeters of horse serum subcutaneosly or intraperitoneally without showing any abnormal symptoms. But if a guinea pig be given one-tenth of a cubic centimeter of horse serum and, after a period of ten days or more has elapsed, 5 cubic centimeters of horse serum are administered intraperitoneally, the animal, after a few minutes, shows signs of restlessness, then falls over on its side, struggles convulsively and dies of respiratory failure. The first injection of a minute quantity of horse serum has "sensitized" the guinea pig so that horse serum is now extremely toxic for it. If the second injection had been given within the ten-day interval, the guinea pig would not have been affected. This incubation period of the hypersensitive reaction has lead some investigators to believe that the process depends upon the formation of antibodies here just as in the case of the immunity reactions. The hypersensitiveness when once established has been shown to last a year and even longer, and probably is present as long as the animal lives.

Instead of horse serum, probably almost any other foreign protein could be used to call forth hypersensitiveness, and this has been already demonstrated for egg white, proteins from certain plants, bacterial extracts and other substances.

The study of the immunity reactions brought forth abundant fruit for the practical side of medicine in the discovery of diphtheria and

[1] Read before the Manila Medical Society on September 8, 1908.

tetanus antitoxin, in the Widal and precipitin tests, in vaccine therapy, etc. Likewise, the study of the hypersensitive reaction, though still in its infancy, has already demonstrated that the rare instances of sudden death following the injection of antitoxin and the rashes, joint pains and fever occurring during the course of serum treatment, are in no wise due to the antitoxin as such but to the vehicle of the antitoxin and are hence nothing more or less than the expression of the hypersensitive reaction to the proteins of the horse serum.

Another important acquisition to practical medicine resulting from the study of hypersensitiveness, is von Pirquet's cutaneous reaction which was first announced in May, 1907. Von Pirquet had observed that if the skin of a tuberculous patient was scarified and moistened with a drop of Koch's old tuberculin, within from twelve to forty-eight hours an urticaria-like swelling or a papule surrounded by a reddened area appeared. His technique consisted in placing a drop of old tuberculin on the skin of the forearm which had been previously cleansed with ether and in scraping away a small portion of epidermis beneath the drop by a boring motion with the point of a scalpel. A bit of cotton was then placed in the tuberculin and left for ten minutes. Instead of a scalpel he later used a special instrument with a chisel-like point for removing the epidermis. Others have made a short superficial incision with a sharp knife, care being taken not to draw blood. A control scarification without tuberculin is made on the same arm for comparison. In the case of a positive reaction a slight reddening appears in about twelve hours and the swelling and redness reaches its maximum in from twenty-four to forty-eight hours lasting four or five days or longer; whereas the swelling due to a slight mechanical injury disappears in a day or two.

Very soon after von Pirquet made known the discovery of his cutaneous reaction, both Wolff-Eisner and Calmette announced results obtained by dropping a diluted tuberculin into the conjunctival sack of tuberculous patients. The reaction that follows this procedure has become known as the ophthalmoreaction, though in reality it is a conjunctival reaction and the eye itself is in no way concerned. Calmette thought that the glycerine of the old tuberculin was irritating and hence precipitated the tuberculin with alcohol, and dissolved the precipitate in water. However, later workers have found that in the dilutions in which it is used (one-half to 1 per cent), the old tuberculin is entirely satisfactory.

Another modification of the skin reaction was suggested by Moro,[2] who prepared an ointment of equal parts of lanolin and old tuberculin and simply rubbed it into the skin over an area about 5 centimeters in diameter. The positive reaction was indicated by the appearance of papules and vesicles in the treated area.

[2] *Münch. med. Woc.* (1908), 55-1, 216.

The important question to be answered in regard to these reactions is what value have they in the diagnosis of tuberculosis. A rather voluminous literature has already appeared with this object in view, which is not surprising when one considers the ease with which the tests may be applied and that every hospital offers material for investigating one phase or another of the question.

The consensus of opinion with regard to von Pirquet's cutaneous reaction seems to be that it is a specific reaction for tuberculosis and hence scientifically and statistically valuable. As an aid to diagnosis, a distinction must be made according as children or adults are being subjected to the test. In children, a positive result indicates that the child is tuberculous but a negative one does not necessarily mean that the child is free from tuberculosis since only about 50 per cent of the cases of miliary tuberculosis and tuberculous meningitis give the reaction. The test is of distinct value as an aid in diagnosis in children. In adults, since from 50 to 90 per cent of healthy individuals react positively, only the failure to get the reaction can be of service, and its diagnostic value is extremely limited.

Wolff-Eisner's conjunctival reaction yields approximately the same results as the cutaneous reaction, though he claims that it does not indicate healed foci as does the cutaneous reaction and that therefore it is of more value as an aid to diagnosis in adults.

The ointment reaction of Moro would seem to give less satisfactory results than the other two.

It will be remembered that the old subcutaneous injection of Koch's tuberculin was open to the same objections as are encountered in these recent methods: that is, it called forth a reaction in a large percentage of healthy adults and failed to give the reaction in many cases of miliary tuberculosis, tuberculous meningitis and in cachectic individuals.

If the cutaneous and ophthalmo-reactions should prove to be of equal diagnostic value with Koch's subcutaneous injection, then the latter method would probably cease to be used for diagnostic purposes because (1) of the danger of activating an old tuberculous focus, (2) it can not be used in patients with fever, (3) it requires that the patient be kept in bed four days, two days for observation before the injection and two days after the injection.

Attempts have been made to apply the cutaneous and ophthalmo tests to a number of other bacterial diseases. Chantemesse's work on the conjunctival reaction in typhoid fever attracted wide attention, but has not been confirmed by German investigators. However, Meroni [3] recently has obtained positive results on 25 cases with more than that number of controls.

[3] *Münch. med. Woc.* (1908), 55-I, 1379.

Link [4] used the cutaneous reaction on 14 cases of typhoid and paratyphoid fever. Killed cultures of *Bacillus coli communis, typhosus* and *paratyphosus* were prepared and all three suspensions used on all the patients. One case in which paratyphoid bacilli had been found in the stool some months previously and in which the serum of the patient gave a negative Widal reaction to all three organisms, showed a distinct cutaneous reaction to *Bacillus paratyphosus* and no reaction to *Bacillus coli communis* or *Bacillus typhosus.* In general the reactions agreed with the agglutination tests but taken all in all they were rather unsatisfactory. He suggests that it would be interesting to see if typhoid carriers give the reaction. If this should prove to be the case the reaction would be of value in locating such dangerous individuals in the army and among other large bodies of men who live in close contact with one another.

In glanders the ophthalmo-reaction has given good results with horses and Martel [5] has reported four human cases which gave positive reactions with mallein diluted one-tenth.

Attempts, in most instances unsuccessful, have been made to distinguish between infection with the bovine and with the human type of the tubercle bacillus by vaccinating simultaneously with the two kinds of tuberculins, but the patients react to both. Wolff-Eisner has suggested that by working quantitatively; i. e., by using decreasing dilutions of the two tuberculins and comparing the degree of the resulting reactions better results might perhaps be obtained.

The reaction has been tried in diphtheria with doubtful results.

In April, 1907, Wooley [6] suggested that, since the leprosy bacillus has not been grown on culture media, nodules obtained from a leprous patient be extracted in salt solution and the resulting extract be used as a vaccine for treatment of the patient. It was but a short step to use such an extract in an attempt to obtain a cutaneous reaction in lepers such as von Pirquet had observed in tuberculosis. I hoped that in this way an aid in the diagnosis of doubtful cases of leprosy might be obtained.

Since the leprosy bacillus bears more resemblance to the tubercle bacillus than to other pathogenic organisms, extracts were prepared in a similar way as in the preparation of old tuberculin.

Four different extracts were made as follows: first, from nodules taken from living lepers, second, from the nodulous skin of a dead leper, third, from the spleen of a dead leper, fourth, a control from the skin of a cholera corpse. The material thus obtained was cut into small pieces or ground in a mortar in case of the spleen, and extracted in 5 per cent glycerine. It was then heated on the water bath until the volume was reduced to about one-tenth of the original.

[4] *Loc. cit.* (1908), **55-I**, 730.
[5] Berl. klin. Woch. (1908), **45**, 451.
[6] *Proc. Soc. Exp. Med. & Biol.* N. Y. (1907), **4**, 121.

Fifty lepers were vaccinated with these extracts, a control vaccination with the extract of skin from the cholera case being made in each instance. In two or three cases there was a doubtful reaction, but otherwise the vaccinations were in all respects like the controls. Further attempts will be made to secure a more concentrated extract of the leprosy bacilli. Owing to the low resistance of the tissues of lepers, it was not thought advisable to use the ophthalmo-reaction until the cutaneous reaction had been given a thorough trial.

I wish to thank Doctor Newberne for the courtesies extended to me at the San Lazaro Leper Hospital.

THE NASTIN TREATMENT OF LEPROSY.[1]

By Oscar Teague.

(*From the Biological Laboratory, Bureau of Science, Manila, P. I.*)

In 1904 Deycke Pasche and Reschad Bey[2] of the Imperial Hospital and Medical School of Constantinople, while attempting to cultivate the leprosy bacillus, obtained a streptothrix in pure culture to which they gave the name *Streptothrix leproides.* The culture was made by laying back a flap of skin containing a leprous nodule and excising a piece of tissue from the under surface of the flap. The tissue was placed in salt solution and kept at incubator temperature. After three weeks the filaments of the streptothrix were seen growing from the tissue in great profusion.

With the idea of determining whether or not this streptothrix bore any relationship to the leprosy bacillus, the living culture was injected subcutaneously in a very severe case of leprosy. Strange to say, this patient showed marked improvement in his subjective symptoms and requested that the treatment be continued. Accordingly injections were given at seven-day intervals and after two months the patient considered himself cured and left the hospital. Similar results were obtained in three other cases.

The streptothrix was then grown in large quantities and the protein substances of the culture separated from the fats by extraction with ether. On injecting these two portions separately into patients, the authors came to the conclusion that the etherial extract contained the curative agent. Finally they believed that they had isolated this active principle and that it was a true fat—a glyceride of one of the higher fatty acids. To this fat they gave the name "nastin." The authors claimed that subcutaneous injections of this substance produced a specific action on leprous nodules, causing inflammation with subsequent softening. This reaction was sometimes accompanied by high fever lasting for days.

[1] Read at the Sixth Annual Meeting of the Philippine Medical Association, Manila, P. I., February 11, 1909.

[2] *Deutsche med. Wchnsch.* (1905), 31, 488.

The hypothesis advanced to explain this action was as follows: The leprosy bacilli contain the same fat as "nastin," or a similar one, and it is to this fat that the bacilli owe their resistance to the protective forces of the body. By spaced injections with nastin an active immunity is produced against the resistant fatty substance of the bacilli, so that these latter are destroyed.

This hypothesis is not in accord with our ideas with regard to immunity; for with the exception of the glucosides of Ford of Johns Hopkins University, immunization has not been produced with a substance known to be of non-protein nature. It is, to say the least, highly improbable that immunization could be effected against a chemically pure fat. In his lecture [3] delivered at the London School of Tropical Medicine, Professor Deycke makes no further mention of this hypothesis but advances another one to explain the destruction of the leprosy bacilli by the Nastin treatment. He had found that benzoyl chloride dissolves out the fatty substances from tubercle bacilli much more readily than the ordinary fat solvents, such as ether and chloroform. On mixing benzoyl chloride with his Nastin he obtained much more constant reactions than with the Nastin alone. The nastin now on the market consists of such a mixture in the proportions which he found to yield the best results. He believes—to use his own words—that—

> "The nastin is carried to the leprosy bacilli, to which, owing to its near chemical and physical relation, it attaches itself, and then benzoyl can fully display its anti-bacterial action in the fat-removing sense. When deprived of fat the leprosy bacilli seem to be doomed; the human organism then effects with comparative ease the further dissolution and ultimately the complete destruction of the bacterial nuclei."

Although we did not agree with Professor Deycke's theoretical considerations, nevertheless in view of the favorable results reported by him, at Doctor Strong's suggestion I determined to give the method a trial. Four patients were selected at San Lazaro Hospital. Two were well-marked cases of the nodular type in young boys of ten years, both free from ulcerations; the other two were male patients of about twenty years of age, one with very slight lesions in which only comparatively few leprosy bacilli were found; the other was a well-marked case having both nodules and ulcers.

The injections were begun on the 8th of September, 1908, and have been continued up to the present time, being given at about seven-day intervals except for two slight interruptions due to delay in receiving the nastin from Europe.

A general febrile reaction was observed only once and then in one of the well-marked cases. About twenty-four hours after the fifth injection

[3] *Brit. Med. Journ.* (1908), I, 802.

the patient had a temperature of 104° and complained of a severe headache and general malaise. The fever lasted about twenty-four hours and then all unusual symptoms quickly disappeared. In this same patient some of the nodules have become soft and have broken open, the ulcers thus formed healing readily.

However, since the febrile reactions and healing of nodules sometimes occur without any treatment whatsoever in severe cases of leprosy, and especially since none of the other patients under treatment have shown similar reactions, we do not feel inclined to look upon the nastin injections as the cause of the phenomena in this case. Furthermore, in spite of the fact that a few isolated nodules have healed, it can not be said that there is any noticeable improvement in the patient.

Professor Deycke states that—

> "We will be able, except in the most severe, hopeless cases, to effect at least the arrest of the leprous process; frequently, however, far better results will be obtained."

Some of his results were obtained within two months after treatment was begun; in other instances the patients were under treatment for over twelve months. I regret that the cases here considered have been under treatment for only five months but one would have a right I believe, to expect some improvement in them in this time, judging from Professor Deycke's reports.

Two other patients who were under X-ray treatment received at their own request the nastin treatment also. One of these, a rather mild case of the nodular type who, however, has been under treatment for a shorter time than the other patients, recently developed a fresh crop of nodules. I mention this because Professor Deycke states that the nastin is able to hold all but the very severe cases in check although it can not cure all of them.

In conclusion, then—

(1) It seems to us unlikely that the *Streptothrix leproides* of Professor Deycke bears any relationship to the leprosy bacillus;

(2) The nastin treatment is not based upon any of the established principles of immunity reactions; it is not a vaccine therapy, but is a drug treatment and is purely empirical; it is claimed that nastin is a glyceride of one of the higher fatty acids and in this connection it is interesting to note that Chaulmoogra oil, one of the most widely known drugs employed for leprosy, is also a fatty substance;

(3) The nastin treatment has not produced beneficial results in the four cases which I have treated during the past five months.

FILTRATION OF IMMUNE SERUMS.

By E. H. Ruediger.

(*From the Serum Section, Biological Laboratory, Bureau of Science, Manila, P. I.*)

Because of the difficulties encountered in endeavoring to obtain antiserums for therapeutic purposes free from corpuscles, precipitates, and bacteria, it was thought advisable to study the effects of filtration through Berkefeld filters on immune serums. Early in the year 1906 attempts to filter anticattle plague serum had been made in this laboratory, but were soon abandoned because the filters invariably became clogged.

More recently filtration of serum was again attempted and it was found that the serum readily passes through the filter, provided that it is free from blood corpuscles, precipitates and other extraneous matter. These substances as a rule are removed easily from the serum by centrifugating for thirty minutes at a speed of 3,000 revolutions per minute, and at the present time all serums prepared by this laboratory are passed through a germ-proof filter prior to bottling. The serum thus obtained is perfectly clear and is free from bacteria which may have entered accidently during the process of handling.

TECHNIQUE.

The serum, having been collected, is centrifugated at a speed of 3,000 revolutions per minute for thirty minutes, which process usually renders it fairly clear. It is now passed through a clean, sterile Berkefeld filter marked N or W. If, after centrifugating, the serum is not clear, it is advisable to first pass it through a Berkefeld V filter to remove most of the extraneous matter which might lead to rapid clogging of the finer grained filter marked N or W. Using an apparatus of one liter capacity, one liter of serum under two atmospheres pressure should pass through the Berkefeld filter V in three minutes or even in less time, while with the N filter not more than five minutes should be required. A ten-liter filtering apparatus should deliver a liter of serum through Berkefeld V filter in one minute, and not more than three minutes per liter should be required when an N filter is used.

Care must be taken to cleanse the filter after it has been used. Any serum left in the pores of the filter will be coagulated by autoclaving and render the filter impermeable. To insure thorough cleansing, the following procedure has been found satisfactory: immediately after having been used, the surface of the filter is scrubbed with a brush under running water and the serum is removed from the pores of the filter by passing through it a liter or more of distilled water or an aqueous solution of 0.75 per cent sodium chloride. The filter is then boiled in distilled water, and after the boiling, is again washed by passing water through it. It has been my experience that if the boiling is omitted the filter gradually becomes impermeable, and to insure a thorough cleansing none of the steps mentioned should be omitted.

Martini,[1] in studying the effect of filtration on antidiphtheritic serum, demonstrated great loss in the potency of the serum after it had passed through Chamberland filters. Serum which before filtering contained 140 units of antitoxin per cubic centimeter, after filtering contained 100 units per cubic centimeter. Another lot of serum which contained 135 units of antitoxin per cubic centimeter, lost 75 units per cubic centimeter through filtering. By evaporating he reduced antidiphtheritic serum to the consistency of syrup; the concentrated serum contained 850 units of antitoxin per cubic centimeter; after passing it through a Chamberland filter it contained only 40 units of antitoxin per cubic centimeter, having lost 810 units per cubic centimeter.

Dziergowsky [2] passed antidiphthetric serum through Chamberland filters and could not demonstrate any loss of antitoxin thereby.

Cobbet [3] repeated the work of the previous authors and showed that antidiphtheritic serum may be passed through Chamberland filters without losing its potency provided the filters are clean and the serum passes through readily. On the other hand, if a filter is allowed to clog, the serum passing through drop by drop invariably suffers great loss of antitoxin.

I have studied the question as to whether a serum suffers any loss in immunizing value by being passed through Berkefeld filters. The following experiments show the immunizing value of unfiltered and filtered antitetanic and antidiphtheritic serums and the agglutinating value of unfiltered and filtered typhoid serum.

EXPERIMENT NO. I.

A quantity of about 1,500 cubic centimeters of antitetanic serum was divided into four portions A, V, N and W. Portion A was neither centrifugated nor filtered, portion V was passed through Berkefeld filter V, portion N was passed through Berkefeld filter N and portion W was passed through Berkefeld filter marked W.

[1] *Centralb. f. Bakt. etc.* (1896), 20, 796.
[2] *Ibid.* (1897), 21, 333.
[3] *Ibid.* (1898), 24, 386.

Varying quantities of each of these portions were mixed with 100 lethal doses of tetanus toxin, allowed to stand in a test tube for thirty minutes and were then injected under the skin of guinea pigs weighing between 245 and 255 grams.

TABLE I.—*Unfiltered and filtered antitetanic serum mixed with tetanus toxin and tested on guinea pigs.*

Portion of serum.	Quantity of— Serum.	Toxin.	Result.
	cc.	*Lethal doses.*	
A	$\frac{1}{800}$	100	Lived.
	$\frac{1}{1000}$	100	Lived.
	$\frac{1}{1200}$	100	Died.
	$\frac{1}{1400}$	100	Died.
V	$\frac{1}{800}$	100	Lived.
	$\frac{1}{1000}$	100	Lived.
	$\frac{1}{1200}$	100	Died.
	$\frac{1}{1400}$	100	Died.
N	$\frac{1}{800}$	100	Lived.
	$\frac{1}{1000}$	100	Lived.
	$\frac{1}{1200}$	100	Died.
	$\frac{1}{1400}$	100	Died.
W	$\frac{1}{800}$	100	Lived.
	$\frac{1}{1000}$	100	Died.
	$\frac{1}{1200}$	100	Died.
	$\frac{1}{1400}$	100	Died.

As is shown by the Table I the neutralizing values of these portions of the serum must be considered identical. Although 0.001 cubic centimeter of portion W did not protect the guinea pig inoculated, such variations are entirely within the bounds of experimental error and even greater differences are frequently encountered with one and the same serum. Portions N and W were sterile.

EXPERIMENT NO. II.

To 200 cubic centimeters of antitetanic serum 800 cubic centimeters of physiological salt solution was added. This diluted serum was divided into four portions, A, V, N and W. Portion A remained unfiltered, and portions V, N and W were passed through the Berkefeld filters so lettered.

Varying quantities of these portions of serum were mixed with 100 lethal doses of tetanus toxin, allowed to stand for thirty minutes and were then injected under the skin of guinea pigs weighing between 245 and 255 grams.

TABLE II.—*Antitetanic serum diluted with physiological salt solution in proportion of 1–4, unfiltered and filtered tested on guinea pigs.*

Portion of serum.	Quantity of— Diluted serum.	Quantity of— Toxin.	Results.
	cc.	*Lethal doses.*	
A	$\frac{1}{160}$	100	Lived.
	$\frac{1}{200}$	100	Lived.
	$\frac{1}{240}$	100	Died.
	$\frac{1}{280}$	100	Died.
V	$\frac{1}{160}$	100	Lived.
	$\frac{1}{200}$	100	Lived.
	$\frac{1}{240}$	100	Died.
	$\frac{1}{280}$	100	Died.
N	$\frac{1}{160}$	100	Lived.
	$\frac{1}{200}$	100	Died.
	$\frac{1}{240}$	100	Lived.
	$\frac{1}{280}$	100	Died.
W	$\frac{1}{160}$	100	Lived.
	$\frac{1}{200}$	100	Lived.
	$\frac{1}{240}$	100	Died.
	$\frac{1}{280}$	100	Died.

The results obtained shown in Table II show the neutralizing value of the filtered serum to be practically identical with that of the unfiltered serum.

Bacteriological examination showed portions N and W free from bacteria.

EXPERIMENT NO. III.

A quantity of antidiptheritic serum was divided into four portions A, V, N and W. Portion A was not filtered while portions V, N and W were passed through Berkefeld filters V, N and W respectively.

Varying quantities of these different portions were mixed with a test dose of diphtheria toxin, allowed to stand for thirty minutes and were injected under the skin of guinea pigs weighing between 245 and 255 grams.

TABLE III.—*Antidiphtheric serum unfiltered and filtered mixed with diphtheria toxin and tested on guinea pigs.*

Portion of serum.	Quantity of—		Results.
	Serum.	Toxin.	
	cc.		
A	$\frac{1}{200}$	Test dose	Lived.
	$\frac{1}{250}$	Test dose	Lived.
	$\frac{1}{300}$	Test dose	Died.
	$\frac{1}{350}$	Test dose	Died.
V	$\frac{1}{200}$	Test dose	Lived.
	$\frac{1}{250}$	Test dose	Lived.
	$\frac{1}{300}$	Test dose	Died.
	$\frac{1}{350}$	Test dose	Died.
N	$\frac{1}{200}$	Test dose	Lived.
	$\frac{1}{250}$	Test dose	Lived.
	$\frac{1}{300}$	Test dose	Died.
	$\frac{1}{350}$	Test dose	Died.
W	$\frac{1}{200}$	Test dose	Lived.
	$\frac{1}{250}$	Test dose	Lived.
	$\frac{1}{300}$	Test dose	Died.
	$\frac{1}{350}$	Test dose	Died.

The results shown in Table III would suggest a loss of antitoxin in portion W, but owing to the small number of animals used a definite statement can not be made.

A few cubic centimeters of filtrates N and W planted in agar yielded no bacterial growth.

EXPERIMENT NO. IV.

A quantity of typhoid agglutinating serum was divided into four portions A, V, N and W. Portion A remained unfiltered, and portions V, N and W were passed through the corresponding Berkefeld filters. After filtration of portions V, N and W the agglutinating values of the different portions were determined on a suspension of Bacillus typhosus.

TABLE IV.—*Typhoid agglutinating serum unfiltered A, and filtered V, N and W tested for its agglutinating value.*

Dilution.	Portion. A.	V.	N.	W.	Time.
					Hours.
1-100	+	+	+	+	9
1-200	+	+	+	+	9
1-400	+	+	+	+	9
1-800	+	+	+	+	9
1-1,000	+	+	+	+	9
1-1,400	+	+	+	+	9
1-1,800	+	+	+	+	9
1-2,200	+	+	+	+	9
1-2,600	—	+	—	—	9
1-3,000	—	—	—	—	9
1-3,200	—	—	—	—	9
1-6,400	—	—	—	—	9

A glance at Table IV shows the agglutinating value of the filtered portions V, N and W to be practically identical with that of the unfiltered portion A.

EXPERIMENT V.

The influence of high pressure on the permeability of Berkefeld filters to small yet microscopically visible bacteria.

It has been known that bacteria which are not ultramicroscopic may and will pass through the pores of Berkefeld filters. Wherry[4], in the year 1902, showed that the bacillus of guinea pig pneumonia frequently passes through the Berkefeld filters under ordinary conditions of filtration.

In this laboratory, the Berkefeld filter marked W is used almost exclusively for the final filtration of anticattle plague serum. Filtration was formerly carried on with the Chamberland filter stand under a pressure of one and one-half to two atmospheres; bacterial contamination of the filtrate was rare, but the filtration frequently was slow and tedious. In order to facilitate the filtration the air pressure in the institution, which is kept fairly constant by an automatic electric regulating device, was increased to four atmospheres. Bacterial contamination of the filtrate soon became common and the contaminating organism usually was a small bacillus. This at once led me to study the influence of various pressure on the permeability of the filters to these bacilli.

Method of investigation.—Nine new Berkefeld filters, three marked V and designated here as V_I, V_{II}, and V_{III}, three marked N, designated N_I, N_{II}, and N_{III}, and three marked W designated W_I, W_{II} and W_{III}

[4] *Journ. Med. Research* (1902) **8**, 322.

respectively, were washed by passing distilled water through them and were sterilized in the autoclave.

Three hundred cubic centimeters of previously filtered serum inoculated with these small bacilli were passed through each of the nine sterile filters under various pressures ranging from one to four atmospheres; the portions of the serum were then collected in a sterile receptacle provided with a protected mouthpiece and stopcock at the bottom, and then bottled in two portions, *a* and *b*, of about 150 cubic centimeters each. Portion *a* was drawn off into a sterile bottle as soon as about 150 cubic centimeters had collected, and portion *b* was bottled after all serum including the froth obtained in the end had passed through the filter.

After two days' incubation 1 cubic centimeter of each portion of the filtrate was planted in liquefied agar.

TABLE V.

Filter.	Portion.	Pressure. 1 atmosphere.	2 atmospheres.	3 atmospheres.	4 atmospheres.
V_I	a	+	+	+	+
	b	+	+	+	[illegible]
V_{II}	a	+	+	+	+
	b	+	+	+	−
V_{III}	a	+		+	[illegible]
	b	+	+	+	[illegible]
N_I	a	−	+	[illegible]	[illegible]
	b	+	+	+	[illegible]
N_{II}	a	−		+	[illegible]
	b	−	+	+	+
N_{III}	a	−	−	+	+
	b	+	[illegible]	−	+
W_I	a	−	−	+	[illegible]
	b	−	−	+	−
W_{II}	a	−	−	−	−
	b	−	−	+	+
W_{III}	a	−	−	+	+
	b	−	+	+	+

The foregoing Table V shows the results that were obtained. All filtrates from Berkefeld filter V yielded growths of these small bacilli, they frequently passed through filter N, while filter W arrested them under one and under two atmospheres pressure, except in portion *b* from filter III under two atmospheres pressure. Throughout the experiment contaminations were more frequent in portion *b* than in portion *a*.

CONCLUSIONS.

Although the foregoing tabulated records of experiments are very limited in extent, I feel justified in saying that with proper care immune serums can be passed through germ-proof filters without suffering any appreciable loss of immune bodies. During the last three years large quantities of immune serums have been filtered with great success. The Berkefeld filter marked W usually furnishes a germ-free filtrate under a pressure of two atmospheres or less. If a much higher pressure is used germs appear to be forced through occasionally.

In order to avoid rapid clogging of the filter the serum should be centrifugated before filtration is attempted, and the filters must be cleansed thoroughly immediately after being used.

THE REACTION OF CULTURE MEDIA IN RELATION TO THE MORPHOLOGY OF THE CHOLERA ORGANISM.[1]

By Y. K. Ohno.

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During the previous year, on making a microscopical examination of a direct smear of the fæces from a case of cholera I was able to observe organisms which appeared to be cholera vibrios and was able to cultivate the cholera vibrio in plating a loop of the stool in 1 per cent alkaline agar. However, when a loop of the stool was first added to cholera peptone solution according to the enriching method of Schottelius-Koch,[2] I failed to isolate the cholera organism. Investigation of the peptone solution revealed the fact that its reaction upon titration was 1.75 per cent acid to phenolphthalein. The cholera vibrio, isolated from the same stool by plate culture, failed to grow in this peptone solution.

This experience led me to study the behavior of this organism in culture media of different degrees of acidity and alkalinity. I began these experiments with a few cultures of the cholera vibrio which I had at that time, and found that the vitality of the different strains varied and that the same strain changed its morphology in solutions of peptone of different reaction. The degree of acidity or alkalinity of the peptone in which the morphology of the vibrio is most likely to appear typical may be different for different strains of the cholera organism. In general, in acid media, the vibrio tends to lose its curve and to appear as a rod, while in strongly alkaline media it becomes short and appears oval or even spherical.

Having carried on experiments of this nature with the strains of the cholera vibrio on hand in the laboratory, I decided to use media of different reaction in the bacteriological examination of cholera stools and of fæces from suspected cholera cases sent to the laboratory for diagnosis during the recent epidemic. In this way I hoped to identify the cholera

[1] Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 12, 1909, Manila, P. I.

[2] *Deutsche med. Wochnsch.* (1885), 14, 213.

vibrio even if it should appear in rod or spherical form in the 0.3 per cent alkaline peptone solution commonly used as an enriching media.[3] I first determined for a number of strains of the cholera organism, the reaction of the media in which the morphology of the vibrio was most typical, and from these experiments found that for the cultivation of cholera vibrios of typical morphology from suspected stools or other materials, at least three solutions of peptone of the following reactions should be used:

1. 0.3 per cent acid
2. 0.5 per cent alkaline
3. 1.3 per cent alkaline

} With phenolphthalein as an indicator.

From Table 1 it may be seen that some cholera strains appear as rods in 1 per cent acid peptone solution, and appear oval or spherical in form in 1 per cent alkaline peptone solution. I have also isolated a strain "Hoffman" (see Table 4) which even in a 0.5 per cent alkaline peptone solution has the bacillary form, and changes to its typical curved form only in a strong alkaline peptone of a reaction of 1.5 per cent. Strains of this nature were occasionally isolated in the bacteriological examination of cholera stools during the recent epidemic.

TABLE 1.—*The change in morphology of cholera vibrios in peptone solutions of different reactions (cultures incubated for twenty-four hours at 37° C.).*

— = clear. ± = a trace of turbidity. + = slight turbidity. ++ = moderate turbidity. +++ = marked turbidity. ++++ = maximum turbidity.

No.	Reaction of peptone solution.	Strain "George."	
		Turbidity.	Morphology.
1	Acid, 1.5 per cent	—	Not visible in stained preparations.
2	Acid, 1.0 per cent	±	Several small slender rods.
3	Acid, 0.5 per cent	+	The rods are slightly curved and larger than in No. 2.
4	Neutral	++	Moderately curved organisms, somewhat thick, both ends sharp.
5	Alkaline, 0.5 per cent	+++	Typical vibrios with some oval forms.
6	Alkaline, 1.0 per cent	++	The vibrios are thicker and less curved than in No. 5. Some oval forms are present.
7	Alkaline, 1.5 per cent	+	Cocco-bacilli; here and there arranged like diplococci.
8	Alkaline, 2.0 per cent	±	Cocco-bacilli which are smaller than those in No. 7.
9	Alkaline, 2.5 per cent	—	Not visible in stained preparations.

[3] Kolle u. Wassermann: Handbuch der pathogenen Mikroorganismen (1903) 3, 38.

TABLE 1.—*The change in morphology of cholera vibrios*—Continued.

— = clear. ± = a trace of turbidity. + = slight turbidity. + + = moderate turbidity. + + + = marked turbidity. + + + + = maximum turbidity.

No.	Reaction of peptone solution.	Strain "Valentine." Turbidity.	Morphology.
1	Acid, 1.5 per cent	± ?	Not visible in stained preparations.
2	Acid, 1.0 per cent	± ?	Not visible in stained preparations.
3	Acid, 0.5 per cent	+	Small, straight, slender rods.
4	Neutral	+++	For the most part curved, some straight.
5	Alkaline, 0.5 per cent	+++	Typical vibrios, somewhat short and thick.
6	Alkaline, 1.0 per cent	++++	Thick and short organisms, approaching the oval form.
7	Alkaline, 1.5 per cent	+	For the most part oval forms, a few curved.
8	Alkaline, 2.0 per cent	± ?	Very short bacilli and some spherical forms.
9	Alkaline, 2.5 per cent	± ?	A few coccus forms.

No.	Reaction of peptone solution.	Strain "Mendoza." Turbidity.	Morphology.
1	Acid, 1.5 per cent	± ?	Not visible in stained preparations.
2	Acid, 1.0 per cent	± ?	Small oval bacilli.
3	Acid, 0.5 per cent	±	Organisms longer than in No. 2.
4	Neutral	+++	Curved forms appear.
5	Alkaline, 0.5 per cent	++++	For the most part curved; some rods.
6	Alkaline, 1.0 per cent	+++	Organisms all typical and thick.
7	Alkaline, 1.5 per cent	+	Very thick and short, some have the oval form.
8	Alkaline, 2.0 per cent	+	All organisms have the oval form.
9	Alkaline, 2.5 per cent	±	Spherical forms.

Five years ago Kolle and Gotschlich published a report on the bacteriological diagnosis of Koch's cholera vibrio. They collected 65 strains of the cholera organism and were able to prove that all of these strains could be identified by the reactions of agglutination and bacteriolysis with a cholera immune serum. Although these strains did not differ in their biological characteristics, yet they did show morphological differences. Table 2 indicates the morphology of the strains studied by Kolle and Gotschlich.[4]

[4] *Ztschr. f. Hyg.* (1903), 44, 1.

TABLE 2.—*Differentiation of the cholera vibrio according to its morphology into four groups.*

I. GROUP "RODS."

Series.	Morphology of the cholera strains studied by Kolle and Gotschlich.	Number of strains collected.	Percentage.
1	Moderately long curved rods	7	
2	Short well-curved rods	7	
3	Very long slender rods	1	41.535
4	Long, slender and curved rods	6	
5	Moderately long and moderately slender rods	6	

II. GROUP "VIBRIO."

6	Rather long and thin, very slightly curved	1	
7	Moderately long, curved	9	
8	Fairly well curved	1	
9	Fairly well curved	2	
10	Short, only slightly curved	3	40.000
11	Very short, curved	2	
12	Short, curved	4	
13	Well curved, very short	1	
14	Short, moderately slender	2	

III. GROUP "COMMA FORM."

15	Thick and short	3	
16	Moderately long comma	2	15.353
17	Short	4	
18	Short, slender	1	

IV. GROUP "COCCO BACILLUS."

19	Short, almost a coccus	1	4.616
20	Short and thick	2	
	Total	65	

	Per cent.	Per cent.
Cocci form, Group IV	= 4.616	16.923
Bacillus form, series 3+5+6	=12.307	
Curved form, series 1+2+4	=30.768	
Total	57.691	

With regard to morphology, the cholera organism may be said to assume four forms:

1. The bacillary form, which varies in length and thickness.

2. The typical vibrio form, which shows variation in the degree of curving, in length, and in breadth.

3. The "comma form," with variation only in regard to length and thickness.

4. The "coccus form," which varies in its diameter assuming sometimes an oval form and then again a spherical one.

A most important factor in the campaign against an epidemic of cholera is the discovery of every source and locality of infection. The finding and disinfection of these sources is accomplished by the detection of the cholera vibrio in stools, waters, sewage, and other places, and its morphology may be a very important factor in its detection. In stained preparations from cultures in peptone, or even in those made directly from the stools, the form of the vibrio is often the starting point in the detection of the cholera organism. If we examine Table 2, we perceive that in 4.616 per cent of the different strains of the cholera vibrio this organism assumed the coccus form, while in 12.307 per cent it appeared as a rod. Therefore, if we should neglect the further examination by means of plate cultures and the performance of the agglutinative and bacteriolytic reactions, we would fail in the detection of the cholera vibrio in 16.923 per cent of the cases. Moreover, if we pursue the complete bacteriological investigation only in those cultures in which the typical vibrio form is present, we would fail in the detection of the cholera organism in 57.691 per cent of the cholera cases. Therefore, in the examination of suspected material for the cholera organism, much assistance can frequently be given if the three solutions of peptone of different reactions are employed, since in one of these it is very likely that the organism will assume its typical vibrio form.

It seems to me that most authors do not lay sufficient stress upon the reaction of the peptone solution used in isolating the cholera vibrio. It is usually merely stated that the peptone solution should be slightly alkaline. In Prussia, 0.3 per cent of crystallized soda after neutralization to litmus, is employed for the media, and most German authors agree that this is the optimum reaction for the media; that is, 0.3 per cent alkaline to litmus. Lehmann [5] thinks it is preferable to use 2 per cent normal sodium hydroxide, or 1 per cent crystallized or 0.3 per cent water free soda after neutralization with phenolphthalein. However, with peptone solution of but one degree of alkalinity as stated above, it is not uncommon to fail to discover cholera vibrios from the microscopical examination owing to the fact that they do not appear in typical form.

[5] Lehmann & Neumann: Bacteriologische Diagnostik. Munich, 4th ed. (1907) 487.

TABLE 3.—*Showing the development of cholera vibrios from suspected cholera stools in peptone solutions of different reaction.*

	Number of strain.	Reactions. Acid 0.3 per cent.	Reactions. Alkaline 0.5 per cent.	Reactions. Alkaline 0.5 per cent.	Cholera?	Number of strain.	Reactions. Acid 0.3 per cent.	Reactions. Alkaline 0.5 per cent.	Reactions. Alkaline 1.5 per cent.	Cholera?
Development	36	+	–	+	+	42	++	++	++	+
Form		—	—	)			)	)	)	
Indol		—	—	—			—	—	—	
Development	37	++	+±	+±	+	43	++	++	+	+
Form		)	)	)			—	?	)	
Indol		±	—	—			—	—	+	
Development	38	++	—	—	—	44	++	++	+	+
Form		—	—	?			)	)	)	
Indol		—	—	—			—	+	+	
Development	39	+++	+++	++	+	45	++	+++	++	+
Form		)	—	—			)	)	)	
Indol		—	—	—			—	+	—	
Development	40	+	+	+±	—	46	++	++	±	+
Form		—	—	)			)	)	?	
Indol		—	±	—			—	—	+	
Development	41	++	++	++	—	47	+++	++	+++	+
Form		—	—	)			?	)	?	
Indol		—	±	—			—	+	+	

) Indicates the presence of comma-shaped vibrios.

It is very easy to make a bacteriological diagnosis from typical cholera stools, and, after the organisms have been obtained in pure culture, it is not difficult to differentiate and identify them by means of agglutinative and bacteriolytic reactions; however, it is nevertheless very difficult to isolate the cholera vibrio when it is present in very small numbers in the suspected material, the reaction of which is unknown and in which the organism sometimes appears with a different morphology.

If, in the beginning of a bacteriological examination, microscopical preparations are made from the fæces directly or from the peptone used for enriching, we may fail sometimes entirely to recognize the presence of the cholera vibrio in such preparations because of the divergent morphology which it may assume, and therefore neglect further to pursue the bacteriological examination. Therefore during a cholera epidemic where it is necessary to examine bacteriologically a very large number of specimens of fæces for diagnosis, my proposal to use culture media of three different degrees of alkalinity or acidity so that the different strains of the cholera vibrio will appear in typical vibrio or comma form in at least one of them, notwithstanding the original form of the strain, is, I believe, a distinct aid and advance in the bacteriological diagnosis of cholera and therefore will be of assistance in the suppression of a cholera epidemic.

From my investigations it would appear that the different strains of the cholera vibrio may be arranged, with reference to their resistance to acid and alkali, into four groups:

1. Cholera vibrios resistant to acid solutions but not resistant to alkaline ones.

2. Cholera vibrios resistant to alkaline solutions but not resistant to acid ones.

3. Cholera vibrios resistant to both alkaline and acid solutions.

4. Cholera vibrios not resistant to either alkaline or acid solutions.

By *resistance* is meant the power of the organism to grow and to multiply in the culture medium in question in a typical form.

TABLE 4.—*Types of cholera vibrios developing typical morphology, (1) in highly alkaline media, (2) in acid media, (3) in both alkaline and acid media, (4) in neutral media.*

Series of tubes, peptone solution.	Reaction of media.	(1) "Hoffman."	
		Turbidity.	Morphology.
1	Acid, 1.5 per cent	—	Not visible.
2	Acid, 1.0 per cent	—	Not visible.
3	Acid, 0.5 per cent	—	Not visible.
4	Neutral	—	Not visible.
5	Alkaline, 0.5 per cent	++++	Bacillary form, some slightly curved.
6	Alkaline, 1.0 per cent	+	Thick and short, with slight curve.
7	Alkaline, 1.5 per cent	+	Typical comma forms.
8	Alkaline, 2.0 per cent	±?	Spherical forms.
9	Alkaline, 2.5 per cent	—?	Few spherical forms.

Series of tubes, peptone solution.	Reaction of media.	(2) "Felix II."	
		Turbidity.	Morphology.
1	Acid, 1.5 per cent	+	Half in straight form, half in curved form, size small.
2	Acid, 1.0 per cent	+	Half in straight form, half in curved form, size small.
3	Acid, 0.5 per cent	++	Mostly typical comma forms.
4	Neutral	+++	Organisms thick and short, mostly of oval form.
5	Alkaline, 0.5 per cent	+++	Thicker and shorter, a few curved forms, the majority like cocci.
6	Alkaline, 1.0 per cent	+	Oval or coccus forms.
7	Alkaline, 1.5 per cent	±	Spherical forms.
8	Alkaline, 2.0 per cent	±?	Spherical forms.
9	Alkaline, 2.5 per cent	—?	Very few spherical forms.

TABLE 4.—*Types of cholera vibrios developing typical morphology*—Continued.

Series of tubes, peptone solution.	Reaction of media.	(3) "Helmon 1."	
		Turbidity.	Morphology.
1	Acid, 1.5 per cent	+	Very few straight forms.
2	Acid, 1.0 per cent	+	Slightly curved forms.
3	Acid, 0.5 per cent	++	Comma forms, numerous spirilla.
4	Neutral	+++	Typical comma forms, no spirilla.
5	Alkaline, 0.5 per cent	+++	Typical, spirilla.
6	Alkaline, 1.0 per cent	++	Typical, comma forms.
7	Alkaline, 1.5 per cent	±	Typical, comma forms.
8	Alkaline, 2.0 per cent	+	Short, curved and some oval forms.
9	Alkaline, 2.5 per cent	+	Spherical forms.

Series of tubes, peptone solution.	Reaction of media.	(4) "Juan 1."	
		Turbidity.	Morphology.
1	Acid, 1.5 per cent	+	Very few thin, short rods.
2	Acid, 1.0 per cent	+	A few rods and a few oval forms.
3	Acid, 0.5 per cent	+±	Curved rods.
4	Neutral	+±	Rods slightly curved.
5	Alkaline, 0.5 per cent	++	Curved, rods and oval forms.
6	Alkaline, 1.0 per cent	++	Oval and spherical forms.
7	Alkaline, 1.5 per cent	±	Short, small forms.
8	Alkaline, 2.0 per cent	±	Not visible.
9	Alkaline, 2.5 per cent	±	Not visible.

It is a striking fact that the reaction of the typical cholera stool generally agrees with the reaction of the peptone solution in which the typical form of that strain of cholera vibrio occurs. I have examined the reaction of 26 typical cholera stools in all of which cholera vibrios were found, and I was able to ascertain that most of them (that is, 73 per cent) showed an alkaline reaction (the maximum corresponding to 0.88 per cent normal caustic soda), while about 20 per cent were acid (the highest degree of acidity equaling 1.24 per cent of normal hydrochloric acid), and the rest (about 7 per cent) being neutral. (See Table 5.) From one sample of 1.24 per cent acidity, the typical vibrio form was not seen in 0.5 per cent alkaline peptone, but the smear from the stool showed typical vibrios, and slightly thick and short vibrios developed on 0.3 per cent acid peptone. The alkalinity of a stool which contains cholera vibrios in almost pure culture usually increases by standing a few days, and from these stools it is very difficult to cultivate cholera vibrios in typical form in acid peptone solution.

TABLE 5.

STOOLS OF ALKALINE REACTION.

No.	Name of patient.	Age.	Duration of illness before admission.	Symptoms.	Date of examination.	Reaction of stools (with phenolphthalein).	Date of admission to hospital.	Date of discharge from hospital.
						Per ct. react.		
1	Mariano Compatete	30	Unknown.	Serious	Aug. 30	0.01	Aug. 30	[a] Aug. 30
2	Mariano de la Cruz	29	3 hours	Serious	Sept. 14	0.12	([d])	Sept. 14
3	Juan de la Cruz	75	2 hours	Serious	Sept. 1	0.04	Sept. 1	[a] Sept. 1
4	Lesaria Hilacio	29	14 hours	Serious	Sept. 4	0.04	Sept. 4	[a] Sept. 4
5	Antonio Baglud	15	(?)	Serious	Sept. 4	0.12	Sept. 4	[a] Sept. 4
6	K. Abe	24	8 hours	Serious	Sept. 4	([b])	Sept. 4	[a] Sept. 4
7	Masuda	27	5 hours	Moderate	Sept. 4	0.88	Sept. 4	Sept. 18
8	Alfreda Antonio	2	2 days	Moderate	Sept. 5	0.08	Sept. 5	[a] Sept. 7
9	Feliciano Cuson	60	(?)	Moderate	Aug. 25	0.32	Aug. 25	Sept. 13
10	Marcela Euson	3	4 hours	Serious	Sept. 15	0.08	Sept. 15	[a] Sept. 15
11	Miguel Seño	23	2 hours	Serious	Sept. 8	0.20	Sept. 8	Sept. 20
12	G. Walter Garrens	29	16 hours	Serious	Sept. 9	0.21	Sept. 1	[a] Sept. 1
13	Gregorio Alcarez	23	16 hours	Moderate	Sept. 10	0.32	Sept. 10	Sept. 20
14	Masuda	27	([e])	([e])	Sept. 11	0.32	Sept. 4	Sept. 18
15	Juan Lumaban	40	6 hours	Serious	Sept. 13	0.16	Sept. 13	[a] Sept. 14
16	Bruna Zamora	40	19 hours	Serious	Sept. 15	0.12	Sept. 15	[a] Sept. 16
17	Elocia	30	4 days	Serious	Sept. 15	0.04	Sept. 15	[a] Sept. 15
18	Engracia Estada	8	4 days	Moderate	Sept. 13	0.12	Sept. 13	[a] Sept. 17
19	Bartolome de Mendoza	45	10 hours	Serious	Sept. 13	0.07	Sept. 13	[a] Sept. 17

STOOLS OF NEUTRAL REACTION.

20	Raymundo Legaspi	23	12 hours	Serious	Sept. 8	([c])	Sept. 8	[a] Sept. 9
21	Ambrocio Salvador	5	18 hours	Moderate	Sept. 13	([c])	Sept. 13	Sept. 20

STOOLS OF ACID REACTION.

22	Pedro Dominguez	53	16 hours	Serious	Sept. 5	0.02	Sept. 5	Sept. 10
23	Felix Siamingo	18	4 hours	Serious	Sept. 13	0.01	Sept. 13	Sept. 21
24	Ciriaco Eunion	29	3 days	Serious	Sept. 15	1.24	Sept. 15	[a] Sept. 16
25	Leoncio Rogue	44	20 hours	Serious	Sept. 16	0.12	Sept. 16	[a] Sept. 16
26	Alfonso Leonardo	50	17 hours	Serious	Sept. 20	0.40	Sept. 19	[a] Sept. 21

[a] Died.
[b] Slightly alkaline.
[c] Neutral.
[d] Transferred to Mary Johnston Memorial Hospital.
[e] Second specimen.

Acidity average, 0.39 per cent.

Percentage of stools with acid reaction = 19.22
Percentage of stools with alkaline reaction = 73.09
Percentage of stools with neutral reaction = 7.69

From the experiments given in the tables above it may be seen that different strains of the cholera vibrio react differently toward acid and alkaline solutions, and that the medium in which the morphology appears most typical is different for the different strains. Therefore, it follows that peptone solutions of different reaction should be used in isolating the cholera organism in cultures, and, as I have stated, I believe that at least three different peptone solutions are necessary to obtain the best results.

The cholera vibrio shows a great adaptability to culture media of different reaction. For example, if we inoculate a strain of the cholera vibrio into 2.5 per cent alkaline peptone solution in which the organism at first develops but slightly and appears in a spherical form, in the course of a number of passages through peptone of the same reaction the rapidity of growth in this media increases and it finally regains its original size and thickness and its typical form. (See Table 6.)

TABLE 6.—*Adaption of cholera vibrio to alkaline media.*

Strain.	First generation.	Third generation.	Fifth generation.	Eighth generation.
"Margarita I".	Slight development of spherical forms.	Slight development, some curved, some oval forms.	Development moderate, most forms curved, some oval.	Well developed, typical forms.
"Juan"	Very slight development of spherical forms.	Slight development, some curved, some oval forms.	Development moderate most forms still oval.	Well developed, typical forms.
"Engracia I".	Slight development of spherical, oval and thick curved forms.	Development moderate, most forms curved and of still smaller size.	Development marked, most forms curved, thick, and large.	Well developed, typical forms.
"Leon I"	Slight development of coccus forms.	Slight development, all oval forms.	Development moderate, some oval, some curved forms.	Well developed, all forms curved, thick, and short.

This adaptability can also be demonstrated in a single inoculation of the culture media, when the quantity of peptone present is sufficient to furnish nutritive material to the strain for a long period of time. The adaption takes place slowly, so that if we inoculate a strain which is highly adapted to an alkaline medium on acid culture media, the morphology of the vibrio changes at first to that of a rod or to an oval or spherical form. When this strain is adapted on the acid medium, on re-inoculating it on the original alkaline culture media it appears in oval or spherical form even if its morphology was typical formerly on this.

TABLE 7.—*Changes in morphology in a typical cholera vibrio from 0.5 per cent alkaline peptone first transferred to 2.5 per cent alkaline peptone for various periods of time and then to 0.3 per cent acid peptone, and to 1.0 per cent acid agar.*

Generation.	Morphology when transferred to 2.5 per cent alkaline peptone.		Morphology when transferred to 0.3 per cent acid peptone.	Morphology when transferred to 1 per cent acid agar.
	Transfered.	Left standing.		
First	Spherical forms first day.	After 10 days, typical forms.	Spherical or oval form, very few curved.	Mostly cocci, a few oval forms.
Second	Oval forms, first day.	After 8 days, typical.	Spheres or oval and thick forms.	Spherical or oval forms, a few curved rod forms.
Third	Oval rods, first day.	After 6 days, typical forms.	Spheres or oval and thick forms.	Few spherical forms, oval and rods forms.
Fourth	Curved rods, fourteenth day from the first generation.	After 4 days, typical forms.	Few spherical forms, mostly curved short forms.	Oval and rod forms some curved forms.
Fifth	Typical forms, fifteenth day from the first generation.	After 2 days, typical forms.	Mostly curved forms, a few oval or rod forms.	Rods most of them curved.
			All show moderate development.	Luxuriant growth.

From Table 7 it may be seen that all the strains of the cholera vibrio show variations in morphology in the culture media of different reaction, and that each has no constant form in any one culture medium until after its adaption to that medium has become complete. After the cholera vibrio has become adapted to media of high alkalinity or high acidity and grows in typical form in such media, if it is then transplanted to media of a neutral reaction, it assumes an atypical or spherical form. This variability in the morphology of the cholera vibrio seems to justify the employment of three peptone solutions of different reaction for the routine technique in the isolation of this organism. I do not claim that the reaction of the culture medium is the only factor that gives rise to pleomorphism in the cholera vibrio; there are probably other factors which also do this and this question should be investigated further.

No relationship between the production of indol on the one hand and the reaction of the culture medium and the morphology of the cholera organism on the other could be established. (See Tables 8 and 9.) For this reason the indol reaction is not of great assistance in the diagnosis of the cholera vibrio.

TABLE 8.—*Relation between the reaction of the peptone solution and the production of indol.*

Series of tubes.	Hoffman. Development.	Hoffman. Indol.	Felix II. Development.	Felix II. Indol.	Helmon I. Development.	Helmon I. Indol.	Juan I. Development.	Juan I. Indol.	Reaction of tubes.
1	—	—		—	+	—	+	—	Acid, 1.5 per cent.
2	—	—	+	+	+	+	+	+	Acid, 1.0 per cent.
3	—	—	++	—)	++	—)	+±	—	Acid, 0.5 per cent.
4	—	—	+++	++	+++	—)	++	+)	Neutral.
5	++++	—	+++	+	+++	++)	++	+)	Alkaline, 0.5 per cent.
6	+	—)	+	—	++	—)	++	—	Alkaline, 1.0 per cent.
7	+	+)	±	+	±	—)	±	—	Alkaline, 1.5 per cent.
8	±?	—	±?	—	+	—	±	—	Alkaline, 2.0 per cent.
9	—?	—	—?	—	—	—	+	—	Alkaline, 2.5 per cent.

)Indicates typical morphology of the cholera vibrio.

TABLE 9.—*Examination of stools from individuals who had been in contact with cholera patients (no cholera vibrios present); showing the development of other vibrios, than the cholera vibrio, when cultivated in the 3 peptone solutions of different reaction and their relation to the production of indol.*

	Number of strain.	Reaction. Acid, 0.3 per cent.	Reaction. Alkaline, 0.5 per cent.	Reaction. Alkaline, 1.5 per cent.	Cholera?	Number of strain.	Reaction. Acid, 0.3 per cent.	Reaction. Alkaline, 0.5 per cent.	Reaction. Alkaline, 1.5 per cent.	Cholera?
Development	60	+++	++	++	—	66	+++	++	±	—
Form of vibrio		—	—	)			—	)	—	
Indol		—	—	±			±	—	—	
Development	61	+++	++	+++		67	++	++	+++	—
Form of vibrio		—	)	—			)	)	)	
Indol		—	·	±			—	—	±	
Development	62	++	+±	+	—	68	++	++	++	—
Form of vibrio		—	—	—			)	)	)	
Indol		—	—	±			+	—	—	
Development	63	++	++	+++	—	69	+++	+	±	—
Form of vibrio		—		—			)	)	)	
Indol			—	±			+	—	—	
Development	64	+	+	++	—	70	+++	++	±	
Form of vibrio		)	)	)			)	)	—	
Indol		—	—	±			—	—	±	
Development	65	++	+	+	—	71	+++	+±	±	—
Form of vibrio		—	)	—			—	—	—	
Indol		±	—	—			+++	—	—	

As to the relation between the cholera vibrio in culture media of different reaction and its agglutinability, it would appear from the results of my experiments that the more the acidity or alkalinity of the media is increased the more the agglutinability of the organism is decreased. Further observations on this question are now being pursued.

IMMUNIZING CATTLE AGAINST ANTICATTLE-PLAGUE SERUM.

By E. H. Ruediger.

(*From the Serum Section of the Biological Laboratory, Bureau of Science, Manila, P. I.*)

In connection with the formation of antibodies after injections of anticattle-plague serum, it has been stated that animals that have been repeatedly inoculated with anticattle-plague serum eventually become more susceptible to infection with the disease. While the views of the author did not coincide with such an idea, nevertheless, as the question was one of considerable practical importance, it was thought advisable to investigate this question by experiment.

It is an established fact that certain immune substances present in the serum of one species of animal, when injected into an animal of another species lead to the production of antiimmune substances.

Metschnikoff,[1] in 1900, injected spermotoxic serum of guinea pigs into rabbits, and, after so treating the rabbits for a short period of time, found that their serum had acquired the property of neutralizing or peventing the toxic action of the spermotoxic guinea pig serum upon spermatozoa. Weichart[2] also obtained antispermotoxic serum by treating animals with spermotoxic serum.

Metschnikoff,[3] Ehrlich,[4] Mueller[5] and others produced antihæmotoxin (hæmolysin) by treating animals with haemotoxic serum.

The subject of antiimmune bodies soon became an important one from a practical as well as from a scientific standpoint. Diphtheria antitoxin, tetanus antitoxin, antiplague serum and other immune serums, are frequently given to persons who have been exposed to the respective diseases, and if antiimmune substances were produced such prophylactic treatment would become detrimental instead of beneficial.

Kraus and Eisenberg[6] treated rabbits, dogs and goats with diphtheria antitoxin, typhoid agglutinating serum, and with lactoserum. The serum

[1] *Ann. Inst. Pasteur.* (1900), **14**, 1.
[2] *Ann. Inst. Pasteur.* (1901), **15**, 832.
[3] *Bull. de l'Acad. de Med.* (1909), **43**, 598.
[4] *Berlin klin. Woch.* (1901), **38**, 569.
[5] *Centralbl. f. Bakt.* (1901), I, **29**, 175.
[6] *Ibid.* (1902), I, **31**, 208.

of animals which had been treated with diphtheria antitoxin or with typhoid agglutinating serum did not possess any substances which neutralized or prevented the action of the respective antitoxin or agglutinin. On the other hand, the serum of animals which had been treated with lactoserum, when mixed with lactoserum prevented the action of the latter upon milk. The authors conclude:

I. Immune substances, as diphtheria antitoxin and typhoid agglutinin, can not lead to the production of antibodies when injected into an animal.

II. Treating an animal with lactoserum produces antilactoserum.

It must be borne in mind that practically all of our ideas concerning the production of antibodies are based upon experimental work relating to bacterial diseases and that the nature of the causative agent of cattle plague is as yet entirely unknown. It is therefore possible that the protective substances of anticattle plague serum are radically different from the antibodies with which we are acquainted and have a different mode of action. According to current notions, it is theoretically impossible to obtain antibodies by injecting an antiserum obtained from one animal into another animal of the same species. Nevertheless, cattle were used in these experiments both for the production of the anticattle-plague serum and in the attempt to obtain a serum antagonistic to the anticattle-plague serum. This plan was pursued primarily as has been intimated because of the imminently practical question as to whether or not overimmunization could lead to the production of susceptibility to the disease. However, it was also desirable to observe whether the laws of immunity involved were the same for cattle plague as they were for bacterial infections.

The following experiments were performed to show whether or not substances which render inert anticattle-plague serum are produced when the latter is injected at intervals into cattle.

EXPERIMENTAL.

Nine bullocks, non-immune to cattle plague, numbered 16, 17, 18, 19, 20, 22, 23, 24, and 25 were used.

Bullocks Nos. 16, 17, 18, 19 and 20 remained untreated; Nos. 22, 23, 24 and 25 received three injections of 100 cubic centimeters each of anticattle-plague serum at intervals of ten days. On the 28th day of June, these bullocks were subjected to the simultaneous method of immunization, bullock No. 16 acting as control.

Bullock No. 16 received 0.5 cubic centimeter of virulent blood under the skin and died of cattle plague within eleven days after inoculation. (Chart No. 16.)

Bullock No. 17 received 0.5 cubic centimeter of virulent blood, and 50 cubic centimeters of anticattle-plague serum per 100 kilos weight and died of cattle plague within eleven days after inoculation. (Chart No. 17.)

Bullock No. 18 was inoculated with 0.5 cubic centimeter of virulent blood and 75 cubic centimeters of anticattle-plague serum on the 28th day of June and was found dead on the morning of July 10th. (Chart No. 18.)

Bullock No. 19 inoculated with 0.5 cubic centimeter of virulent blood and 100 cubic centimeters of anticattle-plague serum died twelve days after inoculation. (Chart No. 19.)

Bullock No. 20 died within fourteen days after having received 0.5 cubic centimeter of virulent blood and 125 cubic centimeters of anticattle-plague serum under the skin. (Chart No. 20.)

Bullock No. 22 received 0.5 cubic centimeter of virulent blood and 50 cubic centimeters of anticattle-plague serum. He developed typical cattle plague from which he recovered. (Chart No. 22.)

Bullock No. 23, after inoculation with 0.5 cubic centimeter of virulent blood and 75 cubic centimeters of anticattle-plague serum, had a mild attack of cattle plague from which a good recovery was made. (Chart No. 23.)

Bullock No. 24 received an inoculation of 0.5 cubic centimeter of virulent blood and 100 cubic centimeters of anticattle-plague serum. A very mild attack of cattle plague followed from which an uneventful recovery resulted. (Chart No. 24.)

Bullock No. 25, having received 0.5 cubic centimeter of anticattle-plague serum, showed a slight rise of temperature and made a rapid recovery. (Chart No. 25.)

The results are summarized in the following table.

Number of bullocks.	Virulent blood.	Serum.	Result.	Remarks.
16	0.5	None.	Died	Control.
17	0.5	50	Died	Not treated previously.
18	0.5	75	Died	Not treated previously.
19	0.5	100	Died	Not treated previously.
20	0.5	125	Died	Not treated previously.
22	0.5	50	Lived	Treated previously.
23	0.5	75	Lived	Treated previously.
24	0.5	100	Lived	Treated previously.
25	0.5	125	Lived	Treated previously.

CONCLUSION.

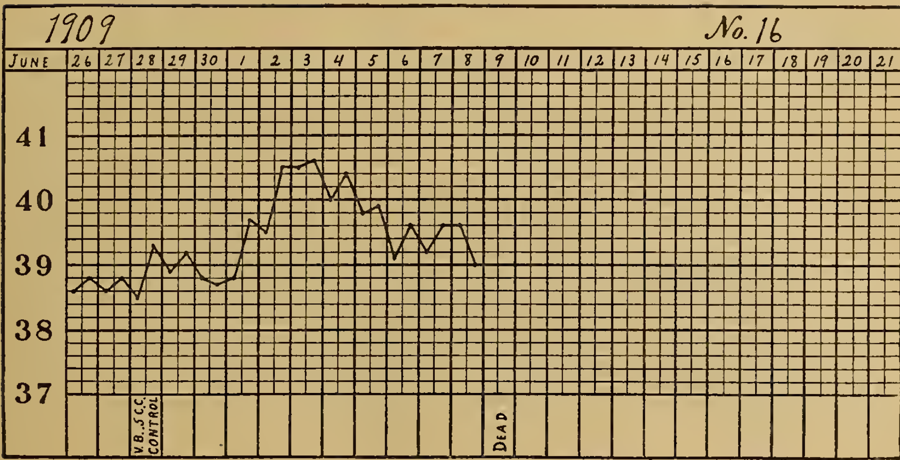
Apparently anticattle-plague serum, when repeatedly injected under the skin of healthy, non-immune bullocks, does not lead to the production of antiimmune bodies.

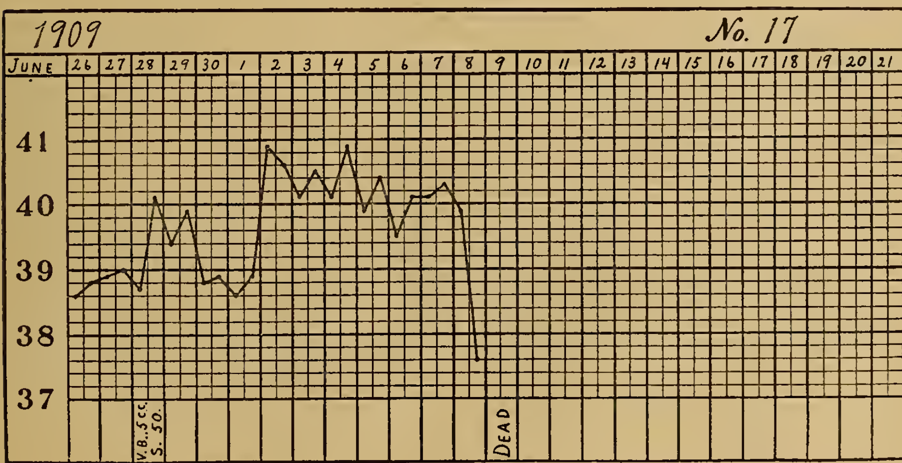
The more serum injected into an animal the milder is the attack of cattle plague which follows inoculation with virulent blood.

In this respect the immunity reactions in cattle plague are similar to those observed in many infections of known bacterial origin.

ILLUSTRATIONS.

Temperature charts Nos. 16–25.


1909
No. 16
JUNE 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
41
40
39
38
37
V.B. 5 C.C. CONTROL
DEAD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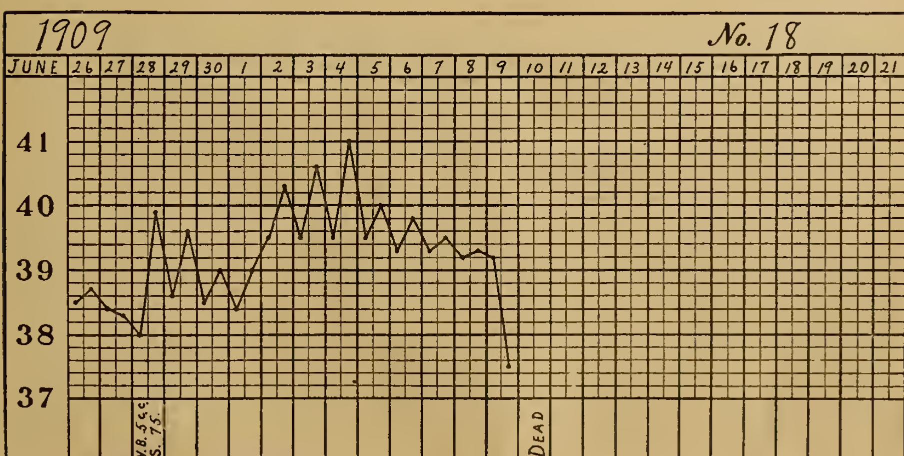
No. 17
JUNE 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
41
40
39
38
37
V.B. 5 cc. S. 50.
DEAD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No. 18
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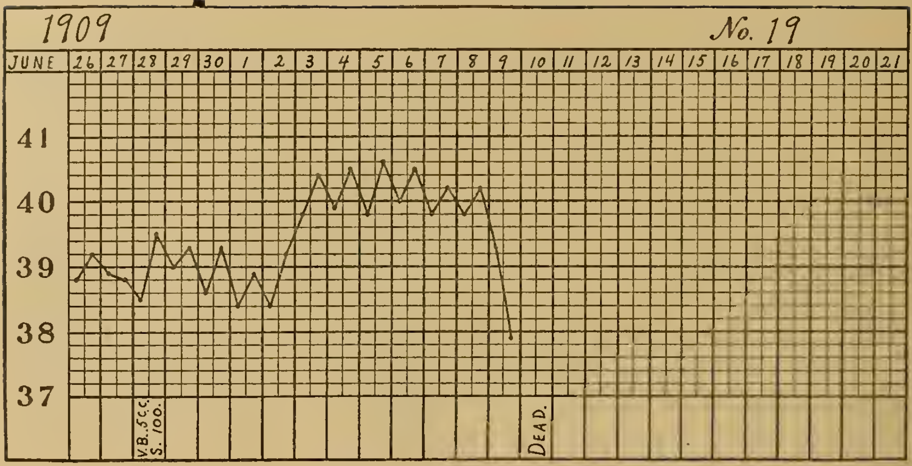
41
40
39
38
37
V.B. 5 cc S. 75.
DEAD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41
40
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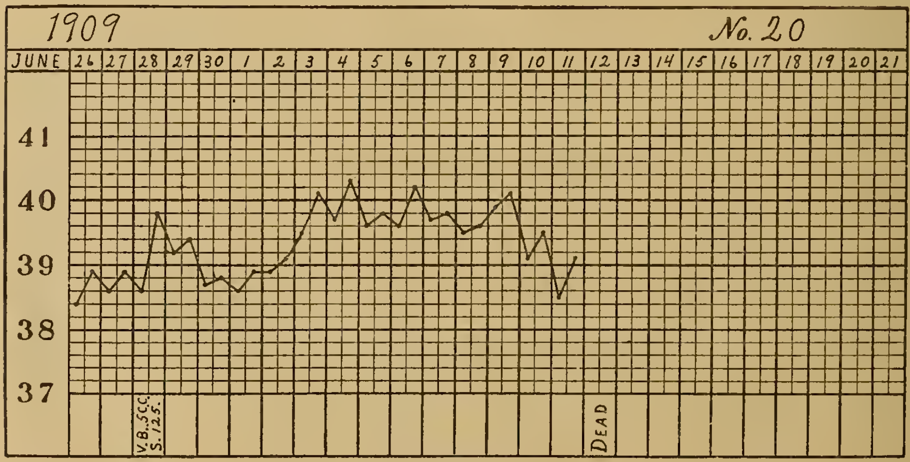
37
V.B. 5 c.c.
S. 100.
DEAD.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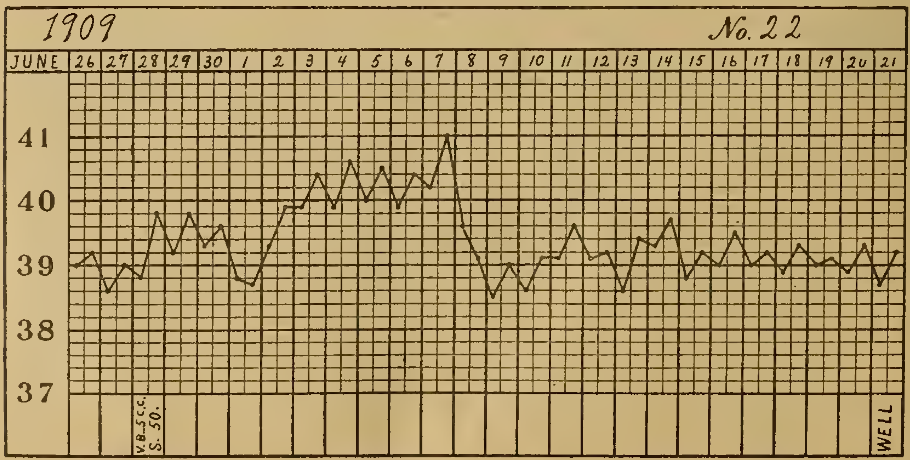
41
40
39
38
37
V.B. 5 c.c.
S. 125.
DEAD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41
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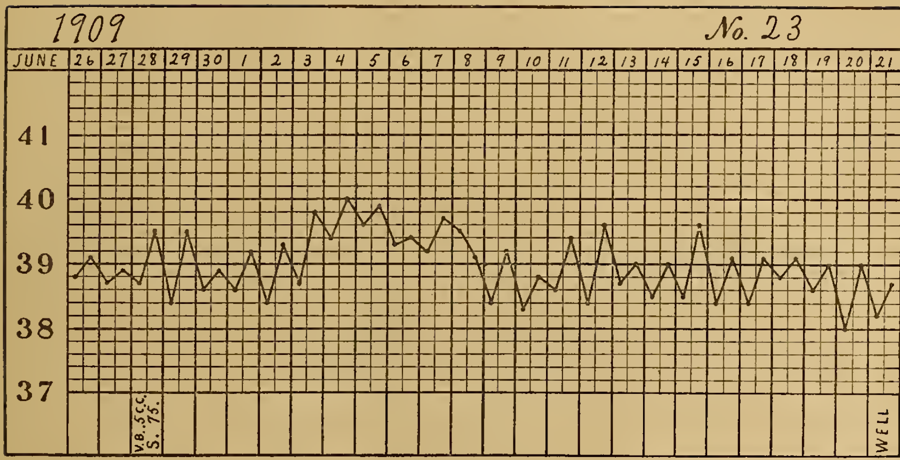
37
V.B. 5 c.c.
S. 50.
WELL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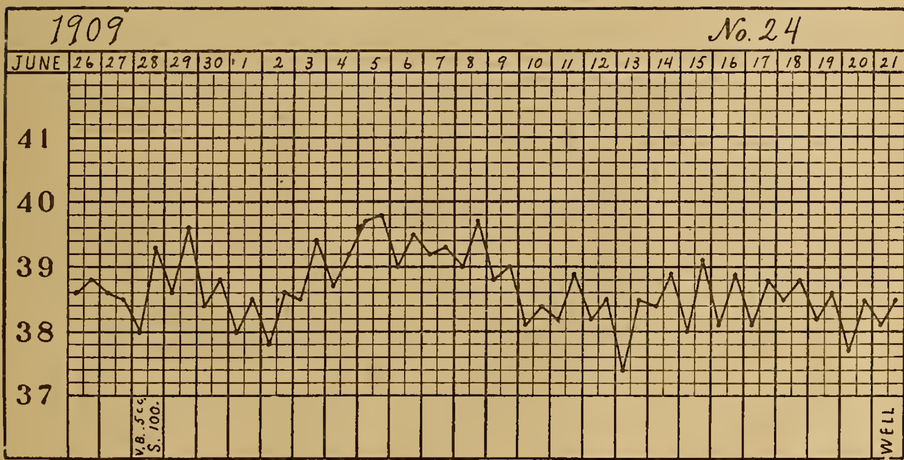
WELL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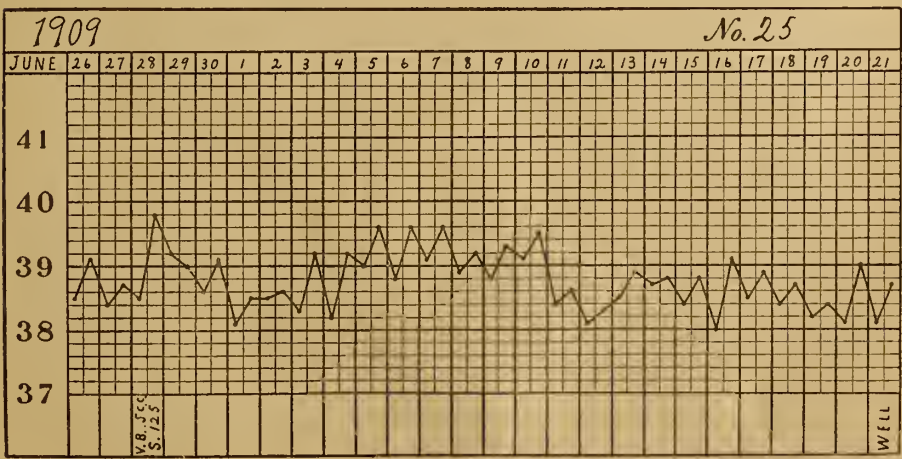
S. 100.
WELL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41
40
39
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37
V.B. 5cc.
S. 125
WELL

SOME OBSERVATIONS UPON CHOLERA IN CHILDREN.

By Allan J. McLaughlin.[1]

(From the Bureau of Health.)

There is no reason for believing children to be less susceptible to cholera than adults, especially in view of the fact that children are particularly prone to all other intestinal disorders.

Statistics of incidence in children in Manila under 10 years of age of certain diseases during the three years 1907, 1908, 1909.

	Percentage of cases.
Meningitis [a]	96.80
Enteritis	93.14
Dysentery	63.66
Cholera	22.82

[a] Meningitis is here included with the intestinal diseases of children because we are able to show that real acute meningitis is rare and that the disease diagnosed by Filipino physicians as acute meningitis is usually an intestinal infection with marked cerebral manifestations.

During cholera epidemics in the Philippines, about 22 per cent of the reported cases of cholera occur in children, while the increase of deaths among children from other diseases is remarkable. By examining the following tables and charts, it will be seen that the notable increase in the deaths of children from meningitis, enteritis, and dysentery in Manila is coincident with or that it immediately precedes an epidemic of cholera, and that the increase is not dependent upon the season, as it occurs in January and February as well as in July, August, or September.

Owing to the investigations made by the writer in the past three months upon deaths in children from meningitis, enteritis, and dysentery, more care has been exercised in making the diagnosis upon the death certificates of children, and many cases were sent to San Lazaro Hospital as cholera which probably formerly would have been classified as enteritis, meningitis, or dysentery. Thus, the percentage of cholera cases reported in children under 10 years of age during the past outbreak was

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raised to 32.5 per cent, while the usual incidence in children has been 22 per cent. For this reason, the upward curve upon the charts of meningitis, enteritis, and dysentery of the last quarter does not show so sharp a rise coincident with the cholera outbreak.

There is no foundation for the theory that cholera vibrios live outside of the human body for months during the inter-epidemic periods. There is scientific evidence to show that this is improbable if not impossible. It has been demonstrated also that the duration of cholera vibrios in the human intestine is limited, both in true cases of cholera and in "vibrio carriers." In the majority of cases the duration is less than ten days.

The periods of quiescence between epidemics vary from several months to years. One hears constantly in the Philippines the statement that cholera always recurs in the same places, the inference being that the infection lies dormant for months or years and suddenly, under favorable conditions, breaks out in epidemic form. There is no scientific evidence to support such an inference. On the contrary, one outbreak of cholera can be traced practically always to another source of infection in a neighboring province. In the few apparent exceptions, our failure to trace the source of infection is probably due to our inability to find the connecting links in the chain of infection. During the past eighteen months, I have never known of an outbreak of cholera which was not traceable to some known source of infection, either by direct conclusive evidence or by reasonable logical deduction.

Where the periods between epidemics last for several months or for years, the beginning of an outbreak in the locality is due to infection introduced from outside. In quiescent periods of less than two months duration, the infection has been re-introduced or has been continuously present in persons with light or with atypical symptoms of cholera.

Three classes of unreported cases may be responsible for continuing the infection of cholera from one outbreak to another, where the interval between the outbreaks is short but of more than five days' duration:

1. Cases without symptoms. ("Vibrio carriers.")
2. Cases with slight symptoms.
3. Cases with atypical symptoms.

During epidemics, the importance of the "vibrio carrier" in spreading infection can not be overestimated, but the presence of the "vibrio carrier" can not be depended upon to explain all periods of quiescence of the disease, especially as such individuals are rare except during an epidemic of cholera.

It is well known that light cases of cholera occur with no symptoms beyond vomiting and a slight diarrhœa, and that they may be confused readily with an attack of acute gastro-enteritis. However, the atypical cases of cholera in children are of far greater importance.

The reporting of cases of communicable disease in the Philippines is compulsory under the Sanitary Code. Living cases, especially light ones, may go unreported or unrecognized and the error not be discovered. In fatal cases, the Bureau of Health has more perfect control. All interments necessitate a burial permit from the Bureau, and before granting this a death certificate from a municipal or a private physician, countersigned by a medical inspector of the Bureau of Health, is necessary. These death certificates are scrutinized very closely at the central office of the Bureau. Practitioners might interchange the diagnosis as between cholera and acute enteritis, but they would scarcely dare to attempt gross deception. The cases of cholera which have not been reported as such have been reported usually as acute or chronic gastroenteritis, enteritis, entero-colitis, acute or chronic dysentery, and acute meningitis.

It was noted that the deaths from the above causes always increased just before or during an outbreak of cholera. I decided to investigate these fatal cases, and the results given below corroborated my suspicion that cholera cases were frequently unrecognized and unreported in Manila. Some of these cases were sent to the morgue for autopsy; in others, samples of the intestinal contents were taken in lieu of an autopsy. The following cases are examples:

Case 1.—D. G.—Age, 1 year 8 months. Male. Duration of illness, three months. Diagnosis and history by municipal physician. Diagnosis, chronic gastro-enteritis. Absence of symptoms of cholera other than diarrhœa of a fæculent character. Post-mortem findings obscured by decomposition of organs. Cholera vibrio recovered from intestinal contents.

Case 2.—T. P.—Age, 3 years. Male. Case diagnosed as chronic enteritis, of six months' duration. No vomiting, cramps, or other symptoms of cholera. Diagnosis and history by Dr. L. L. Specimen taken from intestine positive for cholera vibrio.

Case 3.—J. V.—Age, 5 years. Female. Diagnosis and history by municipal physician, Dr. H. Diagnosis, acute dysentery. Duration of illness, fifteen days. Diarrhœa, bloody stools, no vomiting or other symptoms of cholera. Post-mortem findings atypical of cholera. Examination of intestinal contents positive for cholera vibrios.

Case 4.—D. E.—Age, 6 years. Female. Diagnosis, chronic enteritis. Duration, three months. None of the symptoms of cholera were present except diarrhœa, the stools were not of a rice-water character. Diagnosis and history by Dr. B., a private physician. Post-mortem findings, acute specific enteritis, cloudy swelling of the kidneys and other lesions suggestive of cholera. Examination of intestinal contents positive for cholera.

Case 5.—F. S.—Age, 2 years. First appearance of illness, August 7. Visited by municipal physician August 14. Patient weak, thin. Diarrhœal stools, two to 3 a day. Slight fever. Above conditions continued, gradually reducing the child's strength until on August 25 a slight cough and vomiting began. Some meteorism and great emaciation. No meningeal symptoms noticeable. History and diagnosis of acute enteritis by Dr. C., municipal physician. Examination of intestinal contents positive for the cholera vibrio.

Case 6.—A. C.—Age, 3 years. Male. Diagnosis, enteritis and meningitis. Presented no symptoms other than diarrhœa until the last twenty-four hours. Duration of illness, ten days. On the last day, convulsions, coma and death. History and diagnosis by Dr. P., private physician. Necropsy unsatisfactory because of post-mortem decomposition. Examination of intestinal contents positive for cholera vibrios.

Case 7.—A. V.—Age, 4 years. Female. Diagnosis, chronic enteritis. Duration of illness, six months. No symptoms of cholera. Diagnosis and history by Dr. H., municipal physician. Specimen taken from intestine at post-mortem examination positive for cholera vibrios.

Case 8.—C. F.—Age, 5 years. Female. Diagnosis, acute dysentery. Bloody stools. Duration of illness, eight days. No symptoms of cholera. History and diagnosis by Dr. Q., private physician. Specimen taken from intestinal contents positive for cholera vibrios.

Case 9.—S. A.—Age, 2 years. Female. Acute meningitis. History and diagnosis by Dr. H., private physician. Taken sick, September 15, with fever and nausea. Vomited a worm. Stool contained other worms. September 16 had two liquid stools. September 17, no stools, very restless, side to side movements of the head. September 18 and 19 the same condition with some delirium. September 20, fever, 39.5° C., general convulsions, photophobia. Purgative and ice cap prescribed. One large stool. Condition unimproved. Died at 11 p. m.

Necropsy twenty-seven hours after death by Doctor Andrews.

Body well nourished, rigor mortis slight, nails blue, eyes sunken and lids half closed.

Subcutaneous tissues dry, muscles dark.

Peritoneum dry, smooth, no fluid in cavity.

Pericardial sac contains few drops of fluid. Right side of heart soft, left, firm.

Lungs.—Organs crepitate throughout, light pinkish gray in color. Cut section, dark cherry surface from which dark tarry blood can be expressed.

Kidneys soft, light plum colored, capsule strips readily, striations seen clearly. Cortex a dull gray color.

Intestines congested in some parts, the congestion being more marked in lower part of ileum. Contents semifluid, yellow color. Mucosa intact. Intestines distended with gas.

Urinary bladder empty.

Brain.—Meninges congested, dry, brain substance firm, vessels in brain substance also congested. No fluid in ventricles. No evidence of inflammation.

The intestinal contents were examined bacteriologically by the Biological Laboratory, Bureau of Science, and a diagnosis of cholera made.

Case 10.—M. S.—Age, 2 years 4 months. Female. Said to have had slight fever September 9. September 19, had watery stools of a fæculent character. Family stated that diarrhœa continued until death. Dr. R., private physician, furnished the following history: Called on September 20 to what he considered case of acute meningitis; he prescribed calomel and rhubarb and castor oil. He noted high fever, 39° C., strabismus, rigidity of neck, restlessness, and evidences of headache. The urinary secretion was present.

Necropsy fourteen hours after death by Doctor Andrews.

Body well nourished, rigor mortis absent, nails blue, skin shrunken, eyes half open.

Subcutaneous tissues dry.

Peritoneal cavity slightly moist, contains no fluid.

Pericardial sac contains few drops of fluid. Right side of heart distended with blood, left side firm.

Lungs.—Left voluminous, crepitant. Cut section, reddish-brown from which a frothy blood-tinged fluid can be expressed. Right lung similar, slight increase of pleural fluid in both cavities.

Kidneys.—Fœtal lobulations obliterated, capsule strips easily. Cut section, cortex and medulary portion dull gray in color, striations indistinct.

Urinary bladder contains about 30 cubic centimeters of pale turbid urine.

Brain.—Meninges of brain are deeply congested, otherwise apparently normal. Slight amount of blood-tinged fluid in lateral ventricles; blood vessels are engorged.

Intestines distended with gas, slightly congested, mucosa intact throughout. Contain semi-fluid, brownish yellow fluid, slight in amount. Solitary lymph follicles slightly enlarged, especially in the lower end of the ileum. Peyer's patches are not involved except those immediately above the ileo-cæcal valve.

Examination of intestinal contents reported positive for cholera by the Biological Laboratory, Bureau of Science.

Case 11.—T. N.—Age, 10 months. Female. History and diagnosis of acute meningitis by Dr. B. Taken sick on September 14 with fever. September 15, two bowel movements of yellow color. September 16, temperature 38° C., nausea, strabismus and evidence of headache. Calomel prescribed. September 17, no bowel movements. September 18, temperature normal, strabismus and general convulsions. September 19, same. September 20, 21 and 24, adynamic and semi-comatose condition. Died at 3 p. m. September 22.

Necropsy by Doctor Andrews:

Body of small infant, rigor mortis absent, nails bluish. Skin shriveled, expression of face drawn; eyes sunken, half open.

Subcutaneous tissues and muscles dry.

Peritoneum moist but no fluid in cavity.

Pericardial sac contains a few drops of fluid. Right side of heart distended, left side firm.

Lungs.—Left voluminous, heavy, light purple in color. Posterior part of lower lobe has a slight consolidation present. Cut section of the lower lobe shows a dark cherry surface in which two or three dark slightly elevated areas are seen. These are drier than the surrounding tissues and more granular. Right lung, dark gray anteriorly, dark purple posteriorly. Posterior border firmer than anterior part. Lung is voluminous, slight amount of frothy material can be expressed.

Kidneys are soft, fœtal lobulations absent, surface grayish purple in color. Cut section shows cortex and medullary portion to be of a dull gray color. Striations indistinct.

Urinary bladder empty.

Brain.—Meninges are very much congested. Basal part of brain shows considerable congestion with slight increase of spinal fluid. No inflammatory exudate present. Choroid plexus in lateral ventricles much congested. No fluid present. Section of brain shows intense congestion throughout its substance.

Examination of intestinal contents reported positive for cholera by the Biological Laboratory, Bureau of Science.

Case 12.—T. G.—Age, 3 years. Female. History by Medical Inspector A. Diagnosis, acute meningitis by Dr. R., private physician. September 22, had 4 liquid stools without fever or vomiting. September 23, no bowel movements. September 24, calomel and castor oil administered by Dr. R. Slight fever and convulsions. Semi-comatose, dyspnœa and death at 4 p. m.

Necropsy by Doctor Andrews.

Body slightly emaciated, rigor mortis absent. Nails blue, skin shriveled; expression drawn; eyes half open and sunken.

Subcutaneous tissues fairly dry.

Peritoneum moist, fluid absent.

Pericardial sac contains several drops of fluid. Heart is very soft.

Lungs voluminous, crepitant. Cut section shows congestion, dark tarry blood can be expressed.

Kidneys soft, grayish red in color, capsule strips readily, fœtal lobulations absent. Cut section shows grayish red surface in which the medullary portion and the cortex show clearly with the striations partially obliterated.

Intestines slightly congested, filled with watery material mixed with mucus and dark fæcal material.

Urinary bladder empty.

Examination of intestinal contents reported positive for cholera by Biological Laboratory, Bureau of Science.

Case 13.—E. M.—Age, 1 year. Female. History and diagnosis of chronic enteritis by Dr. G., municipal physician. Indefinite history of malnutrition and digestive disturbance, fever, constipation and diarrhœa alternating. Presented picture of marasmus. On September 21, removed to 192 Calle Felix Huertas where a case of cholera had occurred the previous day. No symptoms of cholera present; patient died four days later (September 25).

Necropsy by Doctor Andrews.

Body greatly emaciated, rigor mortis absent, nails white, skin not shriveled, no external evidence of cholera.

Subcutaneous tissues moist.

Peritoneum moist, few cubic centimeters of fluid present.

Pericardial sac grayish white. Heart is soft.

Lung.—Voluminous, pinkish gray in color, lower lobe of left lung firm, solid, slight fibrinous exudate on its surface. Cut section shows hepatization, grayish brown in color, quite moist. Upper lobe crepitant. Cut section pinkish in color. Right lung upper lobe dark red, firm, numerous petechial hæmorrhages show beneath visceral pleura. Cut section shows hepatization, surface light brown in color, and is moist. Pieces sink in water. Lower lobe softer than upper, dark colored, similar in consistency.

Spleen.—Enlarged, firm, dark purple. Cut section shows dark chocolate surface in which Malpighian bodies and trabeculae are seen plainly.

Kidneys.—Left is enlarged, fœtal lobulations lost, pale gray in color, capsules strip readily. Cut section shows moist surface, anæmia. Striations clearly seen, glomeruli seen as reflecting dots of light.

Liver enlarged, chocolate colored, lobulations distinct. Organ fairly firm.

Intestines not congested, mucosa intact, contents are watery with some yellowish semi-fluid fœcal material.

Urinary bladder empty.

Examination of intestinal contents reported positive for cholera by the Biological Laboratory, Bureau of Science.

Case 14.—L. S.—Age, 1 month 29 days. Male. History and diagnosis by Dr. C., municipal physician. September 16 had fever, vomited milk; abdomen was distended. September 17, fever, slight strabismus, no diarrhœa, thirst, and in a semicomatose condition. September 18, fever higher, "localized in the head," cold extremities, transient convergent strabismus, much restlessness, crying continually. Diagnosis, acute meningitis.

The medical inspector in charge of the district failed to secure a sample of the intestinal contents of the child.

Case 15.—L. S.—Age, 3 years. Brother of case 14. Taken sick on September 13 with vomiting and diarrhœa. Three to five movements per day. Stools were fæculent and fœtid. Thirst, no loss of voice, and no suppression of urine. Fever first two days, but afterwards temperature normal.

Necropsy by Doctor Andrews.

Body well nourished, rigor mortis marked; nails blue; skin shriveled; eyes half open and sunken.

Subcutaneous tissues moist, muscles dark.

Peritoneum smooth and moist, few cubic centimeters of blood-colored fluid present. Intestines distended with gas, slightly congested.

Pericardial sac blood-stained, increase of fluid. Heart soft, flabby and blood-stained.

Lungs.—Increase of pleural fluid in both cavities. Lungs voluminous and heavy. Cut section shows congestion and considerable frothy fluid present.

Kidneys swollen, soft, capsule strips readily. Cut section dull gray color. Striations partially obliterated. Intestines distended with gas. Lower part of ileum slightly congested, contents dark and watery; mucosa intact.

Urinary bladder contains about 200 cubic centimeters of dark colored urine.

Examination of intestinal contents for cholera reported positive by the Biological Laboratory, Bureau of Science.

It seemed probable at first glance that cases of cholera were being concealed, or that typical symptoms were carelessly overlooked, but I have seen a number of cases in which a diagnosis of Asiatic cholera would not have been made from the clinical picture; and without the bacteriological investigation of the stools these cases would never have been recognized as cholera. I am convinced that many of the diagnoses of acute or chonic enteritis, acute dysentery, meningitis, etc., are made in good faith by the Filipino doctors. They have erred in looking for a typical picture of Asiatic cholera, and this picture is lacking in children in many instances. The erroneous diagnosis of chronic and acute enteritis and of dysentery alone is often due to the actual presence of these conditions, probably before infection with cholera occurred, and to the absence of the classical symptoms of cholera.

The frequency of diagnosis of meningitis by native phycisians is due to lack of or failure to observe the early symptoms of cholera, vomiting, rice-water diarrhœa, muscular cramps, collapse and anuria, and to the presence, late in the disease, of marked cerebral symptoms, due to a profound toxæmia. Accurate diagnosis of cholera in these fatal cases was only possible from the post-mortem findings and the isolation of cholera vibrios from the intestines.

In other cases, we have found the acute enteritis, acute parenchymatous nephritis, dryness of the tissues and serous cavities, tarry appearance of the blood on section of the lungs, dry appearance of the spleen on cut section, and other pathological appearances of cholera, without being able to demonstrate the presence of cholera vibrios in the intestines. These cases were probably cholera in which the duration of the illness was so long that the disappearance of the vibrios from the intestines had occurred.

The following diagnoses were made by municipal physicians and private physicians, apparently acting in good faith. An effort was made to investigate cases of acute intestinal troubles in living children, and a circular letter was addressed to all practicing physicians in Manila requesting samples of the dejections of children ill with enteritis, dysentery and allied disorders. Municipal physicians and medical inspectors were directed to secure such samples wherever possible. The medical profession was apathetic and but few physicians, responded. The municipal physicians and the medical inspectors, however secured a considerable number of samples, and of these several with very atypical symptoms were found to be positive for cholera organisms as described below.

LIVING CASES.

Case 16.—I. M.—Age, three months. Male. Slight diarrhœa; mother stated that child had vomited. Seen in convulsions. Admitted to San Lazaro Hospital September 9. Temperature normal. This case may be regarded as an example of what is commonly diagnosed as acute meningitis in Manila. It presented symptoms of cortical irritation, twitching and convulsive movements; some apparent but not real rigidity of the neck, and spasmodic movement of the head from side to side. After admission to the hospital, no vomiting or diarrhœa occurred; the stools were soft and fæculent. There was no collapse and no anuria. The urine was highly albuminous, and during the following ten days the temperature was always normal or slightly elevated. Examination of the intestinal contents revealed the presence of the cholera vibrio, and this organism remained present for ten days as was demonstrated by daily bacteriological examination. The patient recovered.

Case 17.—P. M.—Age, 5 years. Male. A diagnosis of acute dysentery and meningitis was made by a municipal physician. Duration of illness, one week. Blood and mucus in stools. No vomiting or other symptoms of cholera. Admitted to San Lazaro Hospital on September 14. Had cerebral symptoms, twitching, rigidity of muscles of neck, head drawn back, urine scanty and highly albuminous. Examination of the intestinal contents positive for cholera vibrios. The urine increased in quantity, the cerebral symptoms disappeared, the vibrios disappeared from the intestines, and the patient was discharged cured on September 21.

Case 18.—E. P.—Age, 4 years. Female. Duration of illness, fifteen days. Fever but no vomiting. Diarrhœa. alternating with constipation was present. The patient was treated for worms and later for meningitis by Dr. G., municipal physician. Admitted to San Lazaro Hospital September 16. No symptoms of cholera. Temperature 100.4 on entrance. The temperature reached normal on the next day and remained normal until recovery. Cerebral symptoms, muscular twitchings and convulsive movements were present. The patient was semicomatose at times. There was no anuria. The urine was albuminous. The cerebral symptoms disappeared within twenty-four hours after admission to the hospital. Examination of the intestinal contents was positive for the cholera spirillum. The patient was discharged cured, September 20.

Case 19.—M. M.—Age, 1 year 7 months. Male. September 20, had fever; two liquid stools, no vomiting, slight meteorism. September 21 and 22, two stools per day, of a yellow color. Semi-comatose at times. Diagnosis, acute enteritis. History and diagnosis by Dr. G., municipal physician. Admitted to San Lazaro Hospital on September 23. Pulse, good; respiration, good. Large liquid stool at 7 p. m. Slept well. Passed roundworm. September 24, yellow liquid stool, face flushed, pulse full, respiration somewhat labored, voiding of urine normal. Did not retain nourishment. September 25, slight rigidity of muscles of neck, patient insists on lying on back. Sleeps better, apparently recovering. Examination of intestinal contents positive for cholera spirillum.

Case 20.—R. V.—Age, 1 year 4 months. Female. Duration of illness at time of admission to hospital, five hours. Mother stricken with cholera the day before. Admitted to hospital September 19. Condition upon admission apparently fair. Temperature 102, pulse 140, respirations 55. An enema was administered and when passed small flakes and guava seeds were present. Voiding of urine normal. Abdomen greatly distended on the evening of the 19th. Patient frequently vomited nourishment. The temperature varied between 102° and 99.4° but registered 103.6° on September 25 at 5 p. m. The stools as a rule were greenish and liquid. Stool specimen of September 19 was positive for the cholera vibrio. The patient recovered.

Case 21.—F. M.—Age, 1 year 3 months. Male. History and diagnosis of acute enteritis by Dr. G., municipal physician. September 21 had yellow stools. No fever. September 22, slight diarrhœa continued; no fever. September 23 and 24, child much better. September 25, one soft yellow stool; sample from this was positive for cholera vibrios. Admitted to San Lazaro Hospital September 26, at 10.50 a. m. No symptoms. Child apparently well. Held awaiting disappearance of vibrios from intestinal tract.

Case 22.—M. B.—Age, 1 year 4 months. Female. History by Dr. B., medical inspector, Bureau of Health. September 21, diarrhœa and passing of worms. Stomach distended, also vomited a roundworm. Dr. R. was called and diagnosed acute gastro-enteritis. Specimen was taken and the Bureau of Science reported positive for cholera. Dr. B. noted the following: Eyes slightly sunken, lids slightly drooping; fitful and restless; very slight wrinkling of skin of fingers and toes; abdomen distended; diarrhœa had ceased, pulse rapid, temperature normal, body warm, urine not suppressed. Admitted to San Lazaro Hospital September 24, 9.45 a. m.

On admission, patient's condition was fairly good; irritable all afternoon of 24th; stools liquid; temperature varies from 98.6° to 100.2°. Voids urine freely. September 25, temperature 99.8°, pulse 144, respiration 28. Pulse intermittent. September 27, quiet, slept most of night. Temperature 98.4°, pulse 102. General condition practically normal.

The average number of deaths from enteritis, meningitis and dysentery during months in which cholera is not reported in Manila varies about as follows:

	Cases per month.
Enteritis	40– 50
Meningitis	20– 30
Dysentery	10– 20
Total	70–100

This is the death rate which may be expected when cholera is not present officially. By examination of the tables, it will be noted that whenever cholera is present the increase in the number of cases of enteritis, dysentery and meningitis is remarkable; so that one may say that if the total for these three diseases exceeds 100 cases per month there is probably cholera in Manila. (See Table IV.)

Sufficient work has already been done to show that many cases of cholera in children during epidemics are unrecognized and unreported as such. Further, careful investigation of all acute diseases and of deaths of children during inter-epidemic periods is necessary before an opinion can be expressed upon the possibility of cholera existing in Manila unreported for months. This work will be carried out as rapidly as possible and I hope before long to be able to present additional interesting data upon the actual findings in cases reported as "infantile" beriberi, convulsions of children, acute bronchitis and other diseases of children.

There were two cases of cholera reported in July but the epidemic can be said to have commenced August 17 with two cases in Bancusay. From August 17 to date, September 25, there has been a total of 83 cases. To accentuate the importance of the examination of the stools of children reported as suffering with other diseases, I need only call attention to the fact that 27.7 per cent of the total cholera cases were reported as victims of other diseases, and that without routine stool examinations they would never have been recognized as cholera.

CONCLUSIONS.

Cholera in children is often unrecognized and unreported as such, being reported as acute or chronic enteritis, gastro-enteritis, entero-colitis, dysentery, acute or simple meningitis, and probably also as "infantile" beriberi, convulsions of children, and other diseases.

The occurrence of these errors in Manila makes it more than probable that the same confusion exists in a greater degree in the provinces, where skilled diagnosticians are more rarely found.

The clinical picture of cholera in children is often atypical, and the diagnosis may be extremely difficult if not impossible without a bacteriological examination of the intestinal contents. Cerebral manifestations in children suffering from cholera are very common, and their severity is in inverse proportion to the age of the child. Acute meningitis is a very rare disease in Manila, in spite of the statistics to the contrary. The percentage of children attacked by cholera is higher than shown by the statistics of the Bureau of Health.

Further investigation is necessary to demonstrate the relation between "infantile beriberi," "acute bronchitis," "convulsions of children," etc., and cholera in children.

During cholera outbreaks and during June, July and August and September, all acute diseases of children should be reported to the Bureau of Health. A bacteriological investigation of the intestinal contents should be made in every case.

ILLUSTRATIONS.

TABLE I.—*Deaths from cholera and meningitis in Manila.*

Month.	1907. Cholera.	1907. Meningitis.	1908. Cholera.	1908. Meningitis.	1909. Cholera.	1909. Meningitis.
January		23	151	78		33
February		23	11	92	1	32
March		22	5	44		34
April		28		31		27
May		37	1	35		24
June		23	3	45		48
July	2	27	14	93	2	31
August	5	34	48	64	5	40
September	64	53	396	62		
October	65	58	137	54		
November	32	43	30	46		
December	26	50	7	45		

FIG. 1.—Monthly fluctuations of the number of deaths from cholera (solid line) compared with those from meningitis (dotted line).

Table II.—*Deaths from cholera and enteritis in Manila.*

Month.	1907. Cholera.	1907. Enteritis.	1908. Cholera.	1908. Enteritis.	1909. Cholera.	1909. Enteritis.
January		50	151	63		33
February		35	11	42	1	25
March		37	5	45		44
April		49		43		29
May		40	1	37		58
June		53	3	73		81
July	2	81	14	163	2	120
August	5	118	48	144	5	103
September	64	103	396	110		
October	65	60	137	52		
November	32	41	46	28		
December	26	58	7	38		

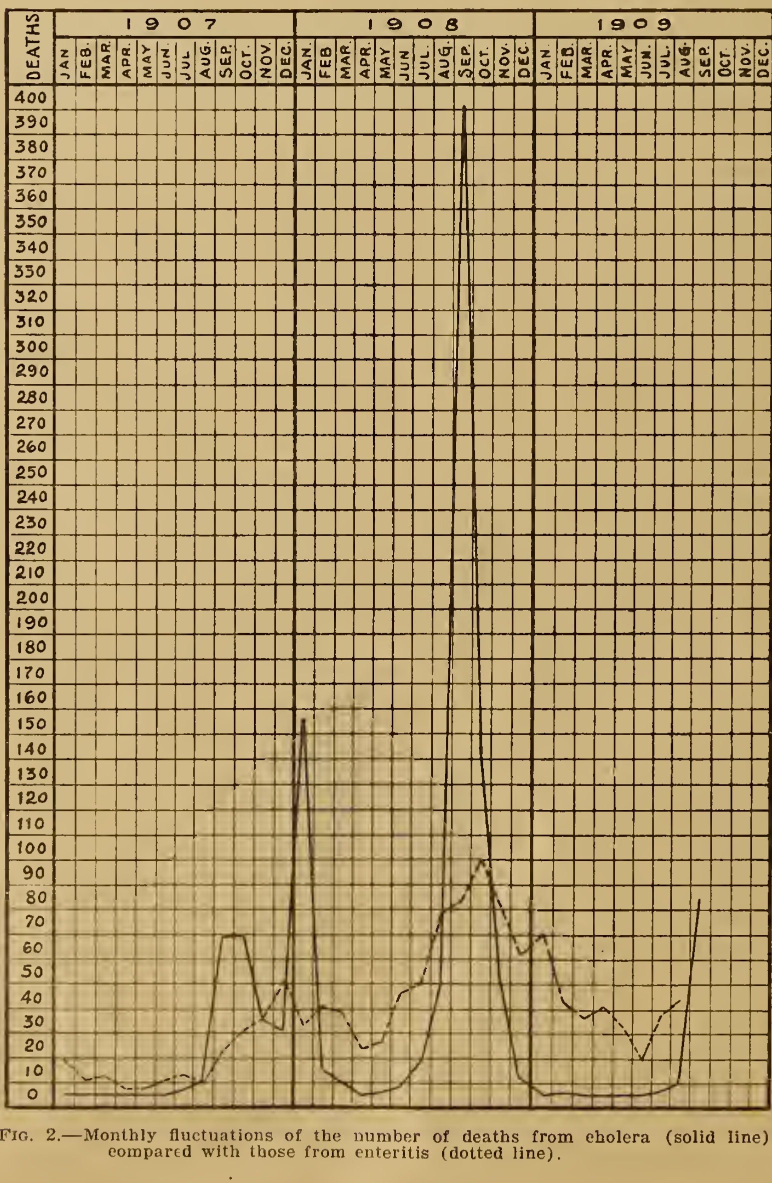


Fig. 2.—Monthly fluctuations of the number of deaths from cholera (solid line) compared with those from enteritis (dotted line).

TABLE III.—*Deaths from cholera and dysentery in Manila.*

Month.	1907.		1908.		1909.	
	Cholera.	Dysentery.	Cholera.	Dysentery.	Cholera.	Dysentery.
January	----------	28	151	52	----------	17
February	----------	13	11	18	----------	13
March	----------	10	5	19	----------	21
April	----------	9	----------	14	----------	16
May	----------	10	1	17	----------	9
June	----------	16	3	24	----------	19
July	2	23	14	64	2	45
August	5	49	48	90	5	31
September	64	59	396	63	----------	----------
October	65	47	137	23	----------	----------
November	32	18	46	17	----------	----------
December	26	31	7	18	----------	----------

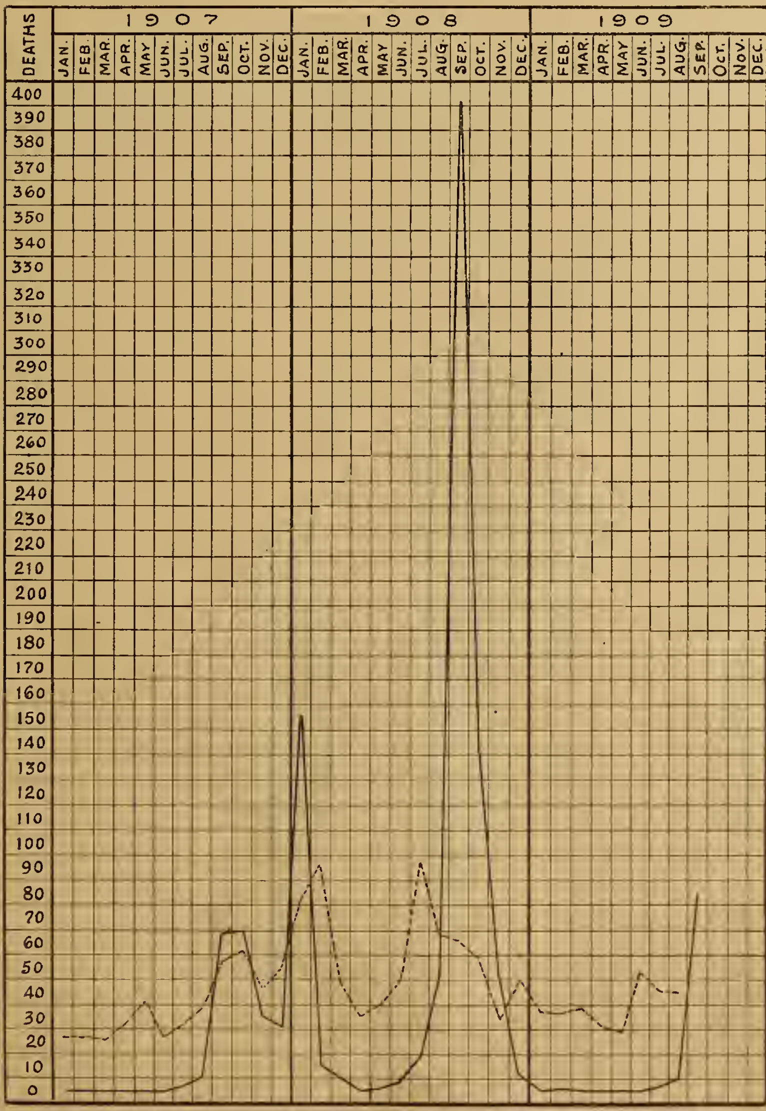


FIG. 3.—Monthly fluctuations of the number of deaths from cholera (solid line) compared with those from dysentery (dotted line).

TABLE IV.—*Deaths from cholera and meningitis, enteritis and dysentery combined in Manila.*

Month.	1907. Cholera.	1907. Enteritis, dysentery, and meningitis.	1908. Cholera.	1908. Enteritis, dysentery, and meningitis.	1909. Cholera.	1909. Enteritis, dysentery, and meningitis.
January	---------	101	151	193	---------	83
February	---------	71	11	152	1	70
March	---------	69	5	108	---------	101
April	---------	86	---------	88	---------	73
May	---------	87	1	89	---------	91
June	---------	92	3	142	---------	148
July	2	131	14	320	2	196
August	5	201	48	298	5	174
September	64	215	396	235	---------	---------
October	65	165	137	129	---------	---------
November	32	102	46	75	---------	---------
December	26	139	7	101	---------	---------

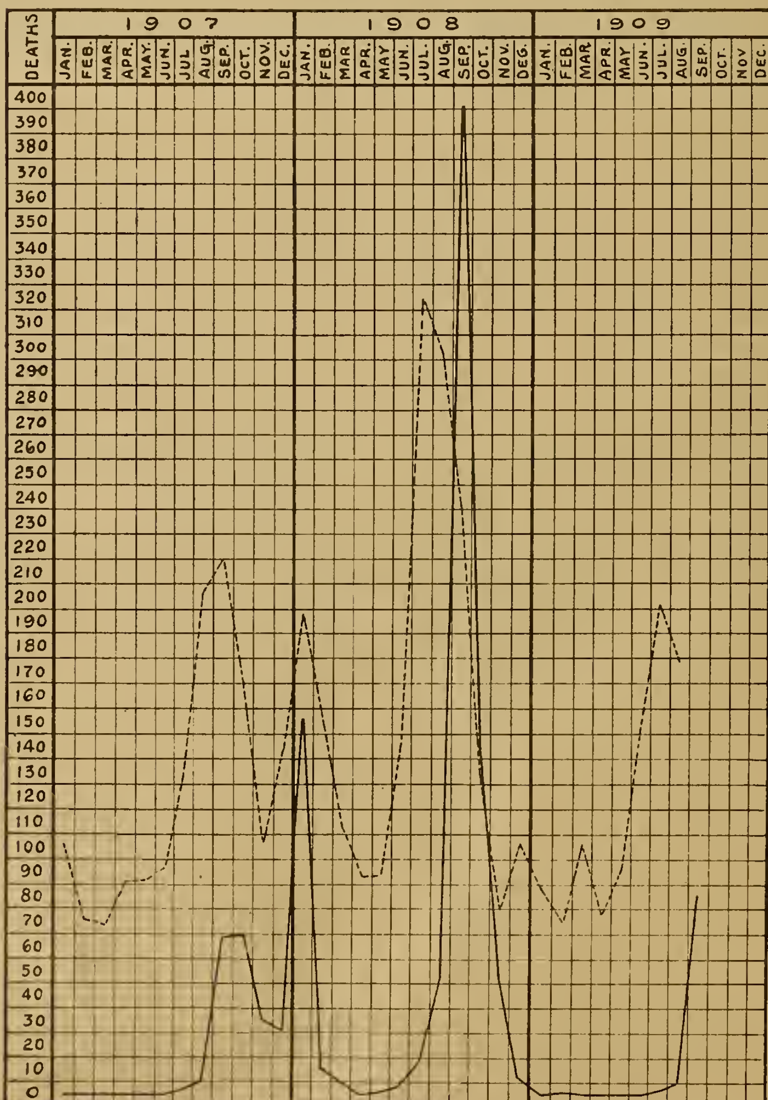


FIG. 4.—Monthly fluctuations of the number of deaths from cholera (solid line) compared with those from meningitis, enteritis and dysentery combined (dotted line).

TABLE V.—*Deaths from cholera and "infantile" beriberi in Manila.*

Month.	1907.		1908.		1909.	
	Cholera.	Infantile beriberi.	Cholera.	Infantile beriberi.	Cholera.	Infantile beriberi.
January	----------	14	151	29	----------	65
February	----------	6	11	36	1	38
March	----------	8	5	34	----------	12
April	----------	3	----------	19	----------	36
May	----------	3	1	22	----------	28
June	----------	6	3	41	----------	15
July	2	9	14	45	2	33
August	5	5	48	74	5	39
September	64	18	396	18	----------	----------
October	65	26	137	95	----------	----------
November	32	32	46	76	----------	----------
December	26	46	7	57	----------	----------

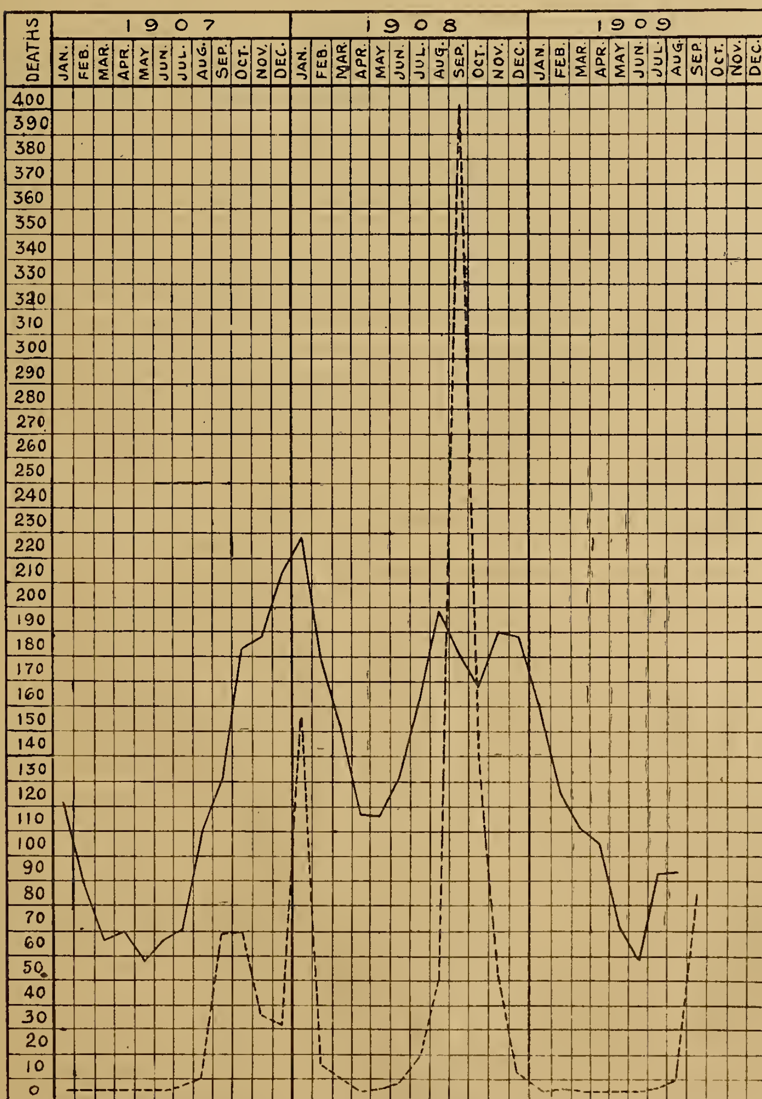


FIG. 5.—Monthly fluctuations of the number of deaths from cholera (solid line) compared with those from "infantile" beriberi (dotted line).

TABLE VI.—*Deaths from cholera and infantile convulsions in Manila.*

Month.	1907.		1908.		1909.	
	Cholera.	Infantile convulsions.	Cholera.	Infantile convulsions.	Cholera.	Infantile convulsions.
January	---------	117	151	223	---------	156
February	---------	84	11	173	1	120
March	---------	61	5	146	---------	106
April	---------	65	---------	112	---------	100
May	---------	53	1	111	---------	67
June	---------	61	3	127	---------	54
July	2	66	14	158	2	88
August	5	105	48	193	5	89
September	64	125	396	177	---------	---------
October	65	178	137	164	---------	---------
November	32	183	46	185	---------	---------
December	26	209	7	183	---------	---------

FIG. 6.—Monthly fluctuations of the number of deaths from cholera (dotted line) compared with those from infantile convulsions (solid line).

OBSERVATIONS ON CATTLE PLAGUE IN THE PHILIPPINE ISLANDS AND THE METHODS EMPLOYED IN COMBATING IT.

By E. H. Ruediger.

(*From the Serum Section of the Biological Laboratory, Bureau of Science*).

A great deal has been written on the subject of cattle plague[1] and the literature is so voluminous that I shall not attempt to review it at this time. All I shall aim to do is to give a brief outline of the more important features of the disease as observed in these Islands and the method employed in combating it here.

Cattle plague is an acute infectious disease characterized by rapid rise of temperature, severe prostration, loss of appetite, hyperæmia of the conjunctivæ, discharge from the nose, violent diarrhœa, and, in the majority of cases, death. The disease is endemic and epidemic, especially in the warmer countries such as China, India, Egypt, other parts of Africa and the Philippine Islands. Many attempts to cultivate and isolate the causative factor have resulted in failure. A number of authors maintain that the organism is ultra-microscopic because it passes through porcelain filters. So far as my own experience with filtered blood is concerned, I feel safe in saying that the filtrate is absolutely harmless when injected into non-immune animals. At any rate, the infectious material present in the blood does not pass through either the Chamberland or the Berkefeld filters.

MODE OF INFECTION.

While the causative factor of cattle plague is as yet unknown, it is generally accepted that infection is conveyed by discharges from a sick animal. Pastures that have been infected by sick animals may remain infected for months or even for years. At times the weather appears to have an influence on the disease. In the Philippine Islands cattle plague nearly disappears during the dry season only to spring up in widespread epidemics soon after the beginning of the rainy season. Cattle kept on high land usually suffer less than those kept on low land. Infected stables, unless well cleaned and disinfected, will remain infectious for a long time. Non-immune animals kept in the vicinity of sick animals

[1] German, *rinderpest;* French, *peste bovine.*

but not coming in actual contact with the latter, may become infected either through attendants who have been in contact with the sick animals, or by the feed or utensils soiled with discharges from them; and the infection may be carried also by birds or flies which eat freely of excreta from the sick animals and then share the food of well animals. Surface water draining from sick toward non-immune animals is sure to carry with it infectious matter. Healthy animals may be infected artificially by mixing discharges from sick ones with the food or water, by directly rubbing discharges into the mouth and nose, or by injecting subcutaneously discharges or blood from a sick animal. After infection has taken place, there is an incubation period varying from two to seven days, rarely longer, before sypmtoms appear.

SYMPTOMS.

In these Islands the disease is usually ushered in by a rapid rise of temperature, the temperature rising 2° or 3° C. within twelve hours. The conjunctivæ are greatly reddened and there is a watery discharge from the eyes and a more or less viscid discharge from the nose. Prostration is severe and there is loss of appetite. Diarrhœa sets in on the third or fourth day after the initial rise of temperatuie. The animal soon passes blood, mucus and portions of the intestinal mucosa, and on about the sixth or seventh day the temperature usually drops rapidly and the animal dies in collapse.

MORBID ANATOMY.

The pathologic lesions vary from discrete ulcers in the stomach and intestines to complete shedding of the mucosa. I have even seen animals pass pieces of intestinal mucosa measuring a meter or so in length, and at autopsy one frequently finds the mucosa completely separated from the remainder of the intestine, ready to be passed off. A large quantity of blood is found in the intestines in such cases. The solid viscera show more or less parenchymatous change. There is no enlargement of the spleen. The mesenteric and other lymph glands are enlarged and hyperæmic.

DIFFERENT FORMS OF CATTLE PLAGUE.

In cattle plague, as in many other diseases, one scarcely ever sees two cases which are alike in all respects, and, for sake of convenience, I will divide the disease as it has come under my observation in the Philippine Islands into the following four forms: Common form, very acute form, afebrile form, and the constipated form.

Common form.—In the common form of cattle plague the temperature rises rapidly, there is discharge from the nose and eyes with reddening of the conjunctivæ, and marked prostration. Diarrhœa sets in on the second or third day, the fæces become bloody and the animal dies in about seven days. At autopsy one finds extensive ulcerations in the mucosa of the stomach and intestines, with occasional shedding of portions of the mucous membrane.

Very acute form.—This form of cattle plague runs a very rapid course. An animal may be apparently well in the evening and be found dead the next morning. Behind the animal a pool of liquid fæces is found with blood and pieces of intestinal mucosa. There is profuse hæmorrhage into the intestines. It would seem that the mucosa is dissected from the underlying tissue by submucous hæmorrhage.

Afebrile form.—Occassionally one sees an animal which appears not to be well, yet has no temperature sufficient to arouse suspicion of cattle plague. The animal loses appetite, has a slight diarrhœa and gradually wastes away in two or three weeks. At autopsy one finds moderate gastro-enteritis without ulceration.

Constipated form.—Although this is a very rare form of the disease, yet in a few instances cattle plague with constipation has been observed. There is rapid rise of temperature, loss of appetite and severe prostration. Death results in four or five days and at autopsy one finds extensive ulcerations limited to the stomach.

ASSOCIATION WITH OTHER DISEASES.

Of the diseases appearing with cattle plague, foot-and-mouth disease occurs most frequently in the Philippine Islands. Although foot-and-mouth disease in itself is not very serious in these Islands, yet when it occurs simultaneously in an animal with cattle plague, the combination proves fatal in nearly every case in spite of the best care and treatment. Other diseases encountered in the Philippine Islands in connection with cattle plague are Texas fever and surra, both of which are very destructive to life.

DIAGNOSIS.

As a rule the diagnosis presents no difficulties, especially in localities frequented by epidemics of the disease. Rapid rise of temperature, loss of appetite, prostration, reddening of the conjunctivæ, discharge from the eyes and nose and diarrhœa are sufficient, when present, to warrant a diagnosis of cattle plague. During an epidemic, sudden rise of temperature alone should justify the diagnosis, for it is of the utmost importance to begin treatment early if the animal is to be treated at all.

PROGNOSIS.

Cattle plague is very destructive to life. Even in localities where it is endemic it may destroy 70 to 80 per cent of the animals attacked. Recovery seems more likely to occur among the younger animals than among the older ones. Ninety-five to 100 per cent of animals from a country entirely free from cattle plague die if brought into contact with the disease.

TREATMENT.

Little or nothing can be accomplished with drugs. The administration of specific immune serum gives good results where treatment is begun early enough. The serum is prepared by hyper-immunizing cattle against the disease. This is accomplished as follows: Blood of an animal sick with cattle plague transmits the disease when injected under the skin of a non-immune animal. If compelled to start without a curative serum, an animal which has spontaneously recovered from the disease is given an injection of 100 cubic centimeters of virulent blood (blood of an animal suffering from an acute form of the disease) under the skin. Within a few days the animal usually sickens, with a slight rise of temperature from which it soon recovers. Having recovered from the effects of the inoculation, the animal receives a larger quantity of virulent blood, and these treatments are repeated until at least 1,000 cubic centimeters have been given at one dose. The process of immunization should not require more than three months' time, and an animal so treated usually furnishes a good protective serum. Once in possession of immune serum, any animal may be immunized by injecting serum and virulent blood simultaneously. Usually from about 50 to 100 cubic centimeters of specific serum are injected under the skin on one side of the animal and from 0.5 cubic centimeter to 1 cubic centimeter of virulent blood under the skin on the other side of the animal. Within a week the animal sickens and goes through a mild attack of cattle plague. Should the temperature rise very high, 41° C. or over, serum treatment should be resorted to. After recovery from an attack of the disease, there is practically no danger of killing the animal by injecting virulent blood. A dose of 500 cubic centimeters may be given without hesitation. The following may be considered a safe procedure in immunizing an animal for curative serum. From about 50 to 100 cubic centimeters (according to the size of the animal and the potency of the serum) of immune serum and from 0.5 cubic centimeter to 1 cubic centimeter of virulent blood are injected simultaneously. I do not fix a rule regarding the exact quantity of immune serum an animal undergoing immunization should receive. Here in the Philippine Islands we have to deal with cattle from China, from India, and from Australia, and with both cattle and carabaos from various parts of the Philippine Islands, some of which are highly susceptible, others but moderately so, others show a considerable degree of insusceptibility, while still others are entirely immune. To be conservative and economical is the best advice I can give.

After the animals have recovered from the first reaction, the following quantities of virulent blood may subsequently be injected: 250, 500, 750 and 1,000 cubic centimeters. Larger doses of virulent blood such as 500, 1,000, 2,000 and 4,000 cubic centimeters may also be given. From seven to ten days after recovery from the effects of the last inoculation the animal is bled three times at intervals of one week. A few days after the third bleeding, the animal is again inoculated with virulent blood, this time one large dose being given, and then bled again three times. This inoculating and bleeding might be continued for years, but, as a rule, the animal is sold after the third series of bleedings, having been bled nine times in all. The blood is collected in sterile flasks or cylinders and allowed to clot, and as the serum separates from the clot it is poured into a sterile vessel. A small quantity of phenol is then added to the serum, after which the serum is passed through a germ-proof filter and is bottled for use.

USE OF ANTICATTLE-PLAGUE SERUM.

The immune serum may be used as a curative agent in animals already infected or it may be used as a preventative. Little or nothing can be accomplished with serum during a virulent attack of cattle plague unless the treatment is begun early. The experience of others and of my self proves that animals which have been sick with the disease for three, four or five days can no longer be saved. Chart No. 1 shows the temperature curve of an animal in which the serum treatment was begun on about the sixth day. I doubt whether life was prolonged even in this case.

Serum treatment begun on the third day of the disease appears to have no effect on the temperature curve nor on the course of the disease. (Chart No. 2.) Even a severe attack of the disease may be brought to a favorable termination when treatment is begun on the first day and when large doses of serum are given. (Chart No. 3.) Protective measures by means of immune serum in experienced hands give far more satisfactory results. The injection of serum alone confers a temporary immunity only, perhaps for not longer than two or three months and hence this method can not be recommended for general purposes other than of temporarily checking an epidemic of cattle plague. In order to accomplish the desired result, the simultaneous method of inoculation must be resorted to as follows: A small quantity of virulent blood is injected under the skin of the animal to be immunized and at the same time an appropriate dose of immune serum is given in some other part of the body. Within a week after inoculation the animal, if susceptible, becomes sick and experiences a mild attack of cattle plague; after which it may be considered immune throughout life. Should the temperature rise high during the reaction, more serum should be given. One-half cubic centimeter of virulent blood suffices for the first inoculation. Even in animals which have received this small quantity of virulent blood, curative measures are frequently resorted to early in the reaction if the temperature rises high. (Chart No. 4.) One cubic centimeter of virulent blood may be given with good result. (Chart No. 5.) After an inoculation with 5 cubic centimeters of virulent blood, the reaction appears to be more severe and larger doses of serum may be required to save the life of the animal. (Chart. No. 6.)

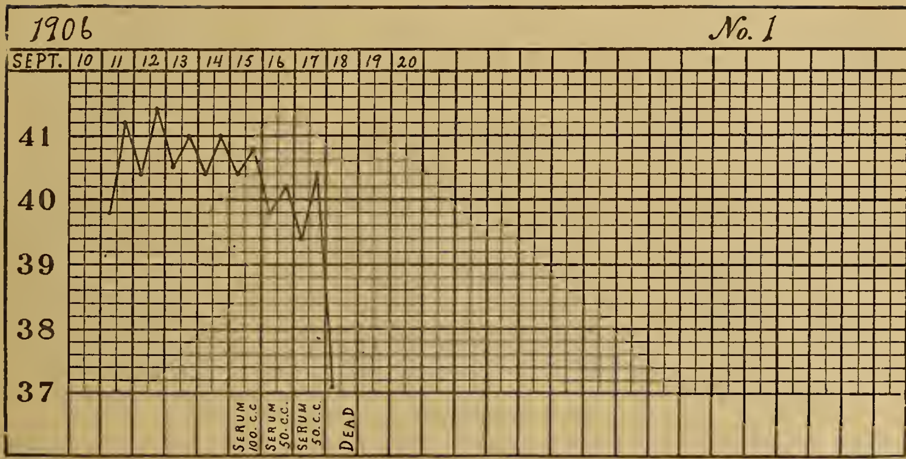
Although the accompanying charts show a more severe reaction after the larger dose of virulent blood, the severity may have been due to other causes, such as individual susceptibility of the animals, difference in the potency of the serum or difference in the virulence of the blood employed.

MANAGEMENT OF THE SERUM STATION.

The methods of immunizing cattle, bleeding them and bottling the serum have already been discussed. One other matter of no small importance is the isolation and care of the non-immune cattle which are to be used for virulent blood. One who is familiar with cattle plague understands readily the ease and rapidity with which this disease spreads. The non-immune animals must be quartered some distance from the infected herd, preferably in a stable screened to keep out the birds and flies which might carry the infection. Persons taking care of the animals should not go near those sick nor should they touch the utensils used around them; and the feed and water of the animals must not become soiled with the discharges. There must be no surface drainage from the sick toward the non-immune animals. The stable should be well constructed and kept in a sanitary condition in order to facilitate disinfection after an accidental outbreak of cattle plague.

Besides the apparatus necessary for the preparation of anticattle-plague serum, equipment for microscopic and bacteriologic work is necessary.

ILLUSTRATIONS.


1906
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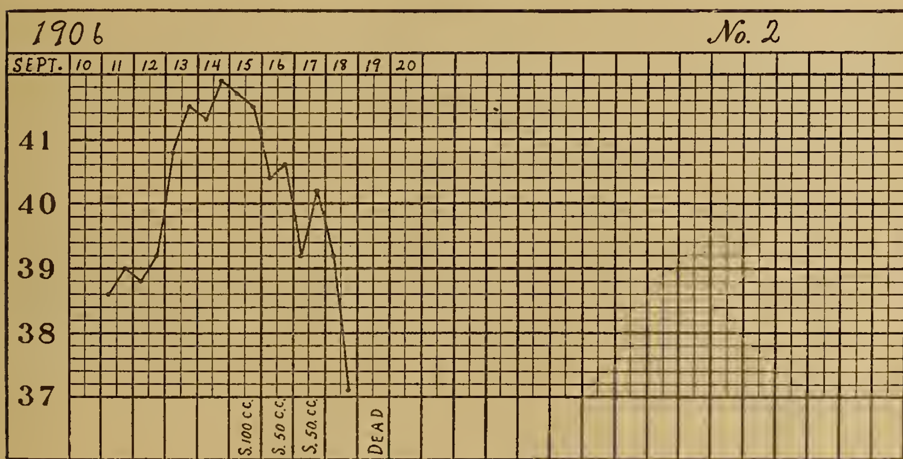
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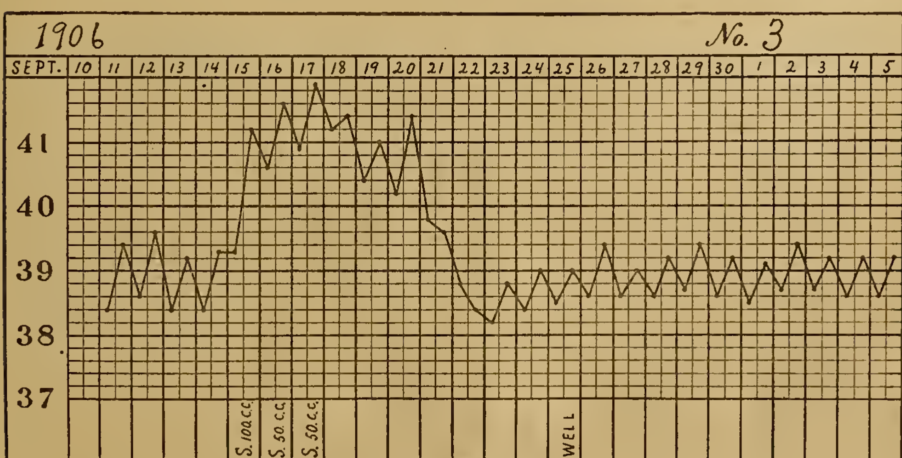
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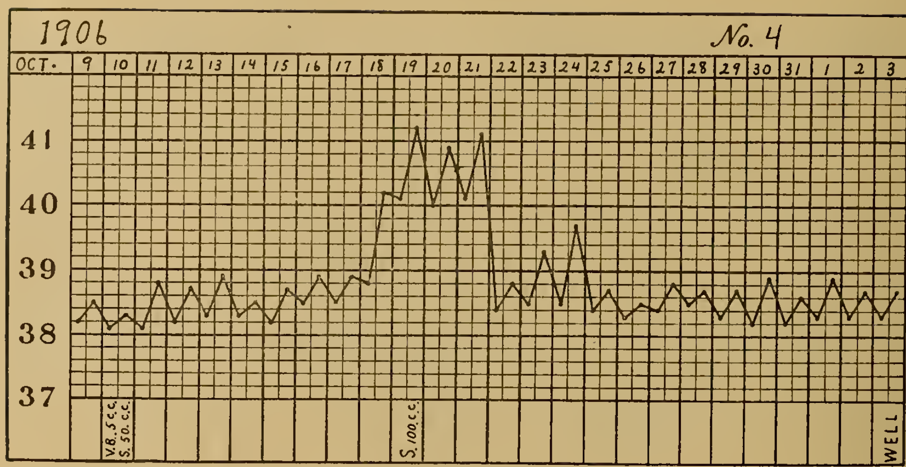
WELL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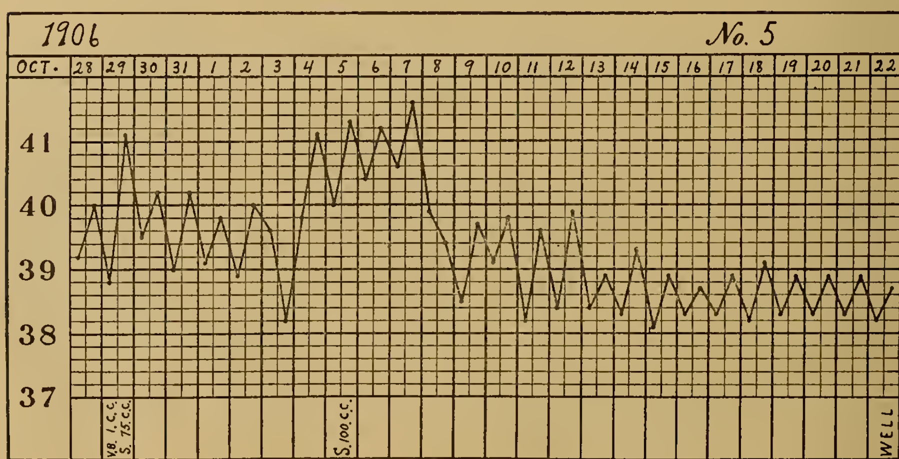
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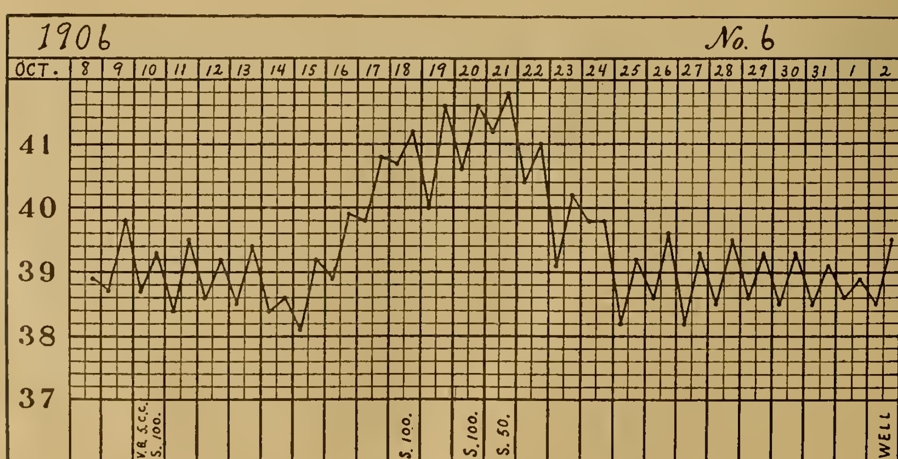
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V.B. 5 c.c.
S. 100.
S. 100.
S. 100.
S. 50.
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B. MEDICAL SCIENCES

Vol. IV DECEMBER, 1909 No. 6

THE SPECIFIC TREATMENT OF CARCINOMA.[1]

(Preliminary Report.)

By Arthur F. Coca and Philip K. Gilman.

(From the Biological Laboratory, Bureau of Science, Manila, P. I., and the Surgical Clinic, Philippine Medical School.)

Since the first experiments by Jensen made in 1903, in immunizing against malignant growths, many investigations have been undertaken on the same subject, in all of which the object of study has been a tumor of some lower animal.

Immunity of greater or less degree has been produced in the mouse, the rat, the dog and the rabbit against many different kinds of tumor; in some instances, however, the attempts to immunize have failed, or have even resulted in an increased rapidity of growth.

It has been found that while the most marked degree of resistance to the development of transplanted tumor cells is called forth by previous inoculation with the protoplasmic substances of the particular tumor under investigation, a good measure of resistance can be produced by the injection of normal tissues, adult or embryonal, provided they be of the same class as the tumor, i. e., epithelial or connective tissue as the case may be. Studies by Ehrlich seemed to show that the induced immunity to tumors in lower animals is not absolutely blasto-specific; but this view has been controverted by Bashford who showed that only the epithelial covering of the embryo, not the rest of the body, could be successfully used in immunizing against epithelial tumors.

[1] To be read before the annual meeting of the Manila Medical Society, January 3, 1910.

Among the more recent investigations upon immunity to tumors, those of von Dungern [2] are perhaps the most significant in their bearing upon the problem of immunization against cancer in human beings.

Von Dungern excised a young, rapidly growing, moderately malignant sarcoma, which had been derived originally from a wild hare, and had been transplanted to the laboratory rabbit, and inoculated with it two groups of rabbits. Group A consisted of normal, i. e., hitherto unused animals; group B had been previously inoculated with an emulsion of an identical tumor derived from another transplant. Among the second group were animals in which the tumor resulting from the first inoculation was still present, as well as animals in which the resulting growth had been excised, or had been spontaneously absorbed, and also animals in which the first inoculation had failed altogether. Although every individual of group A developed large tumors, in not one animal of group B was the second inoculation successful.

Furthermore, the tumors still present in some of the members of group B, which were derived from the primary inoculation, softened after the second injection of tumor material and were converted into sterile abscesses.

The predominant cell found in these softened tumors was the macrophage, which was accompanied by a few lymphoid and plasma cells.

Von Dungern believed that the immunity against the second inoculation was due to the development in the previously inoculated animal of a condition of hypersensitiveness, as a result of which the second introduction of tumor material was met with an exaggerated local inflammatory reaction. He thought he could demonstrate, at the site of the second injection, the presence of nonspecific cytolytic substances which he considered to be produced locally as a part of the exaggerated reaction.

The chief object of all studies upon immunity against cancer is, naturally, the finding of some means by which this fearful disease in human beings may be successfully combated.

While all these experimental results are suggestive in their bearing upon the cancer problem in this restricted sense, none of them correspond strictly with the conditions existing in human beings afflicted with this disease. In man we are dealing with primary growths, whereas in lower animals the experiments have all been made with transplanted tumors.

The all-important problem of cancer research has yet to be solved, namely, is it possible to immunize human beings against their own primary malignant growths? Experiments that throw light upon this question have already been published.

The earliest of these were those of Metalnikoff, who in 1900 demonstrated the production in guinea pigs that had been injected with guinea pig's testicle, of specific antibodies which were capable of destroying the spermatozoa of the same animal. Following these studies, von Dungern and Hirschfeld,[3] after having

[2] *Ztschr. f. Immunitatsf. Orig.* (1909), 2, 391.

[3] *Centralbl. f. Bakt. etc. Ref. Beilage zu Abt. I.* Jena (1909), 44, 57.

excised one testicle of a rabbit and having injected an extract of the organ into the same animal, were able to demonstrate the development, in the treated rabbit, of a condition of hypersensitiveness. According to some experiments of Gorowitz, reported by von Dungern, a condition of hypersensitiveness to the cancer proteids can be demonstrated in the patient bearing the tumor. This condition shows itself in an increased reaction, as compared with that produced by injection into normal individuals, upon subcutaneous inoculation with extracts from the patient's own tumor. No increased reaction could be elicited in these cases by the injection of extracts from the tumors of others.

At first thought it would seem improbable that an organism could be induced to elaborate substances capable of destroying its own tissues. The publications of Metalnikoff, von Dungern and Hirschfeld, and Gorowitz, however, demonstrate just this power. It can still be objected that in the experiments reported by these observers, the injurious effect of the antibodies was exerted not upon the cells of the organs *in situ,* but only when these had been isolated *in vitro.* In reply to this objection, attention may be called to the fact that the normal epithelial cells are separated from the other tissues of the body by a dense basement membrane, the function of which can be to prevent, on the one hand, the entrance into the circulation of the specific epithelial cell products, and, on the other hand, the access to the epithelial cells of any specifically inimical substances carried by the blood. The operation of the latter assumed function would explain the immunity to the destructive action of the complex cytotoxins present in the blood, which is enjoyed by the spermatozoa *in situ,* in the case of the rabbit treated with its own testicular tissue.

Entirely analogous to such a physiological condition is the fact that complement is normally not present in the aqueous humor of the eye.

One of the earliest evidences of beginning malignant change in epithelium is the disappearance of the basement membrane at the point of invasion of the underlying tissue. In the further course of the disease, this peculiarity is maintained, and the tumor cells are thus brought into closer relationship with the blood than were the normal parent cells.

The assumption of a protective function exercised by the basement membranes, taken together with the fact that in all malignant tumors this protective membrane is wanting, would sufficiently explain why the tumor cells in the immunized individual may be destroyed by specific cytotoxins in the blood, whereas the normally situated epithelium is spared.

The experiments of von Dungern upon the sarcoma of the wild hare would seem to stand in direct contradiction to the hypothesis here advanced. It is to be borne in mind, however, that the immunity demonstrated by him against the sarcoma was always against inoculation of tumor tissue taken from another animal, and had in every instance been produced by injections of sarcoma material derived from a similarly foreign source. In most cases the biological relationship between the tissues of the animal to be immunized and that of the sarcoma was a comparatively distant one, and even in the few experiments in which the immunity seemed to be demonstrable in an animal of the same species as the one in which the tumor originated, the material used both for immunizing and for testing the immunity had been growing for some time in a biologically foreign organism.

However, if it is found to be possible to immunize an individual against his own sarcoma, then, of course, the hypothesis here suggested will have to be modified.

Another explanation of this apparently paradoxical phenomenon has been suggested by von Dungern,[4] namely, that the tumor cells may be so altered in biological character from the normal parent cell that the antibodies elaborated against the former may be specifically unrelated to the latter. The superiority of malignant tissue over normal tissue in its power of inducing immunity against tumors would speak in favor of this view.

Theoretical speculations as to the probable outcome of an experiment, while often of value in determining the manner of procedure, are usually less satisfactory than the experiment itself.

In order to immunize a cancer patient against his own cancer, it is necessary, according to our present knowledge of immunity, to inject into his body some of the tumor tissue or an extract from the tissue.

Similar attempts to induce, in human beings, by inoculation an active immunization against their own tumors have already been made. The first of these were reported by von Leyden and F. Blumenthal.[5]

An exact description of the technique of their treatment does not appear in their publication. In none of their cases did they produce a complete cure of the disease, although they believed that in three instances, as a result of the treatment, metastases were prevented, and affected lymph glands reduced in size. These experiments were apparently discontinued.

Von Dungern[6] in his paper, "Untersuchungen uber das Wesen der Immunität gegen Karzinom," read June 4, 1909, in Vienna, stated that such experiments had been instituted in the cancer hospital at Heidelberg, and Ranzi, in the subsequent discussion, referred to his own treatment of a few tumor patients with carbolized extracts of their own tumor tissue. So far as we are aware, neither of these two investigators have made any report as to the results of their treatment.

In our earliest experiments we were apprehensive as to whether we might not reinfect the patient with cancer at the point of injection, and also that large quantities of cancer extract might be directly toxic if

[4] Oral communication.

[5] *Deutsche med. Wchnsch.* (1902), 28, 36.

[6] *Centralbl. f. Bakt.* etc. *Ref. Beilage zu Abt. I.* Jena (1909), 44, 57.

absorbed all at once into the circulation. Furthermore, we feared the possibility of infecting the patients with bacteria with which the material to be used for inoculation might have become contaminated, either before operation, as in the case of any surface growth, or during the preparation of the tissue for injection.

All of these fears have proved groundless. No tumors have appeared at the point of the injection of the cancer material, and in view of the active immunity to the development of the tumor which is called forth by the inoculation of such material, such a contingency need hardly be further considered. Although large quantities, 10 to 15 grams of cancer tissue have been injected, no toxic effect has been observed. Thus far bacterial infection has not occurred. As an antiseptic measure we have found the addition of 1 cubic centimeter of 5 per cent carbolic acid to every 10 cubic centimeters of fluid entirely adequate. The only departure from the rule in this regard was at the first operation, August 14, in Case 7 of group IV. In this instance the tumor material was vigorously shaken with an excess of toluene and left in contact with this disinfectant for about six hours, after which time the toluene was driven off at a temperature of 38°C. By this procedure apparently all the proteids were precipitated. In spite of a large injection of this preparation, recurrence of the tumor followed within four months.

The "vaccine" which we have used in our experiments has been prepared as follows:

The tumor tissue, immediately after excision, is comminuted as far as possible with scissors and passed ten times through a vaccine grinder which has been sterilized by successive rinsing with pure carbolic acid, absolute alcohol, and sterile salt solution. After the first passage through the grinder an equal volume of sterile salt solution is added. By this thorough grinding of the tissue practically all the tumor cells are completely broken up so that the decanted fluid contains all the protoplasmic and nuclear substances of these cells. In order to get rid of the shreds of fibrous tissue the thick, creamy fluid is centrifugated at a high speed for three minutes and decanted.

The injection is made preferably within six hours after the addition of the carbolic acid. If it is reasonably certain that contamination of the vaccine has not occurred, the injection may be made at once without the addition of carbolic acid.

The largest amount of tumor tissue injected at one time was from about 20 to 25 grams. In this instance the tumor contained practically no fibrous tissue, so that almost the entire quantity of the material taken for the "vaccine" could be used for treatment. When such large amounts are injected, they can be distributed conveniently in several (four to six) places in the subcutaneous tissue of the abdominal wall. In some instances we have divided the material into two portions, reserving one for a second treatment three weeks after the first. Whether the material, after three weeks standing in contact with the carbolic acid, still retains its specific biological characters, we do not know. However, the efficacy of a single large injection is amply shown in cases 2, 3, and 4 of group IV.

The degree of local reaction of the tissues to the injections has varied from absolutely none whatever (case of Hodgkin's disease) to abscess formation (two cases of carcinoma). In neither of these latter cases were the ordinary pus organisms found. One was sterile (five cultures having been taken on agar and blood serum) and the other, situated in the subcutaneous tissues of the abdomen and opened four hours after death, contained only *B. coli communis* and *B. proteus vulgaris.*

In one case, following the experiments of Gorowitz, a normal individual received at the same time as the cancer patient the same injection. The local reaction in the control was, if anything, more vigorous than in the patient from whom the cancer tissue was derived. This single experiment, however, can not be considered as contradicting the investigation of Gorowitz, since, in our case, the amount injected was so great as possibly to conceal the small differences that might be evident after the injection of smaller quantities.

We have divided the fourteen cases which form the basis of this preliminary report into four groups in the hope of conveying a clear understanding as to the type of case with which we were dealing in each instance, as to the extent of the effect which the "vaccine" has exerted, and, finally, as to what would have been the probable course of the disease if surgery unaided had been depended upon.. In group I we have included those cases which were considered curable by operation, where the growth and its visible extensions were readily and naturally removable. In group II we have placed those cases probably curable by operation, those in which the removal though possible was more difficult by reason of the infiltrating character of the growth. In group III we have placed those of doubtful curability by operation, those cases where even with radical measures carcinomatous material was probably unavoidably overlooked and not removed. In group IV we have included those positively inoperable tumors, in which the extent of the growth absolutely precluded its complete removal and definite carcinomatous material was seen to remain in the wound.

GROUP I.—CASES CURABLE BY OPERATION.

CASE 1.—No. 7177. Filipino aged 80 years. Ulcerated carcinoma of right forearm with metastases to glands at elbow. Operation May 19, 1909, complete removal of all visible carcinomatous tissue and glands. *Inoculation of cancer vaccine May 19, 1909.* No signs of recurrence on January 3, 1910.

CASE 2.—No. 7419. Filipina aged 39 years. Carcinomatous degeneration of ulcerated fibro-myoma of cervix, with no visible involvement of lymphatics. Operation, pan-hysterectomy, July 5, 1909. *Inoculation of cancer vaccine July 5. 1909.* No signs of recurrence January 3, 1910.

GROUP II.—CASES PROBABLY CURABLE BY OPERATION.

Case 1.—No. 8505. Filipina aged 50 years. Ulcerated buccal carcinoma with metastases to cervical lymph glands. Operation December 1, 1909; complete removal of all carcinomatous material and glands of neck and closed by plastic flap. *Inoculation of cancer vaccine December 1, 1909.* No indications of recurrence have appeared.

Case 2.—No. 8162. Filipina aged 45 years. Medullary carcinoma of right breast with involvement of skin and axillary glands. Operation by Dr. Schiffbauer October 13, 1909. Jackson operation for complete removal of breast and axillary glands. *Inoculation of cancer vaccine October 13, 1909.* Patient was heard from December 28, 1909, at which time there were no signs of recurrence.

GROUP III.—CASES OF DOUBTFUL CURABILITY BY OPERATION.

Case 1.—No. 8197. Filipina aged 44 years. Adeno-carcinoma of left breast with involvement of pectoral muscle, skin, and axillary glands. Operation by Dr. Schiffbauer October 20, 1909. Jackson operation for removal of breast, pectoralis major and minor, and axillary glands. *Inoculation with cancer vaccine October 20, 1909.* Patient was still well on January 3, 1910.

Case 2.—Filipino aged 67 years. Adeno carcinoma of right breast involving, by metastasis, fully one-third of pectoralis major muscle, and the axillary and retroclavicular lymph glands. Operation December 6, 1909; excision of breast, outer half of pectoralis major muscle and majority of axillary glands. *Inoculation with cancer vaccine December 6, 1909.* No signs of recurrence January 3, 1910.

GROUP IV.—POSITIVELY INOPERABLE CASES.

While it is too early to draw any conclusions from any of the above cases the results we have obtained in the cases presented in this group are already of significance.

Case 1.—No. 7052. Filipino aged 51 years. Recurrent carcinoma of right cheek. This patient had been operated upon in the clinic at St. Paul's Hospital and the growth had promptly recurred within three weeks' time, while the patient was still an inmate of the ward. At the second operation only a portion of the growth was removed to use in making a vaccine, as so much tissue had been sacrificed at the previous one, that a plastic operation the second time was impossible. No vaccine treatment had been given at the time of the first operation. *Second operation and inoculation with vaccine were made June 14, 1909.* On December 29, 1909 there were no signs of further growth or recurrence in the cheek, complete healing of carcinomatous areas having taken place, with disappearance of thickening.

Case 2.—No. 8175. Filipino aged 45 years. Carcinomatous cyst of left neck involving, by metastasis, all deep structures including deep vessels, also the overlying skin to a marked degree. Operation November 6, 1909; tumor removed as completely as possible by block dissection of neck; carcinomatous material remained at upper angle of wound, adherent to upper segments of trachea, and to greater corner of hyoid bone. *Inoculation with cancer vaccine November 6, 1909.* Three days after the operation a nodule was noticed at the upper angle of the incision, the nodule measuring 2 centimeters in length and lying about 3 centimeters from the line of incision. The nodule was immovable, hard and lay evidently below the skin. It increased in size until, on the seventh day after the operation, it was distinctly larger and less movable. One week later it had become smaller, softer and more freely movable. At the end of another week—i. e., two weeks after the injection of vaccine—a section extending to the center of the tumor was removed for histologic examination. This showed a dense, thick, fibrous capsule and central reticulum, in the meshes of which were found nests of large cells in all stages of degeneration and necrosis together with invading lymphoid and plasma cells, and macrophages. January 3, 1910; the nodule in the neck has not increased in size, is freely movable, and feels as if it were a mass of scar tissue. Healing is otherwise complete and there are no signs of recurrence.

CASE 3.—No. 8444. Filipino aged 44 years. Carcinomatous cyst of left neck involving structures practically similar to case No. 8175. *Operation and inoculation of vaccine November 23, 1909.* January 3, 1910, neck is completely healed and soft and there are no signs of carcinoma, although at the operation a definite portion of tumor tissue was left adherent to the sheath of the vessels and to the horn of hyoid bone.

CASE 4.—No. 8326. Filipina aged 71 years. Advanced carcinoma of left buccal mucosa involving entire cheek and, by extension, the side of the neck. Operation November 10, 1909; removal of as much tumor as possible and left half of lower jaw; block dissection of the neck. Carcinomatous tissue remained unexcised at the base of the tongue and left pillar of fauces. *Inoculation of vaccine November 10, 1909;* death from intercurrent affection December 18, 1909. At autopsy absolutely no sign of malignant tissue was found locally or anywhere in the body, the unexcised portions of malignant tissue having disappeared from the base of the tongue and from the pillar of fauces.

CASE 5.—No. 8442. Spaniard, male, aged 40 years. Carcinoma springing from some deep epithelial structure of right upper neck, involving all deeper structures, parotid and submaxillary glands, and overlying skin. At the operation December 7, 1909, it was found impossible to remove all of the malignant tissue. In addition to a mass surrounding the great vessels, two large nodules, measuring about 2.5 by 3 centimeters were left superficially, one posterior to and below the angle of the jaw and the other in the region of the submaxillary gland extending outward to the level of the cheek and upward behind the jaw toward the base of the tongue.

Injection of vaccine was made December 7, 1909. On the seventh day thereafter the first nodule was found to be converted into a soft, fluctuating area suggesting a pocket of pus, although lacking all signs of inflammation. The wound had healed cleanly by first intention. This fluctuating area opened spontaneously through a small passage left by a stitch opening. Cultures taken from the contents the next day showed *Staphylococcus aureus* and *albus*. Under simple dressings the area has healed and the nodule has entirely disappeared. The second nodule in the submaxillary region has grown gradually smaller and less board-like until to-day, January 3, 1910, it has almost disappeared and the skin and superficial structures, excepting in one small area, have become normally soft. The patient is able to swallow with much greater ease than he could before the treatment. He is still in the hospital under observation.

CASE 6.—No. 8233. Filipino aged 49 years. Fungating carcinoma involving practically the whole of the right neck in its lower half and extending behind clavicle. First operation October 30, 1909, at which time apparently the entire growth was removed. No treatment by vaccine was given as the material was spoiled. There was a prompt local recurrence within a week.

The second operation was performed when sufficient amount of tumor had grown to supply material for making the vaccine. Only the most superficial portions of the fungus were scraped away as the patient was in very bad condition. At this time a tumor of the right shoulder was observed, which had previously escaped notice. This mass extended over the entire shoulder so that the contour was not very markedly altered. This shoulder mass grew rapidly within the next five days and was hard and brawny; the overlying skin became infiltrated and roughened and the arm œdematous.

On the seventh day after treatment with the vaccine there was noted a marked local disturbance in the shoulder. The skin temperature of the carcinomatous area was markedly increased above that of the rest of the body, which was normal. The tumor was painful, the skin darker and congested, and the entire mass distinctly softer.

The following day, the eighth after treatment, the temperature difference was less marked, the pain less, and the softening more pronounced, amounting almost to fluctuation. Under cocaine anæsthesia the shoulder was incised for the purpose of obtaining material for microscopic and bacteriologic examination. Cultures remained sterile; smears showed the presence of only a small number of polymorphonuclear leucocytes, and large numbers of epithelial-like cells. Sections of the excised tissue showed typical carcinomatous growth identical with that of the original tumor. Several recurrent masses along the upper portion of the neck wound had, during this period, undergone softening and atrophy. The main wound remained clean and free from recurrence, the edges had advanced a centimeter and a half toward the center by a growth of apparently healthy epithelium and a large carcinomatous mass left behind the clavicle became markedly discolored and shrank perceptibly in size. The patient died four days later. Autopsy showed a tumor mass in the mediastinum that had not been noted, and the cause of death to have been hydropericardium, right hydrothorax, and œdema of the left lung.

Cases 7 and 8.—Nos. 8405 and 8497. These cases are under treatment at present. In each of them, large masses of carcinoma, involving the bladder and ureters, the rectum, and pelvic fasciae, were present and only portions were removed for making a vaccine.

Too short a time has elapsed to make it possible to anticipate the effect of the treatment upon the course of the disease. In cases 7 and 8, however, this much can be said: in each of the cases the marked cachexia that was present before the treatment has entirely disappeared.

The disappearance of the cachexia, which was noted within three days after treatment, must be looked upon as a remarkable phenomenon. According to all theories hitherto advanced in explanation of tumor cachexia, the injection of large quantities of tumor material should have increased rather than diminished the symptoms.

The experiments of Gorowitz, together with those of Friedberger dealing with the nature of anaphylaxis, seem to offer the most satisfactory basis of explanation for the cachexia of malignant tumor. Gorowitz has demonstrated in cancer patients a condition of hypersensitiveness to the cellular substances of their own tumors. This condition was absent in normal individuals. We are forced thus to conclude that sufficient quantities of the tumor cell substances enter the circulation to produce in the body the condition referred to.

Friedberger,[7] on the basis of strong experimental evidence, believes that the injurious effects of the second injection, in the condition of anaphylaxis, are due to the entrance into the sensitized cells of the previously treated animal's body, of its own complement. This entrance of complement follows the union of the antigen, introduced at the second injection, with the specific antibodies which are present in the sensitized cells.

The mechanism, therefore, of production of the tumor cachexia, according to the experimental data at our disposal, would be, first, the establishment of a condition of hypersensitiveness to the epithelial substances of carcinomata due to the absorption of these materials in small quantities; secondly, the continual entrance of complement into the sensitized cells as a result of the constant absorption of tumor material.

According to this conception, the disappearance of the cachexia following the injection of large quantities of tumor substance is to be looked upon as corresponding with the condition known as the state of antianaphylaxis.

The introduction of the large doses of tumor material results in the formation of an excess of antibodies which are then thrown out into the circulation. The absorption of these antibodies by the tumor cells transfers the scene of injurious complement activity from the normal cells to the malignant ones.

As already implied, the assumption of von Dungern that the immunity against malignant growths is due to a local reaction of hypersensitiveness, does not seem satisfactorily to explain the results obtained by us in the foregoing experiments. These, we believe, may be best explained by assuming the formation of antibodies in excess, their transportation to the malignant cells by the serum and the resulting destructive action upon these cells of the patient's own "complement."

If this is true, the rational treatment of those cases in which large tumor masses have to be left in the body would be the successive injection at intervals of two weeks (at the end of which time the available antibodies will have been used up) of large quantities (5 to 10 grams) of tumor material. The ideal method of preserving the tissues for this purpose is by freezing.

In only one of the cases of carcinoma in the region of the neck in group IV was the carotid artery ligated, case No. 8326. At autopsy thirty-nine days after operation the carotid in this case was found to be patent.

Only one case of malignant growth other than carcinoma has come to treatment, a very advanced case of Hodgkin's disease. This case was apparently uninfluenced by treatment.

[7] *Ztschr. f. Immunitätsf. Orig.* (1909) I, 2, 208 *Ibid* (1909), 3, 581, 692.

Our thanks are due Dr. John R. McDill, Professor of Surgery, Philippine Medical School, who has placed at our disposal all cases of malignant disease admitted to his clinic since we began this work.

SUMMARY AND CONCLUSION.

1. The protoplasmic substances of malignant epithelial tumors in human beings can be injected subcutaneously in large quantities without injurious results.

2. In three cases affected with carcinoma, such injections have been followed by the softening and disappearance of tumor masses measuring in diameter from 2 to 4 centimeters.

In a fourth case, a rapidly growing lump appeared near the site of the excised cancer two days after treatment. Several days later, when the lump had reached a diameter of 4 centimeters, the growth ceased and subsequent microscopic examination showed it to be a firmly encapsulated mass of dying epithelial-like cells.

Three other surgically absolutely inoperable cases, in two of which visible amounts of cancer tissue were left unexcised, have remained until now, i. e., for from five weeks to six months, free from recurrence of the disease.

Seven other cases have remained free from a return of the disease for from one to seven months. Two of these were designated as "curable by operation;" three were designated as "probably curable by operation;" and two were designated as "of doubtful curability by operation."

In only one case has the disease returned after treatment. In this case the material used for vaccination was rendered inert by too vigorous disinfection.

Hitherto no case of sarcoma has come to treatment; however, in view of the failure of the procedure to affect the course of Hodgkin's disease, the outlook for sarcoma is not promising.

3. Tumor cachexia is not increased by the rapid absorption of large quantities of tumor tissue; on the contrary, large injections of tumor material seem to cause the disappearance of the cachexia.

While this paper was in press further experiments seem to indicate;

(1) That the efficacy of the treatment is *indirectly* proportional to the amount of malignant tissue left in the body, and, within certain limits, *directly* proportional to the amount of tumor-cell substances injected and to the number of such injections made.

(2) That a carcinoma in one individual can be successfully treated with injections of material from a carcinoma of the same kind taken from *another* individual.

(3) That one-half per cent of carbolic acid does not destroy the "vaccine" within thirty-six hours if the latter is kept at a temperature of 7° centigrade.

NOTE.—No attempt has been made in this preliminary article to consider the results of all of the experimental work performed on animals with transplanted tumors, notably among which may be mentioned those obtained by Gay, *Journ. Med. Research* (1909), 20, 175, *Boston Med. Surg. Journ.* (1909), 161, 207. All of the work will be referred to in the more complete paper to be published later in this Journal.

CO-EDITOR.

THE CULTIVATION OF THE LEPROSY BACILLUS.

By Moses T. Clegg.

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At the Sixth Annual Meeting of the Philippine Islands Medical Association which was held at Manila, February 11, 1909, I made a preliminary report [1] upon the cultivation of the *Bacillus lepræ*. In this report I stated that I had succeeded in cultivating, from the spleen and skin nodules of typical cases of leprosy, an acid-fast bacillus which grew upon agar in symbiosis with amœbæ. The amœbæ had been obtained from a dysenteric stool and were cultivated with the cholera vibrio.

At the time of the first publication, the acid-fast organism had been obtained in symbiosis with amœbæ from the spleen in two cases and from skin nodules in three other cases of leprosy, but had not been isolated in pure culture. Since then similar cultures have been obtained from leprous tissue in three additional cases and from two of these the acid-fast organism has finally been isolated in pure culture.

In continuing the work of cultivation I have used the same technique described in the preliminary report, always making the original inoculations from the leprous tissues upon cultures of amœbæ with the cholera vibrio.

Among the sources of experimental error which were mentioned in the previous communication was the possibility that the acid-fast organism had been growing originally with the amœbæ in the human colon. In order to rule out this possible source of error amœbæ obtained from a different source than those used in the first experiments, namely, from the tap water, have been cultivated with the cholera vibrio and these cultures used for the original inoculations with leprous material.

No acid-fast bacteria have been found in the cultures of the water amœbæ excepting after inoculation with material from a case of leprosy, so that the source of error under discussion can be excluded. Furthermore, since the cultivation of the acid-fast organisms has been successful with amœbæ obtained from a case of dysentery as well as those from tap water, it is not probable that any importance attaches to the strain of amœba used. It is important, however, for the successful cultivation

[1] *This Journal, Sec. B* (1909), 4, No. 2, 77.

of the acid-fast organism to have a good growth of amœbæ for the original inoculations.

In the cultivation of amœbæ the following medium, as described by Musgrave and Clegg,[2] was used:

Agar	20.
Sodium chloride	3.0
Extract of beef	3.0
Water	1,000.

This is prepared in the same manner as ordinary nutrient agar, the finished product being made 1 per cent alkaline to phenolphthaleïn.

The medium is placed in tubes and sterilized. Before inoculating with the material containing the amœbæ the medium is melted and poured into sterile Petri dishes and allowed to harden. The material containing the amœbæ is then streaked over the surface of the plate. In cultivating amœbæ from water and other external sources, 100 to 500 cubic centimeters of water, or the same amount of an aqueous solution or suspension of other substances is collected in sterile flasks to which is added 1 cubic centimeter of alkaline bouillon for every 100 cubic centimeters of the sample. The flask is then set aside for from twenty-four to forty-eight hours, when an examination will usually show the presence of amœbæ on the surface of the liquid. A loop of this culture is then streaked over the plates already referred to. The plates are then kept at a temperature not to exceed 37° C. The temperature used for incubation must be regulated according to the growth of the symbiotic bacteria; if the latter are found to grow so profusely at a given degree as to interfere with the development of the amœbæ, then a lower temperature must be used. After incubating twenty-four to forty-eight hours the amœbæ may be detected by examining the plates under the low power of the microscope. After two or three days' growth of the amœbæ upon agar, transplants are made to fresh plates of the same medium. When a suitable growth of the amœbæ and a mixed culture of bacteria has been procured, the next step necessary is the isolation of the amœba with one kind of bacteria. This may be accomplished in the following manner: The sterile medium for cultivating amœbæ is melted and poured into sterile Petri dishes and allowed to harden. With a platinum loop several rings of a pure culture of the organisms with which it is desired to grow the amœba are made on the surface of the hardened agar, and a small smear inoculation of the mixed culture of the amœba is placed on the middle of the smaller or central bacterial ring. If the usual precautions have been taken, most amœbæ, as they multiply, will generally spread rapidly over the plate and, in passing through the bacterial rings, will lose to a certain extent the bacteria with

[2] *Pub. P. I. Bur. Sci. Biolog. Lab.* (1904), No. 18, 9–78.

which they started and take up those forming the rings. In from twenty-four to forty-eight hours the amœbæ will have passed to the outer ring and from this location they may be taken for transplantation to fresh ringed plates with a medium suitable for their growth, the same procedure being repeated until by plating it is shown that the amœba is growing only with the bacterium desired. In continuing the work on the cultivation of the leprosy bacillus, as has been mentioned, an amœba was used which had been isolated from the city water supply and was growing in symbiosis with the cholera vibrio.

The mixed culture of the amœba and the cholera vibrio was inoculated on slant tubes of plain sterile agar-agar without the beef extract, but containing the same amount of sodium chloride and having the same reaction as the amœba medium previously described—and after twenty-four hours' growth of the mixed culture on this medium, material containing leprosy bacilli was added; at the same time control inoculations of the leprous material were made upon the same medium without the amœba and the cholera vibrio. The tubes were incubated for one week at 37°, at the end of which period examination showed an increase in numbers and change in morphology of the acid-fast bacilli in three of the amœba cultures, whereas on the plain agar these bacilli had changed neither in number nor in morphology.

After having been transplanted once a week upon amœba-cholera cultures for six weeks in one case and three months in another, the acid-fast organisms were obtained in pure culture by heating; in this manner the cholera vibrios and amœbæ were killed by a temperature of 60° C. for half an hour, while the acid-fast bacilli survived and grew readily alone, when transplanted.

The acid-fast organism was obtained from the two following cases:

Case F.—A well-marked case of tubercular leprosy. The autopsy was performed three hours after death. The lungs showed the presence of tubercular cavities and extensive adhesions to the chest wall. No lesions of tuberculosis were found in the other organs. The spleen was removed under aseptic conditions by the following method: A flap of the skin on the left side covering an area extending from the median line to the vertebral column and from the axilla to the crest of the ilium was removed. Alcohol was then poured over the muscular layer and burned, after which the peritoneal cavity was opened with sterilized instruments and the spleen removed and placed in a sterile vessel. Cultures were then made in the usual way, after first burning the capsule of the spleen and puncturing it with a sterile knife.

Ten tubes, each containing a 24-hour growth of amœbæ and the cholera vibrio, were inoculated with the splenic pulp as were also ten control tubes containing sterile agar. All the tubes were placed in the incubator and kept at a temperature of 37° C. for seven days. At the end of this period smears from the tubes containing the mixed culture of amœba and cholera vibrio showed, when stained by the Ziehl-Neelson method, a change in the morphology and a multiplication of the leprosy bacilli, while smears made from the control tubes stained in a similar manner showed no evidence of a multiplication of the bacilli inoculated and no noticeable changes in morphology. Transplants of the mixed cultures of amœba, cholera and leprosy bacilli were made to fresh agar tubes and incubated at the same temperature. Smears from these tubes made three days later and stained as before showed a great increase in number of the acid-fast bacilli and also a change in their morphology from the long, slender bacilli found in smears from leprous lesions to short plump rods and occasionally coccus forms. This deviation in morphology is not constant, however, on continued cultivation; some cultures have resumed a more typical morphology, as is shown in the illustrations. (Plate I, fig. 1.) Transplants of the mixed cultures were then made once a week for three months. After having been on the artificial medium for this length of time, the cultures were placed at a temperature of 60° C. for thirty minutes. This temperature was sufficient to kill the amœbæ and the cholera vibrios, but not the acid-fast bacilli. Transplants were made from the heated cultures to fresh tubes containing amœbæ and cholera vibrios and also to tubes containing plain, sterile agar. After three days' incubation, smears from the tubes containing the amœbæ and cholera vibrios showed a development of the acid-fast bacilli, and at the end of six days small, brownish colonies with regular margins appeared on the surface of the tubes containing plain agar only. Smear preparations made from these colonies and stained by the Ziehl-Neelson method showed microscopically an acid-fast bacillus, the cultural characteristics of which will be described in another part of this paper.

Case G.—This was a well-marked case of tubercular leprosy. The autopsy was performed two hours after death. A small nodule was present in the apex of the left lung which might have been of tubercular origin; there were no evidences of gross tubercular lesions in the other organs. The spleen was removed in the same manner as described in Case F. Smear preparations from the spleen stained by the Ziehl-Neelson method showed very few leprosy bacilli. Cultures were made on media containing amœbæ and cholera vibrios and on plain sterile agar. Because of the small number of leprosy bacilli present in the spleen, a large nodule situated in the thigh and containing large numbers of the organism was also selected for use in making the inoculations and was excised. In making the cultures the surface of the nodule was first burned with a hot spatula and an opening made with a sterilized scalpel.

Ten tubes containing amœbæ and cholera vibrios were inoculated with material taken from the center of the nodule, as were also ten tubes containing plain agar. All these cultures, together with several tubes containing amœbæ and cholera vibrios, but not inoculated with leprosy material, were placed in the incubator at a temperature of 37° C. At the end of six days smear preparations from two of the tubes containing amœbæ, cholera vibrios and material from the nodule showed a change in morphology and an evident multiplication of the leprosy bacilli.

All other tubes, including those made from the spleen, were unchanged and remained so. Transplants were made from the two tubes showing a growth of the leprosy bacillus with the amœba and the cholera vibrio, to fresh agar tubes and kept at the same temperature. Smear preparations made at the end of the third day showed a great increase in the number of the acid-fast bacilli and the same change of morphology as was observed in the previous case. Negative results were obtained in transplants from both sets of control tubes, namely, from those containing amœbæ and cholera vibrios, but no leprosy material, and from those containing plain agar inoculated with material from the nodule. The tubes which contained amœbæ and cholera vibrios and which were inoculated with the splenic material were also negative. Weekly transplants were then made from the two tubes showing a growth of the acid-fast bacillus with the mixed culture of amœba and cholera. After having been growing in this mixed symbiosis for six weeks, these cultures were subjected to a temperature of 60° C. for thirty minutes, and as in the previous case, the acid-fast organisms were obtained in pure culture.

Case H.—A mixed type of leprosy. The autopsy was performed three hours three hours after death. The lungs showed tubercular lesions, but there was no evidence of tuberculosis in the other organs.

The spleen was removed by the method described in Case F and cultures were made in a similar manner. Smear preparations made from this spleen showed a small number of leprosy bacilli present. After three weeks' incubation smear preparations from the cultures showed no change in the morphology of the leprosy bacilli inoculated and no evidence of growth.

Case I.—A well-advanced case of tubercular leprosy. The autopsy was performed twenty-four hours after death. The lungs showed the presence of tubercular lesions; there was no evidence of other tuberculous lesions in the body. The spleen was removed aseptically and cultures were made on media containing amœbæ and cholera vibrios and also on media composed of plain sterile agar. After six days' incubation a slight growth was observed in one of the tubes containing the amœbæ and cholera vibrios. No development occurred, however, in transplants from this tube.

CULTURAL CHARACTERISTICS.

The separation of the acid-fast bacilli from the amœbæ and cholera vibrios was accomplished, as already indicated, in a very simple manner; viz, by killing the two latter organisms by subjecting the mixed cultures for half an hour to a temperature of 60° C. At this temperature the acid-fast bacteria are not killed in the first half hour.

From these heated cultures transplants were made upon amœba-cholera cultures and upon plain agar slants without the amœbæ. In both cases a growth of the acid-fast organisms took place.

Cultures were made from these original pure colonies upon ordinary nutrient agar, plain agar, potato, alkaline litmus-milk, glucose-agar, glycerine-agar, Loeffler's blood serum, lactose-agar, Dorsett's egg medium, glucose-bouillon and glycerine-bouillon. The optimum temperature for growth was 37° C.; growth will take place at a lower temperature, but more slowly.

Surface colonies on nutrient agar.—These colonies when they first become visible are raised and possess smooth edges. They measure about 1 millimeter in diameter, are compact in appearance and, under the low power of the microscope, show a brownish pigment which is more plentiful in the center of the colony than at the periphery.

Nutrient agar stroke.—A slightly raised, moist growth appears after three days, producing a brownish-yellow pigment.

Plain agar stroke.—Growth appears after three days as slightly raised, discrete colonies, which later become confluent and moist, producing a bright orange pigment.

Potato.—After three days a raised, moist, creamy growth appears, producing a bright orange pigment. No change in the medium occurs.

Alkaline litmus-milk.—Growth occurs on the surface of the medium as a yellow membrane. The milk gradually loses its color, but does not become acid. A sediment is deposited at the bottom of the tube.

Glucose-agar stroke.—An abundant growth appears on the third day as a raised smooth moist surface with a bright orange pigment. The growth can be lifted in heaps on a platinum loop and may be readily suspended in an aqueous solution.

Glycerine-agar stroke.—Growth is similar to that on glucose agar. It may develop from a single stroke to such an extent that the entire surface of the medium is covered, giving the appearance of a heaped-up creamy substance. The growth is not adherent to the medium.

Loeffler's blood serum.—Growth is slower on this medium. It is slightly raised and moist, and very little pigment is produced. Liquefaction begins in ten days and is complete in twenty days.

Glucose stab.—Very little growth occurs along the needle tract. It is profuse on the surface of the medium.

Lactose stab.—Growth is similar to that in glucose stab. No change in the reaction of the medium occurs.

Dorsett's egg medium.—Growth is profuse on this medium after three days. The appearance is similar to that on glycerine agar.

Glucose-bouillon.—Growth appears as small patches on the surface of the medium. These later coalesce and form a wrinkled membrane. A sediment gradually forms at the bottom of the tube. The medium remains clear.

Glycerine-bouillon.—Growth is similar to that in glucose bouillon.

Fermentation tubes showed no production of gas, nor were acids formed in dextrose and lactose bouillon.

Resistance to heat.—Suspensions of the cultures in salt solution were not killed when exposed to a temperature of 60° C. for thirty minutes. They were killed when exposed to the same temperature for sixty minutes.

The microörganism isolated from the nodule in the thigh of Case G is identical in its cultural characteristics with that isolated from the spleen in Case F.

BACILLUS FROM CASE F.

Morphology.—The length of the organisms varies from 1 to 5 microns. Stained with the method of Ziehl-Neelson, the shortest forms are colored uniformly throughout, as are also many of the long ones. In many instances, however, certain portions of the body of the bacteria are more deeply stained than the remaining ones. Sometimes, especially in the younger cultures, the center of the organism stains more deeply than do the poles, which may be only very faintly colored. Other individuals present a beaded appearance due to the alternate arrangement throughout the body of deeply and lightly stained areas. Finally, a few forms were found in which the deeply stained portions were situated in the poles.

Various shapes have been seen. Some of the very smallest approach the form of a coccus. The majority of the young bacteria are straight or slightly curved rods. Long, slim forms are also encountered. No true branching was observed and spore formation was absent.

The character of the morphology is influenced considerably by the nature of the medium upon which the organism is cultivated. The bacillus is nonmotile.

Staining reactions.—Smear preparations from cultures of all ages of the microörganism stain very faintly with the ordinary alkaline stains. Preparations made from young cultures when stained with hot carbol-fuchsin do not lose the stain when treated with Gabbet's solution. They also retain it after being washed continuously for three minutes in absolute alcohol. When treated for two minutes with a 5 per cent solution of hydrochloric acid in alcohol, a large number lose the fuchsin stain; there are others, however, which are not affected by this decolorizing agent.

Older cultures are more susceptible to the acid-alcohol decolorizing agents. Preparations from a three month's old culture stained with the carbol-fuchsin solution were readily decolorized when treated with hydrochloric acid and alcohol, while smears from the same culture similarly stained and treated with Gabbet's solution or with absolute alcohol retained their color.

The bacilli in smear preparations, from lesions in guinea pigs, are acid fast when treated with hydrochloric acid-alcohol solution. Preparations from cultures of all ages were Gram positive in portions. By this method of staining the central portions of the bacilli retain the stain to a greater degree than do the poles.

A résumé of the successful cultures including those reported in the preliminary paper follows:

Bacillus A.—An acid-fast bacillus cultivated from the spleen of a leper and growing in symbiosis with *Amœba dysenteriæ* and several other varieties of bacteria.

Bacillus B.—An acid-fast bacillus cultivated from the spleen of a leper and growing in symbiosis with *Amœba dysenteriæ* and a number of unidentified bacteria.

Bacillus C.—An acid-fast bacillus cultivated from the nodules in the ears of a leprous patient and growing in symbiosis with amœbæ and a number of unidentified bacteria.

Bacillus D.—An acid-fast bacillus cultivated from the nodules in the ears of a leprous patient and growing in symbiosis with *Amœba dysenteriæ* and a number of unidentified bacteria.

Bacillus E.—An acid-fast bacillus cultivated from the nodules in the ears of leprous patients and growing in sympiosis with *Amœba dysenteriæ* and a mixed variety of bacteria.

Bacillus F.—An acid-fast bacillus cultivated from the spleen of a leper and growing in symbiosis with an amœba isolated from water, and with the cholera vibrio, obtained in pure culture and transplanted repeatedly on various culture media.

Bacillus G.—An acid-fast bacillus cultivated from a nodule in the thigh of a leprous subject and growing in symbiosis with a water amœba and cholera vibrio and in pure culture.

ANIMAL EXPERIMENTS.

Monkey No. 4440 (*Cynomulgus philippinensis* Geoff.) was inoculated subcutaneously with a suspension of four loops of a ten-day culture of Bacillus A, *Amœba dysenteriæ* and a variety of unidentified bacteria.

The animal died three months later and the autopsy showed no evidence of leprosy or of tubercular lesions.

Guinea pig No. 4484 was inoculated in the peritoneal cavity with one loop of a ten-day growth of Bacillus A, *Amœba dysenteriæ* and symbiotic bacteria. The animal died five weeks later from lobar pneumonia. The autopsy showed no evidence of leprosy, or tuberculosis.

Guinea pig No. 4485 was inoculated subcutaneously with a suspension of one loop of a ten-day culture of Bacillus A, *Amœba dysenteriæ* and symbiotic bacteria. Five weeks later it was found in a dying condition and was chloroformed. Autopsy showed hæmorrhagic areas located on the extremities, chest and abdomen. There was markedly œdematous tissue surrounding the joints. The heart was covered with small petechial hæmorrhages. All the vessels were injected. The lungs were normal in consistency and no tubercles were present. All the glands were swollen and some, especially the mesenteric and inguinal, were hæmorrhagic.

Cultures made from the organs were negative.

Guinea pig No. 4486 was inoculated in the peritoneal cavity with a suspension of one loop of acid-fast Bacillus E, *Amœba dysenteriæ* and symbiotic bacteria. The animal died five weeks later. The autopsy findings were similar to those described in guinea pig No. 4485.

Guinea pig No. 4487 was inoculated in the same manner as the previous animal. The animal died six weeks later with similar lesions. There was no evidence of tuberculosis. Cultures made from all the organs remained sterile.

Guinea pig No. 4482 was inoculated in the peritoneal cavity with a suspension of one loop of a ten-day culture of Bacillus F in symbiosis with the cholera vibrio. The animal died one month later. There were severe hæmorrhages in all the organs. There was no evidence of tuberculosis.

Guinea pig No. 4483 was inoculated subcutaneously with one loop of a ten-day culture of Bacillus F and cholera vibrio. The animal died five weeks later with similar lesions. There was no evidence of tuberculosis. Cultures made from all the organs remained sterile.

The foregoing animal inoculations, while giving us little information in themselves as to the pathogenicity of the acid-fast organism, serve to separate the latter from the tubercle bacillus. In none of the injected animals were lesions found that resembled those of tuberculosis. The following animal experiments were made with one of the pure cultures of the acid-fast bacillus:

Guinea pig No. 4596 was inoculated subcutaneously with one loop of a ten-day pure culture of Bacillus F, suspended in 1 cubic centimeter of salt solution. After one week, an indurated nodular thickening appeared at the site of inoculation. This thickening and induration gradually spread and in four weeks the whole abdominal surface was involved. The hair of the skin surface corresponding with the lesion just described *fell out,* and before the exitus the animal became greatly emaciated; it died four weeks after the inoculation. Autopsy showed a marked thickening of the subcutaneous tissues of the abdominal wall, in some parts measuring 2 millimeters in thickness. There was hæmorrhagic infiltration of the muscular tissue as well as around the joints of the extremities. The abdominal cavity contained no fluid. The heart was slightly dilated. The lungs appeared normal. The spleen was enlarged to twice its normal size and was firm in consistency. Cut section showed an increase of fibrous connective tissue. The liver was enlarged and congested, presenting a dark, nearly black color. The kidneys showed some cloudy swelling. The stomach and intestines appeared normal. Cultures made from the subcutaneous lesions were negative. Smears made from the lesions and stained by the acid-fast method showed the presence of large numbers of acid-fast bacilli, the majority of which were intracellular.

A portion of the nodule was placed in Zenker's fluid, hardened in the usual manner in alcohol and embedded in paraffine. The cut sections cut at four microns thickness were stained by a modified Borrel method, and also with eosin, followed by Unna's alkaline methylene blue.

The section includes muscular and subcutaneous tissue and nerve bundles. The nerves, and for the greater part the muscle fiber, show no abnormalities. The usual fibrous subcutaneous tissue has been replaced by richly cellular granulation tissue, consisting almost exclusively of irregularly spindle-shaped, young connective tissue cells. Near the cutaneous border of the section is found an oval-shaped, well-defined area consisting chiefly of leucocytes and necrotic tissue débris. In the rest of the section, leucocytes are present in very small numbers. In many of the cells of this tissue are found numerous short bacilli, some lying singly, but usually in dense masses in the protoplasm. These bacilli are stained deeply with the magenta in the Borrel sections and with methylene blue in the eosin-methylene blue preparations. In a few places the granulation tissue has involved the muscle bundles, and in this situation cells containing the bacteria are seen. Cells containing two or three distinct nuclei are found and in a few sections typical giant cells are seen with marginal nuclei. The blood vessels in the section contain a relatively large number of leucocytes.

The section when stained with carbol-fuchsin showed the presence of acid-fast bacilli corresponding in number with those found in the section just described.

Guinea-pigs Nos. 4597 to 4598 and 4599 were inoculated in a similar manner to Guinea-pig No. 4596. All died in the fourth week with the same symptoms and similar anatomical changes.

Cultures were made from the organs of these animals on media containing amœbæ and the cholera vibrio and on various laboratory media. In one instance only was the acid-fast microörganism reclaimed. The growth in this case occurred on the media containing the amœba and the cholera vibrio.

Guinea-pigs Nos. 4600, 4601, 4602 and 4603 were inoculated intraperitoneally with one loop of a ten-day culture of Bacillus F suspended in 1 cubic centimeter of salt solution. All the animals died during the fourth week. The autopsies showed marked hæmorrhages in the deep muscular tissues. The spleen was greatly enlarged in all the animals. There was severe congestion of the liver. There were no tubercles present and no cutaneous lesions. Cultures made from the organs on media containing amœbæ and cholera vibrios and on ordinary laboratory media were negative.

White rats Nos. 4603, 4604 and 4605 were inoculated subcutaneously with a suspension of Bacillus F, lesions were produced on the site of inoculation consisting of a small, indurated nodule which disappeared after three weeks. Microscopical preparations made from the scrapings of the nodules and stained by the Ziehl-Neelson method showed large numbers of acid-fast bacilli. Cultures made from the nodules on media containing amœbæ and cholera vibrios and ordinary laboratory media were negative.

Twelve monkeys were inoculated subcutaneously and intraperitoneally with various amounts of Bacillus F. At the present time, three months later, there is no evidence of external lesions.

Upon failing to recover the bacillus from the internal organs of these experimental animals, a series of guinea pigs was inoculated subcutaneously with the splenic pulp of guinea pigs Nos. 4597 and 4598. Altogether six animals were inoculated. They died three weeks later with the same symptoms as those inoculated with the culture of the microörganisms. Cultures from the organs in these animals also remained sterile, and smear preparations examined microscopically showed no acid-fast bacilli. The splenic pulp of these animals inoculated subcutaneously into a third series produced identical lesions with fatal results. Cultures made from the organs remained sterile and no acid-fast bacilli were found in the smears.

DISCUSSION OF RESULTS.

Attempts have been made by me to cultivate the leprosy bacillus from the spleens of lepers and from cutaneous nodules in cases of leprosy in ten instances. In eight out of the ten instances an acid-fast bacillus was observed to multiply in successive transplants of the cultures of amœbæ to which the leprosy material had been added. Control plates of the amœba cultures without the addition of leprosy material showed no acid-fast organisms present. By heating such an amœba-cholera-leprosy culture a half hour at 60° C. and incubating, isolated colonies of the leprosy bacillus were obtained which grew readily in pure culture when transplanted to the ordinary laboratory media (nutrient agar, bouillon, coagulated egg medium, etc.).

Guinea pigs inoculated subcutaneously with the pure culture developed in some instances lesions at the site of inoculation which bear a certain resemblance to the leprous lesions of man, both macroscopically and when sectioned and examined under the microscope. The acid-fast organisms were found at the site of inoculation and in some instances also in the spleen. In one instance the acid-fast organism was cultivated from a lesion in the guinea pig. These guinea pigs, as well as others which received intraperitoneal injections, invariably died during the third or fourth week after inoculation.

Inoculations into monkeys have yielded as yet only negative results.

It seems strange, at first thought, that, although the first culture of the leprosy bacillus on artificial media is attended with so much difficulty, it should grow so readily in subsequent transplants; but the tubercle bacillus often acts in a strikingly similar manner, only one or two tubes out of twenty or thirty yielding a growth from tuberculous tissue, whereas subcultures from this growth all develop luxuriantly on various media.

The majority of the lepers from whom the material for these cultures was obtained, had tuberculous lesions in their lungs, but the tissues used for the cultures showed no evidence of tuberculosis. The animal inoculations described in the text prove that the acid-fast organism cultivated by me is not the tubercle bacillus.

SUMMARY.

1. The leprosy bacillus was first cultivated from leprosy material in symbiosis with other unidentified bacteria and amœbæ and later from other cases in symbiosis with amœbæ and the cholera vibrio.

2. By heating a symbiotic culture of amœbæ, cholera and leprosy for a half hour at 60° C. and incubating, the leprosy bacillus was obtained in pure culture.

3. The leprosy bacillus isolated in this manner grows readily on the ordinary laboratory culture media.

4. The bacillus is pathogenic for guinea pigs, subcutaneous inoculations having caused lesions which macroscopically and microscopically resemble the leprous lesions of human subjects.

ILLUSTRATIONS.

PLATE I.

FIG. 1. Leprosy F. From pure culture in glycerine-bouillon.
2. Pure culture of Leprosy F from glycerine-agar.
3. Amœba with cholera vibrio and leprosy bacillus G. Second transplant from primary culture.
4. Amœba with cholera vibrio and leprosy bacillus C. Second transplant from primary culture.
5. Smear from early lesion in guinea pig following a subcutaneous injection of a pure culture of leprosy bacillus F.
6. Smear from leprous nodule in liver of human patient.

All of these preparations were stained with carbol-fuchsin and decolorized with Gabbet's stain.

PLATE II.

FIG. 1. Smear from an early skin lesion of a guinea pig inoculated with a leprosy culture. Stained with carbol-fuchsin and decolorized with Gabbet's stain.
2. Amœba with cholera vibrio and leprosy bacillus C. Second transplant from primary culture.
3. Culture G. From pure culture of leprosy bacilli on glycerine-agar. Stained with carbol-fuchsin and decolorized with Gabbet's stain.
4. Culture F. From pure culture of leprosy bacilli on glycerine-agar. Stained with carbol-fuchsin and decolorized with Gabbet's stain.
5. Culture F. From pure culture of leprosy bacilli, in glycerine-bouillon. Stained with carbol-fuchsin and decolorized with Gabbet's stain.
6. Culture G. Leprosy bacilli with amœbæ and cholera vibrios. Stained with carbol-fuchsin and decolorized with Gabbet's stain.
7. Culture F. From pure culture of leprosy bacilli in glucose-bouillon. Two weeks' growth.
8. Culture F. From pure culture of leprosy bacilli on glycerine-agar. Two weeks' growth.

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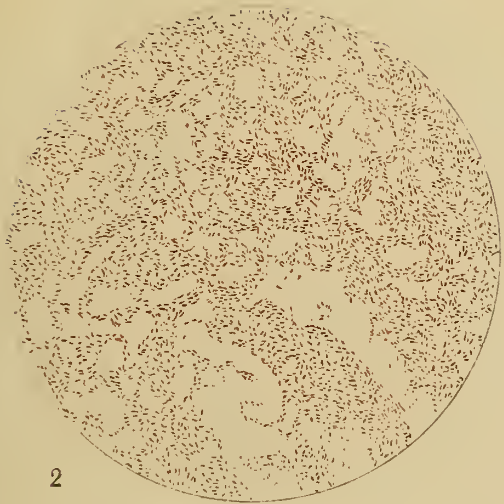

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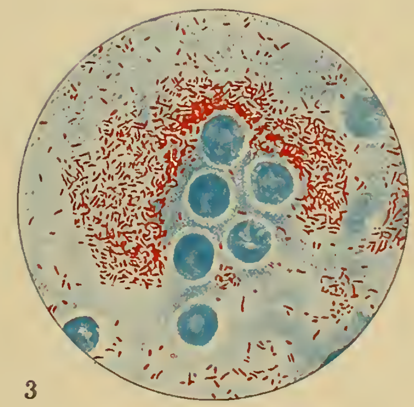

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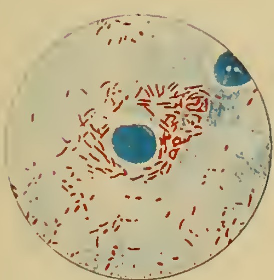

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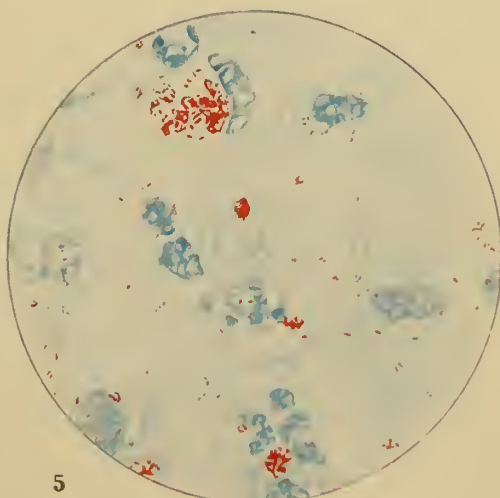

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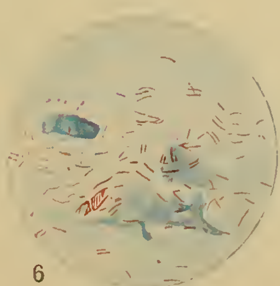

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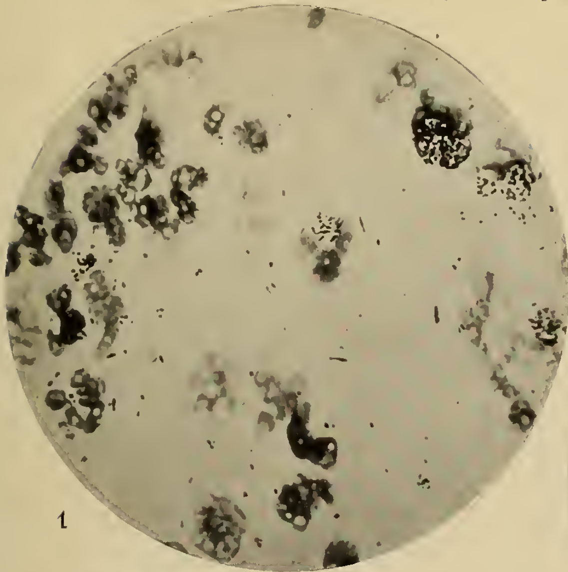
PLATE I.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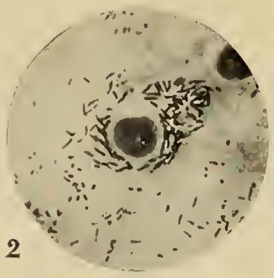
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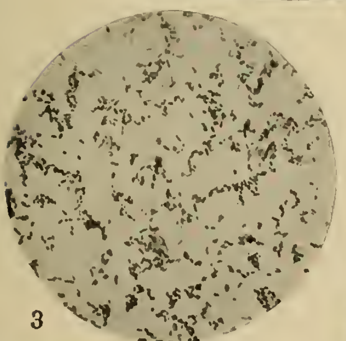
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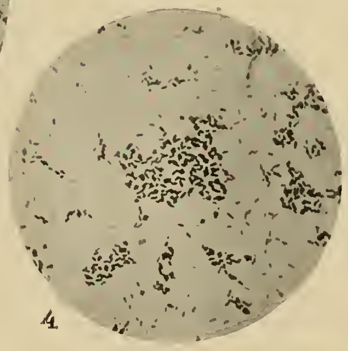
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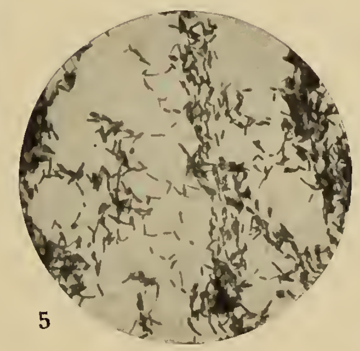
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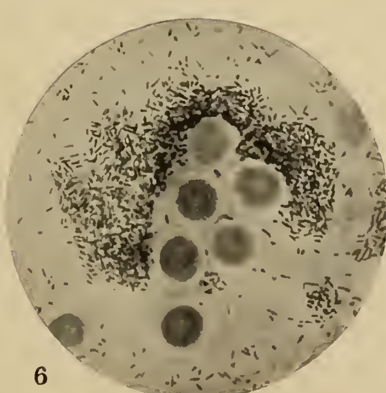
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PLATE II.

TWO CASES OF BALANTIDIUM COLI INFECTION, WITH AUTOPSY.[1]

By Fred B. Bowman.

(From the Biological Laboratory, Bureau of Science, Manila, P. I.)

Infection with *Balantidium coli* in the Philippine Islands is not very common. In the routine examination for intestinal parasites of fæces from 4,000 prisoners confined in Bilibid Prison in Manila, but three individuals examined showed the presence of this organism. It should be mentioned, however, that many of the specimens examined, because of their age, were not favorable for finding *Balantidium coli.*

Of 300 patients which have passed through the wards of the Philippine Medical School, devoted to tropical medicine, during the past year, but three harbored this parasite. One of these patients died. This is one of the cases to be reported in this paper. The second left the hospital before her case could be studied thoroughly, but no other organism was found in the fæces which would account for the severe dysenteric symptoms which were present. The third case, also suffering with diarrhœa, has just been admitted to the hospital while this article is in press.

The report of the clinical symptoms of the following cases and their pathologic study may throw some further light on the question of the pathogenicity of *Balantidium coli.*

Case I.—This case was seen at autopsy and the sections of the intestine studied by Doctor Strong in 1906.

The clinical history showed that the patient, a male Filipino prisoner, was admitted to the Bilibid Prison Hospital complaining of palpitation of the heart.

On physical examination the heart sounds were clear but extremely rapid and throbbing in character. Fever was present.

The stools were diarrhœal in character, no mucus or blood being present. Microscopical examination showed large numbers of the *Balantidium coli.* After an illness of one week, during which the moderate

[1] Read at the Seventh Annual Meeting of the Philippine Islands Medical Association, February 13, 1909.

diarrhœa continued, the patient died. The following brief extracts are taken from the protocol:

Cause of death: Chronic endocarditis and acute purulent pericarditis. *Staphylococcus aureus* was isolated from the purulent exudate. The lungs show a number of areas of broncho-pneumonia. The intestine appears normal until the cæcum and colon are reached. Very numerous small erosions and ulcers may be observed in the mucosa scattered throughout almost the entire length of the large intestine, but more marked in the region of the cæcum and ascending colon. These appear to be of recent origin; none of them measure more than 1.0 centimeter in diameter. Their situation seems to bear no relation to the mesenteric attachment. They are more or less irregular in outline. Some are slightly undermined. There is little indication of acute inflammatory change about their bases or margins which are only slightly reddened. Many are merely erosions extending in depth scarcely through the mucosa; others apparently extend into the submucosa.

Scrapings from these lesions examined microscopically show the presence of the *Balantidium coli* in large numbers. No other protozoa such as *amœbæ* or *flagellata* were present.

The histological examination of sections of these ulcers showed the organisms lying free on the surfaces of the ulcers and invading the adjacent mucosa and muscularis mucosa, and occasionally reaching to the submucosa, where in a few instances they were observed within the blood vessels. The parasites were sometimes found in the submucosa at considerable distances from the ulcerations, and spaces and sinuses were seen in the tissue which had apparently been made by the passage of the parasites through it.

This case is evidently worthy of report for the reason that it has furnished information regarding the production of the very early intestinal lesions caused by this parasite. As Strong has pointed out in his earlier studies.[2]

> "Whether *Balantidium coli* is capable of producing a primary erosion in the intestine has not been conclusively demonstrated. However, if such erosion of the mucosa exists from any cause, the parasite is certainly capable of continuing the process and of modifying and producing in connection with the bacteria which accompany it more or less characteristic pathologic lesions."

A study of the sections from these early ulcerations gives undoubted proof of this latter fact and from the spaces and sinuses left in the trail of this parasite in the submucosa, its mechanical injury to the tissue may be observed.

This case also conclusively demonstrates the fact that the *Balantidium coli* is not merely a secondary invader of chronic ulcerations which

[2] *Pub. P. I. Bur. Sci., Biolog. Lab.* (1904), No. 26, 1–77.

owe their origin to other organisms, for example to tubercle bacilli or to *amœbæ*.

The early ulcerations of the intestine are shown in Plate I.

Case II.—Male Filipino, who entered the tropical medical service of Doctor Strong with the following complaint: Severe diarrhœa, fever, cough, general weakness.

The patient on admission was in such a weak condition that all questions as to previous history, illness, habits, etc., were answered very unsatisfactorily. The following extracts are taken from the author's clinical history: The patient is very pale and somewhat emaciated. Glands of the groin somewhat enlarged, the other superficial lymphatic structures normal. Muscular power greatly diminished. The tongue is heavily furred and the breath is foul. He has no appetite. He expectorates large quantities of mucus semifluid sputum.

The pulse is weak, varying from 120 to 150 per minute, the tension is very low. On examination of the heart the apical impulse can not be seen or felt. The precordial area is hyperresonant and the heart's boundaries can not be sharply determined. On ausculation the heart sounds are weak and distant, but clear.

The respirations are shallow and rapid. Deep inspiration causes pain on both sides of the chest. The thorax on both sides generally is hyperresonant and on ausculation a few coarse râles may be heard at the bases of both lungs posteriorly.

The liver is not enlarged and the spleen can not be palpated. The abdomen is tense, and pressure, particularly over the region of the colon, causes severe pain.

During the time he remained in the hospital, diarrhœa was present, but at no time was it very acute; the number of bowel movements varied usually between five and ten in twenty-four hours. The stools, however, were always semifluid and contained much mucus and blood. The latter occasionally was passed in the form of clots. The temperature was usually normal in the morning, rising to 38° or 39° C. in the evening.

Twice during the course of his illness severe hæmorrhages from the bowels occurred. Immediately after the second hæmorrhage, the patient sank into a state of collapse, and died shortly afterwards.

Laboratory examinations: A blood smear showed no malarial parasites and a Widal test and blood culture also proved negative. The counts of the red blood corpuscles varied from 3,500,000 to 2,500,000. The leucocytes averaged 9,500. A differential count showed a moderate increase in the mononuclear elements and 8 per cent of eosinophiles.

The sputum was negative for tubercle bacilli and for parasites.

The microscopic examination of the fæces showed the presence of the ova of *Ascaris lumbricoides*, *Uncinaria duodenale* and large numbers of the *Balantidium coli.* These protozoa were especially numerous in the flakes of mucus scattered through the specimen.

The urine was highly colored and of high specific gravity. It contained much albumen, hyaline and granular casts and cylindroids. No parasites were present.

Necropsy: Performed four hours after death by the author.

Body extremely emaciated, subcutaneous fat very scanty. *Rigor mortis* is absent.

Heart and pericardial cavity: There is a small amount of clear, straw-colored fluid present in the pericardial cavity. Both serous layers are smooth and glistening.

The heart is small and the surface pale in color. Some fluid blood is present in the right ventricle. On section, the muscle is seen to be thin and pale in color. Valves, and coronary arteries, and aorta, apparently normal.

Lungs and pleural cavity: The left lung is pale and emphysematous and is adherent to the pleura by old fibrous adhesions and can with difficulty be separated from it. No nodules can be felt in the lung substance, and on section none can be seen.

The right lung is emphysematous above and in the lower lobe is somewhat congested. The pleuræ are adherent and can not be separated without tearing the lung tissue.

The bronchi contain considerable mucus; the bronchial glands are normal in size and consistency.

Abdominal cavity: On opening the peritoneal cavity the appearance of the peritoneum is not glistening but is slightly dull. This appearance is more marked in the pelvic portion. In the pelvis, the mesentery is somewhat matted together. No nodules are seen on the peritoneum.

There is little omental fat. Some of the mesenteric lymph glands are enlarged, one or two of them being quite hard, and as large as a pigeon's egg; others situated along the line of the mesenteric attachment of the colon on cut section show inflammatory change and softening. The appendix appears normal. In the pelvis, free fæces are present.

The spleen is slightly enlarged and pale. On section the malpighian bodies are clearly visible.

The kidneys: The capsules are somewhat adherent. On section the kidneys appear pale and cloudy; the striations are irregular and very indistinct.

Liver: Not enlarged; of a dark red color and having a glistening surface. On section it appears normal.

The *pancreas* appears normal.

Intestines: The small intestine is practically normal to within a few centimeters of the cæcum, where definite ulcers are situated which have an irregular shape. Some have tags of necrotic tissue attached to the bases and undermined edges.

The walls of the cæcum are greatly thickened and are riddled with ulcerations. Many of these have healed, others show evidences of a very active process. In the fundus of the cæcum is an ulcer which has perforated into the peritoneal cavity. Other ulcers are found scattered throughout the colon.

The situation of the ulcers bears no definite relation to the mesenteric attachment. They vary in shape, some being oval, others round, and nearly all have ragged edges. The early ulcerations are clean, shallow, and not injected, while the older ones are irregular in outline with their bases covered with mucus and necrotic tissue. Scrapings made from the bases of these ulcers show the presence of large numbers of the *Balantidium coli.* No amœbæ or other protozoa are observed.

The rectum is injected, but free from ulceration.

HISTOLOGICAL EXAMINATION.

The results of the histologic examination of sections of the large intestine and of the mesocolic lymph glands only will be described.

The parasites were found in all the sections of the ulcers examined, being situated both in the mucosa and submucosa. The blood vessels were dilated and contained many parasites. Large numbers of them were also found in the muscular layers. Some of the parasites showed division forms or elongation of the nucleus.

There appeared to be but moderate round-celled infiltration in the deeper layers of the intestine, except where there were several parasites grouped together. Single parasites were found in the tissues far away from the ulcerations.

Sections of an enlarged mesocolic lymph gland removed from the neighborhood of the mesenteric attachment to the intestine showed numerous single parasites which appeared scattered through the lymph sinuses of the gland tissue and situated within the blood vessels. The parasites were not found in groups anywhere in the gland.

Plate IV fig. 1 shows eight parasites in one field. The nuclei of some of the parasites are not visible. There are areas of necrosis in the glandular tissue. A small area of necrosis is shown in Plate IV fig. 2. The parasites are not usually situated in these areas of necrosis, but sometimes single parasites are found nearby. During life the parasites are almost constantly in motion.

Sections of the intestinal ulcers and of the glands, stained by the Ziehl-Neelson method, showed no tubercles or tubercle bacilli.

An examination of a portion of a fresh gland crushed out on a slide and stained in the same way was also negative for tubercle bacilli.

SUMMARY.

Case I shows particularly the earliest stages in the ulcerative process caused by the *Balantidium coli.* (See Plate I.) Case II demonstrates particularly (see Plate II) the later stages of ulceration and also that this process can proceed to the stage of perforation with resulting general peritonitis and death.[3] This case, however, never reached the stage of advanced general peritonitis, for at the time of perforation there occurred a severe hæmorrhage, the patient losing a liter or more of blood, and this, with the shock of the perforation, in his weakened condition caused almost immediate death.

In 1904, Strong[4] collected from the literature all the cases of *Balantidium coli* infection (127 in number) reported up to that time. In two of these cases death occurred from general peritonitis.

The presence of *Balantidium coli* in the mesenteric lymph glands in the second case reported in the present paper is peculiar to this case and has not been described before.

In Doctor Strong's series none of the cases showed abscess of the liver and only in one was the parasite reported as present in the sputum from a case with an indefinite diagnosis of abscess of the lung. The parasites are very frequently situated in the lymph spaces and in the blood vessels of the submucosa, but they do not appear to have caused inflammatory conditions elsewhere in the body. As has been stated, some of the mesocolic lymph glands in the second case showed areas of inflammatory change and of necrosis. On account of the size of the *Balantidium coli* wherever the parasite enters, the intestinal bacteria would also have an opportunity of entering and of causing inflammatory changes. However, bacteria were not definitely discovered in sections of these glands. In this connection it is interesting to note that Glaessner[5] in extracts of *Balantidium coli* in the fæces was able to demonstrate a very active diastase and a fairly strong hæmolytic substance, although the extracts were inert with respect to dilute albumen, peptone solution and to fibrin.

CONCLUSIONS.

I. The intestinal lesions in both of these cases seem to have been caused by *Balantidium coli*.

II. Death may result from perforation in severe *Balantidium coli* ulceration.

III. The presence of the parasite is not always limited to the walls of the intestine. The organism may invade the mesocolic intestinal lymphatic glands.

[3] Both specimens of the intestine from which these illustrations were prepared are at present in the museum of the Biological Laboratory of this Bureau.

[4] *Pub. P. I. Bur. Sci., Biolog. Lab.* (1904), No. 26, 1–77.

[5] *Centralbl. f. Bact. Orig.* (1909), 47, 351.

ILLUSTRATIONS.

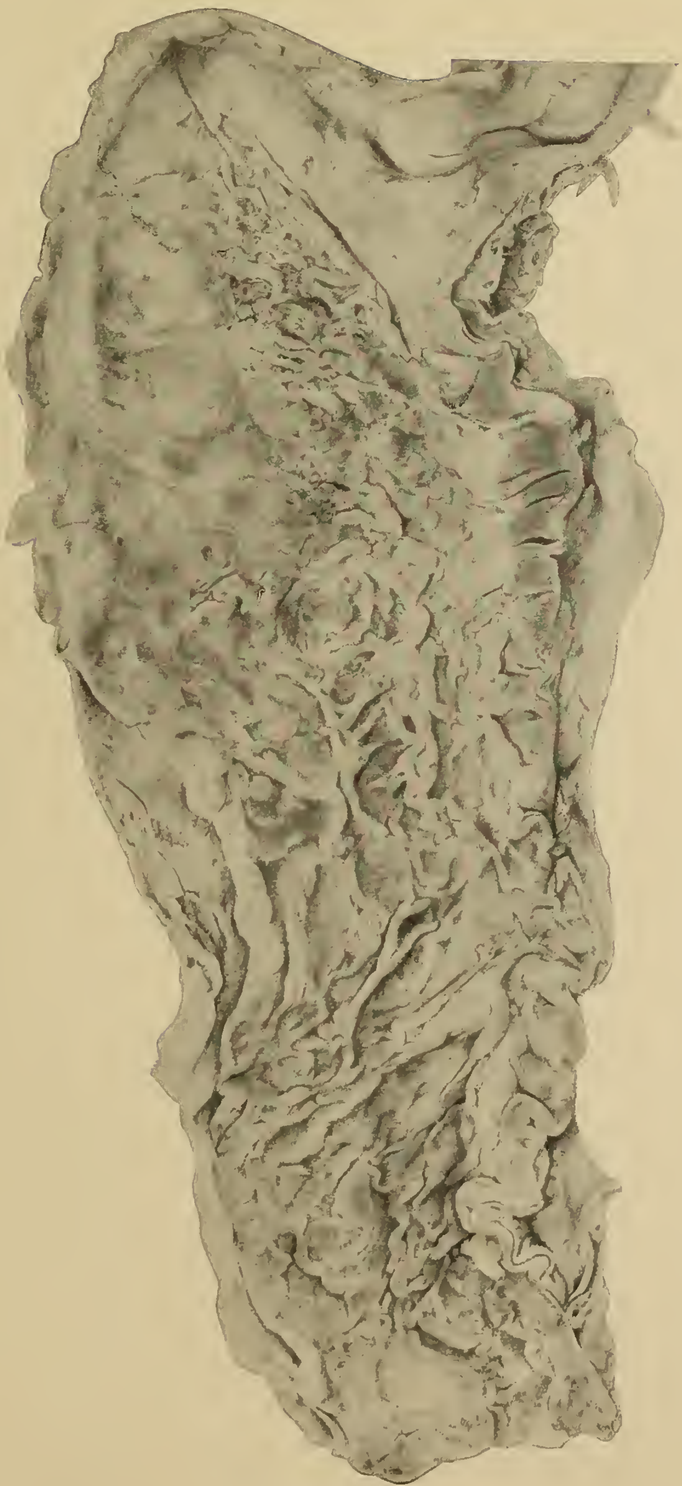


PLATE I.

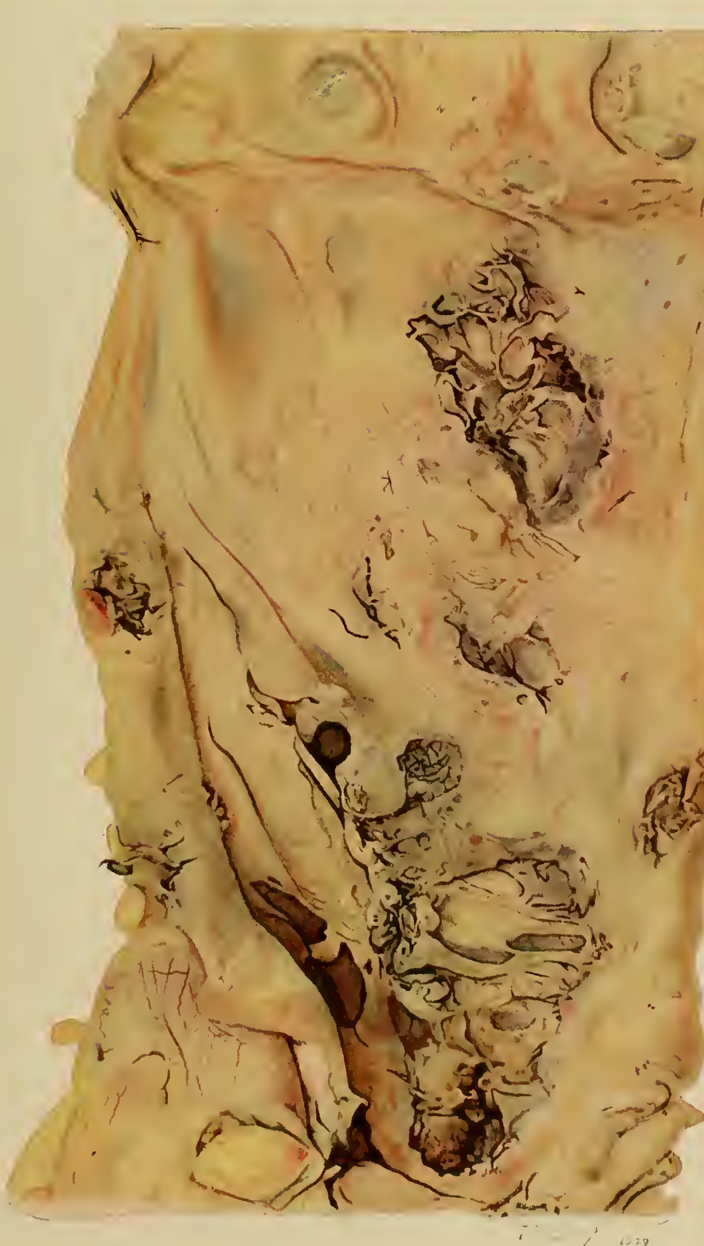


PLATE II.

FIG. 1.

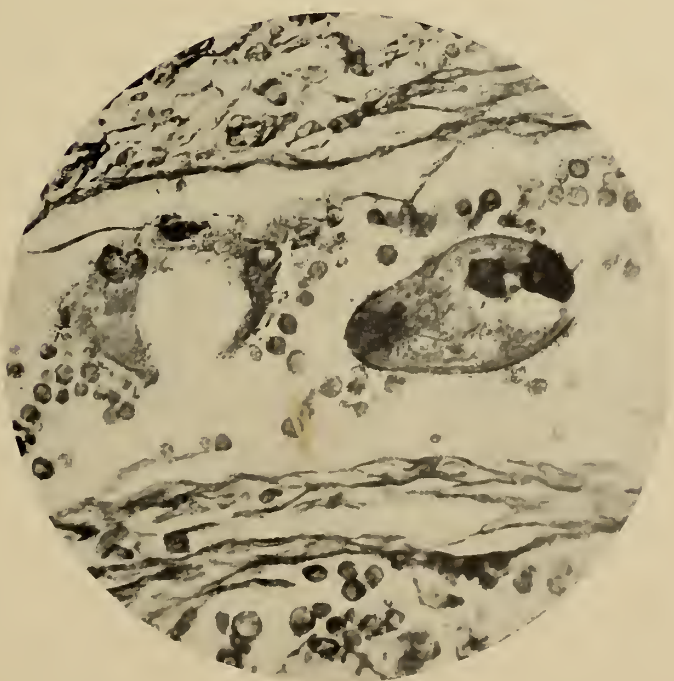


FIG. 2.

PLATE III.

Fig. 1.

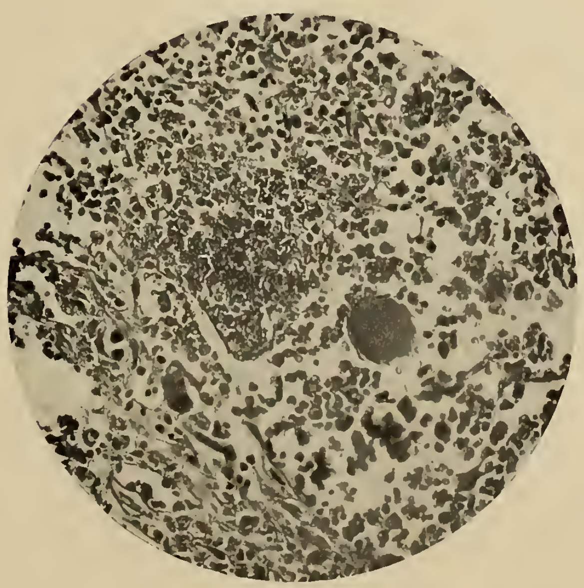


Fig. 2.

PLATE IV.

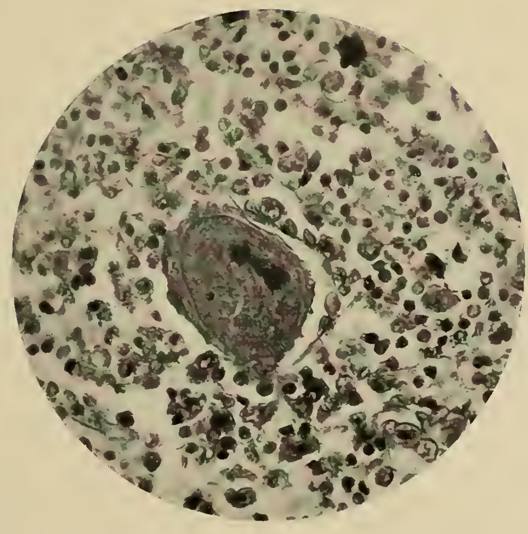


FIG. 1.

FIG. 2.

PLATE V.

THE DIFFERENCE IN SUSCEPTIBILITY TO CATTLE PLAGUE ENCOUNTERED AMONG CATTLE AND CARABAOS.

By E. H. Ruediger.

(*From the Serum Section, Biological Laboratory, Bureau of Science, Manila, P. I.*)

Perhaps the most perplexing problem the worker with cattle plague meets is the dosage of anticattle-plague serum necessary for protective and curative purposes.

Rogers,[1] working in India, prepared anticattle-plague serum and determined its immunizing value on seven head of plains cattle which had never suffered from cattle plague. They received 10, 10, 15, 15, 20, 25 and 30 cubic centimeters of serum, respectively, per 300 kilograms of weight, and 1 cubic centimeter of virulent blood. Three animals showed mild symptoms of plague, two showed moderate rise of temperature, and the remaining two did not react at all. The reactions were entirely independent of the quantity of serum the animals had received, showing a difference in susceptibility.

In his second test, Rogers used 15, 20, 25 and 35 cubic centimeters of serum, respectively, per 300 kilograms of weight on four animals. The first three reacted well. Eleven other cattle were given 20 cubic centimeters of serum and 1 cubic centimeter of virulent blood. Eight reacted moderately and three did not show any reaction.

Of the twenty-two head of plains cattle reported on by Rogers, eight did not react to inoculation with 1 cubic centimeter of virulent blood. From eight to ten days after the first inoculation, these eight animals received 10 cubic centimeters of virulent blood each, and in five of them this inoculation was followed by good reactions.

It is to be regretted that throughout this work Rogers did not use any control animals, for all or nearly all his animals might have had only a mild reaction without any serum.

Having found wide variations in susceptibility among cattle on the plains where cattle plague had been endemic and epidemic for many years, Rogers resorted to mountain cattle from districts that had never been visited by cattle plague, hoping that these would react uniformly to inoculation.

Doses of 10 cubic centimeters of serum per 300 kilograms of weight were worthless against 1 cubic centimeter of virulent blood. Of eight animals so inoculated, seven died of cattle plague. On increasing the quantity of serum to 40 cubic centimeters, 50 per cent, and with doses of 90 cubic centimeters, 66 per cent of the cattle were saved.

[1] *Ztschr. f. Hyg.* (1900), 35, 59.

Five animals were inoculated with 0.5 cubic centimeter of virulent blood and were given 90 cubic centimeters of serum per 300 kilograms of weight. Four of them died of cattle plague and one showed no reaction whatever.

Stockman[2] inoculated fifty head of cattle in India with 4 cubic centimeters of virulent blood and gave them serum varying in quantity from 2 to 10 cubic centimeters. All lived. Nine control animals received 4 cubic centimeters of virulent blood and none of these died.

Eight buffaloes that received 4 cubic centimeters of virulent blood and from 1.8 to 10.2 cubic centimeters of serum, all lived. Four control buffaloes that had been inoculated with 4 cubic centimeters of virulent blood also lived.

Walker[3] found that in India the cattle on the plains or lowlands are far more resistant toward cattle plague than are the cattle on the mountains. Mountain cattle require eighteen times as much serum as do plains cattle. In a later report[4] Walker proposes the following plan for estimating the quantity of immune serum required to protect contact animals during an epidemic of cattle plague: If the death rate is 50 per cent or less, use the standard dose of serum; in an epidemic with a mortality of from 50 to 75 per cent, double the standard dose; if from 75 to 85 per cent, use eighteen times the standard dose of serum.

According to the experience of Daniels[5] with five different breeds of animals in India, Malay buffalo or cariboo (Kerbau) are highly susceptible to cattle plague; while Siamese cattle, Bali bullocks, Indian cattle and Indian water buffaloes are but slightly susceptible.

Kolle[6] makes the statement that in his experience 30 cubic centimeters was the most satisfactory quantity of serum used in the simultaneous method of immunization.

The following results obtained in testing the immunizing value of anticattle-plague serum at Manila may be of interest. Anticattle-plague serum is here prepared on a large number of animals and each lot of serum is a mixture of the serum derived from forty or fifty. In order to obtain serum of uniform quality, bleedings are arranged to include animals in all stages of the bleeding period. The serums here reported upon, with one exception, lot No. 810, may be considered of fairly uniform quality. The latter was obtained during an outbreak of foot and mouth disease among the serum animals. Inoculations and bleedings could not be arranged satisfactorily, and the immunizing value of this lot was lower than usual, but the test is of importance in showing the comparative susceptibility of native cattle and carabaos. The animals used in these tests were all in good health, they weighed about 200 kilograms—unless otherwise indicated—and the quantity of serum mentioned represents the dose per 100 kilograms weight of animal.

[2] *Journ. Comp. Path. and Ther.* (1903), 16, 319.

[3] *Journ. Comp. Path. and Ther.* (1904), 17, 326.

[4] *Journ. Trop. Vet. Science* (1908), 3, 28.

[5] *Loc. cit.* (1907), 2, 159.

[6] Handbuch der Technik und Methodik der Immunitätsforschung, Jena (1909), Zweiter Band, p. 595.

TEST 1.

Five bullocks, numbered 1, 2, 3, 4 and 5, natives of the Island of Sibuyan, received 0.5 cubic centimeter of virulent blood each. Animal No. 1 was used as control, Nos. 2, 3, 4 and 5 received 25, 50, 75 and 100 cubic centimeters of anticattle-plague serum, respectively.

TABLE 1.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	*cc.*	
1	0.5	None.	Died.
2	.5	25	Lived.
3	.5	50	Lived.
4	.5	75	Lived.
5	.5	100	Lived.

Table 1 shows the results obtained. All animals lived except No. 1, which was used as a control. (See charts 1 to 5.)

TEST 2.

On the 15th day of March, 1909, Sibuyan bullocks Nos. 6, 7, 8 and 9 were given 0.5 cubic centimeter of virulent blood each. Animal No. 6 was used as control, Nos. 7, 8 and 9 were given 25, 50 and 100 cubic centimeters of serum No. 767, respectively.

TABLE 2.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	*cc.*	
6	0.5	None.	Died.
7	.5	25	Died.
8	.5	50	Lived.
9	.5	100	Lived.

All animals reacted well after inoculation and, as is shown in Table 2, Nos. 6 and 7 died, Nos. 8 and 9 lived. (See charts 6 to 9.)

TEST 3.

Serum No. 810 was tested on five bullocks, Nos. 10, 11, 12, 13 and 14, which came from the Batanes group of islands. Each animal received 0.5 cubic centimeter of virulent blood. No. 10 acted as control and Nos. 11, 12, 13 and 14 received 50, 75, 100 and 125 cubic centimeters of serum, respectively.

TABLE 3.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	cc.	
10	0.5	None.	Died.
11	.5	50	Died.
12	.5	75	Died.
13	.5	100	Died.
14	.5	125	Died.

As table 3 shows all the animals died succumbing to cattle plague. Serum No. 810 was below the average in immunizing value. (See charts 10 to 14.)

TEST 4.

On the 6th day of July, serum No. 810 was tested on eight native carabaos, Nos. 15 to 22. All received 0.5 cubic centimeter of virulent blood, No. 15 was used as control, and Nos. 16 to 22 received 75, 100, 100, 125, 125, 150, and 150 cubic centimeters of serum, respectively.

TABLE 4.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	cc.	
15	0.5	None.	Died.
16	.5	75	Died.
17	.5	100	Lived.
18	.5	100	Lived.
19	.5	125	Lived.
20	.5	125	Lived.
21	.5	150	Lived.
22	.5	150	Lived.

All animals underwent good reactions and as is shown in Table 4, animals Nos. 15 and 16 died, Nos. 17 to 22, inclusive, lived. Carabaos appear to be more resistant than the Batanes cattle to the disease. (See charts 15 to 22.)

TEST 5.

Batanes bullocks Nos. 23, 24, 25, 26 and 27 received 0.5 cubic centimeter of virulent blood each. No. 23 was used as control and Nos. 24, 25, 26 and 27 received 25, 50, 75 and 100 cubic centimeters of serum No. 872.

TABLE 5.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	cc.	
23	0.5	None.	Died.
24	.5	25	Died.
25	.5	50	Lived.
26	.5	75	Lived.
27	.5	100	Lived.

Table 5 shows the results obtained. Animals Nos. 23 and 24 died of cattle plague, Nos. 25 to 27, inclusive, underwent good reactions but recovered. (See charts 23 to 27.)

TEST 6.

Early in August, 1909, Doctor Gearhardt, of the Bureau of Agriculture, sent to the Biological Laboratory Bureau of Science several bottles of foreign anticattle-plague serum, and requested that its immunizing value be determined. According to directions on these bottles, 20 cubic centimeters of the serum given by the simultaneous method should have been sufficient to protect medium-sized animals against a fatal attack of cattle plague.

On the 15th day of August, five Batanes bullocks, Nos. 28 to 32, inclusive, were each inoculated with 0.5 cubic centimeter of virulent blood. Animal No. 28 was used as control, Nos. 29 to 32, inclusive, received 25, 50, 75 and 100 cubic centimeters of foreign serum, respectively.

TABLE 6.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	cc.	
28	0.5	None.	Died.
29	.5	25	Died.
30	.5	50	Died.
31	.5	75	Died.
32	.5	100	Died.

The results obtained with the foreign serum are recorded in Table 6. All animals died of typical cattle plague despite the fact that animal No. 32 had received ten times the prescribed dose of serum. (See charts Nos. 28 to 32.)

TEST 7.

The foreign serum was now tested on Indo-China heifers Nos. 34, 35, 36, 37 and 38, controlled by Batanes bullock No. 33.

Animals Nos. 34, 35, 36, 37 and 38 received 5 cubic centimeters of virulent blood each and 20, 20, 40, 80 and 100 cubic centimeters of serum respectively. No. 33 received 0.5 cubic centimeter of virulent blood.

TABLE 7.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	cc.	
33	0.5	None.	Died.
34	.5+5	20	Lived.
35	.5+5	20	Lived.
36	.5+5	40	Lived.
37	.5+5	80	Lived.
38	.5+5	100	Lived.

A glance at Table 7 shows that the control died and the others lived. Control animal No. 33 gave a good reaction for cattle plague and died on the twelfth day after inoculation. Of the five Indo-China heifers, only one, No. 35, gave a good reaction. On inspecting the temperature charts, it will be noticed that the dates of chart 33 do not correspond to those of charts 34, 35, 36, 37 and 38. A suitable control animal was not at hand when animals 34, 35, 36, 37 and 38 were inoculated. None having died, and only one having reacted well to the first inoculation, they were reinoculated with 5.0 cubic centimeter of virulent blood each, and the control animal, No. 33, received 0.5 cubic centimeter of virulent blood. (See charts 33 to 38.)

TEST 8.

Anticattle-plague serum No. 891, prepared in the Philippine Islands, was tested on Indo-China heifers, Nos. 40, 41, 42, 43 and 44, each weighing about 100 kilograms, controlled by Batanes bullock No. 39. All were inoculated with 0.5 cubic centimeter of virulent blood, and animals Nos. 40, 41, 42, 43 and 44 received 10, 20, 30, 40 and 50 cubic centimeters of serum.

TABLE 8.

No. of animal.	Quantity of V. B.	Quantity of serum.	Results.
	cc.	*cc.*	
39	0.5	None.	Died.
40	.5	10	Lived.
41	.5	20	Lived.
42	.5	30	Lived.
43	.5	40	Lived.
44	.5	50	Lived.

The results in Table 8 show that the control died and all the Indo China heifers lived. (See charts 39 to 44.)

TEST 9.

Indo-China heifers Nos. 46, 47, 48, 49 and 50, controlled by Batanes bullock No. 45, were tested for immunity toward cattle plague. Each animal was inoculated with 2 cubic centimeters of virulent peritoneal fluid (blood was not at hand).

TABLE 9.

No. of animal.	Quantity of fluid.	Results.
	cc.	
45	2	Died.
46	2	Lived.
47	2	Lived.
48	2	Lived.
49	2	Lived.
50	2	Lived.

Table 9 shows the results obtained. The control died, while the Indo-China heifers lived; each, however, showed a moderated temperature reaction. (See charts 45 to 50.)

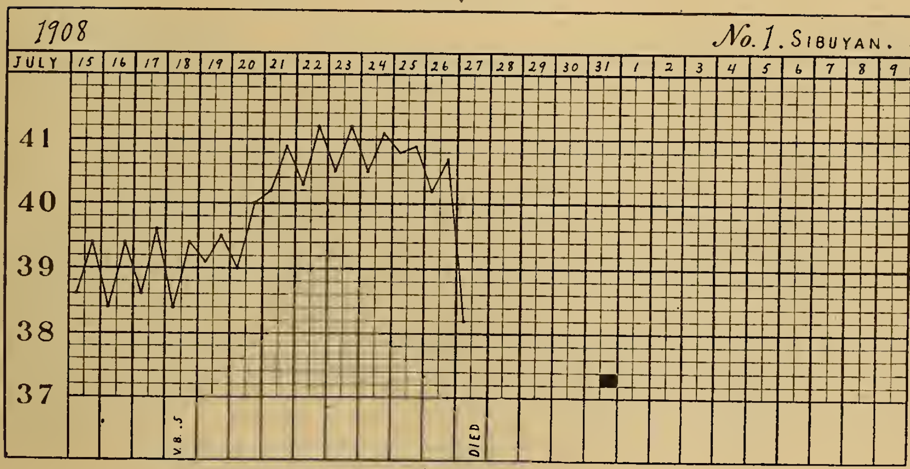
SUMMARY.

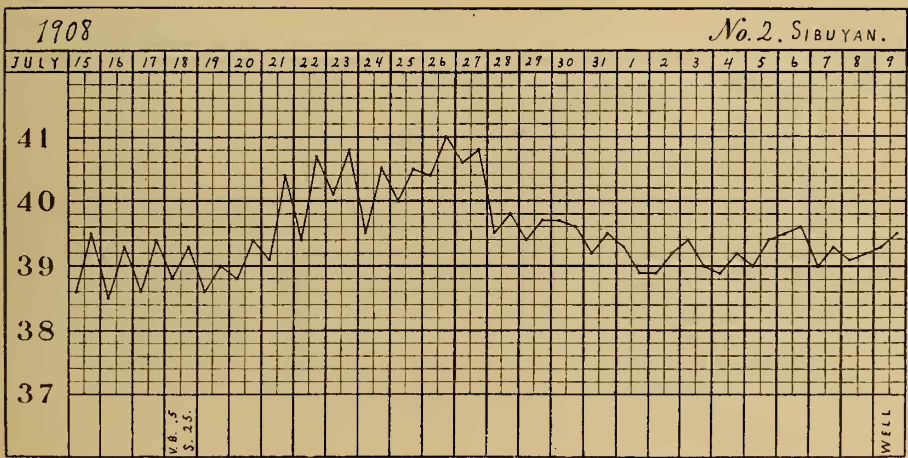
In summing up the results of other investigations and those reported above, it is found that cattle vary greatly in susceptibility to cattle plague. In India the cattle on the plains are resistant while those on the mountains are highly susceptible.

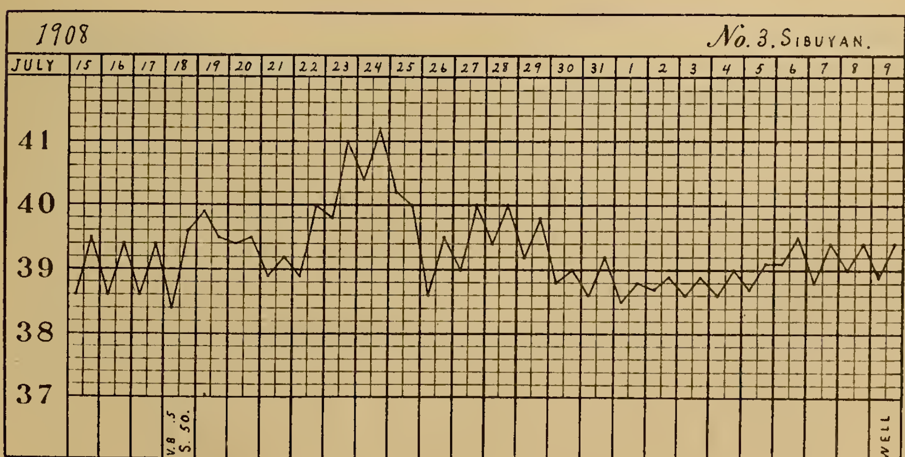
Philippine cattle from noninfected districts are highly susceptible and the carabao, as shown in Tests 3 and 4, appear to be more resistant than the Batanes cattle.

Cattle imported from Indo-China are highly resistant to cattle plague.

ILLUSTRATIONS.


1908
No. 1. SIBUYAN.
JULY
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
38
37
V. B. .5
DIED


1908
No. 2. SIBUYAN.
JULY
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
38
37
V. B. .5
S. 25.
WELL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No. 3. SIBUYAN.
JULY
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
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39
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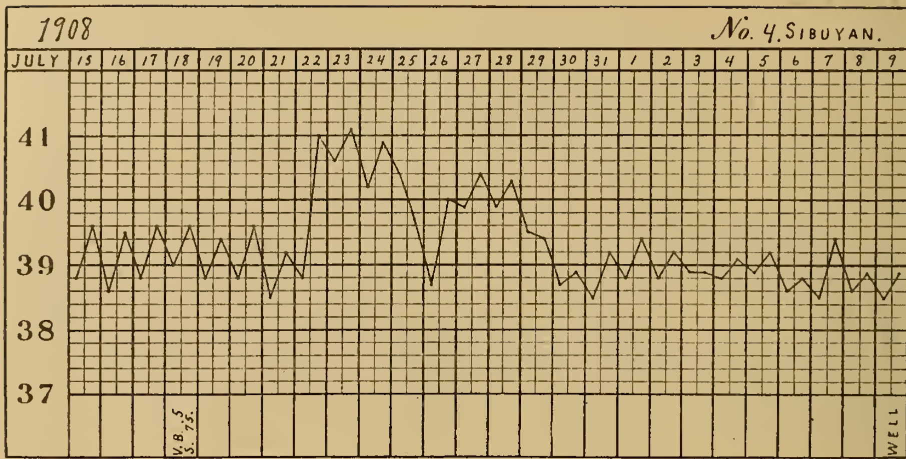
37
V. B. .5
S. 50.
WELL


1908
No. 4. Sibuyan.
July
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
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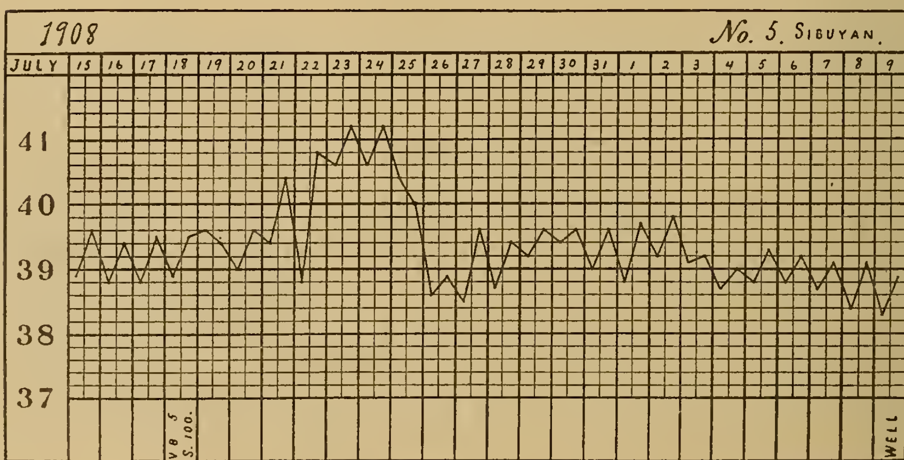
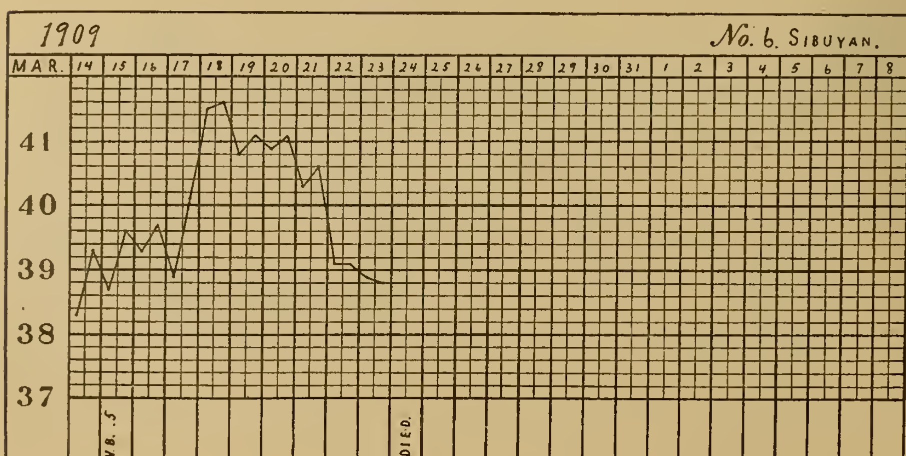
37
V.B. .5
S. 75.
Well


1908
No. 5. Sibuyan.
July
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
38
37
V B .5
S. 100.
Well


1909
No. 6. Sibuyan.
Mar.
14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
41
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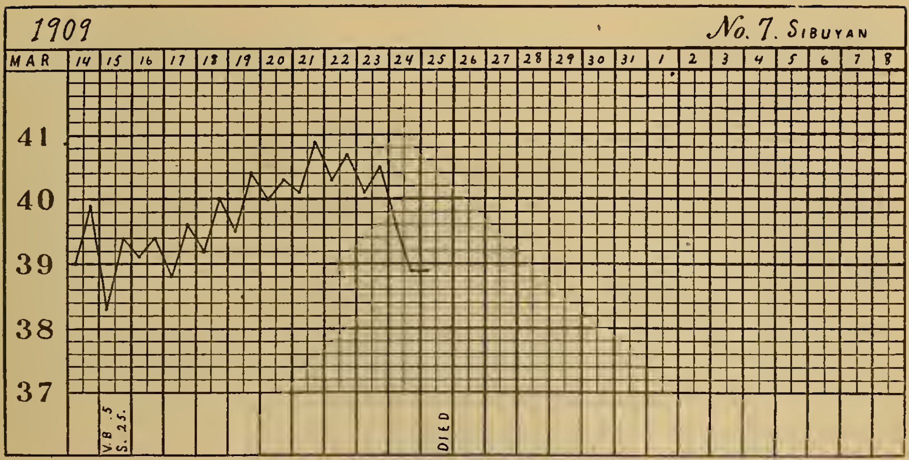
38
37
V.B. .5
Died.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MAR
14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
41
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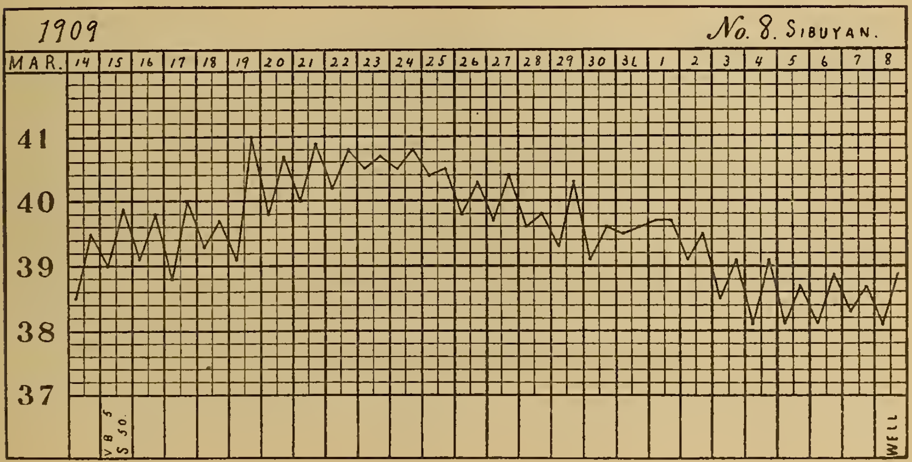
V.B. .5
S. 25.
DIED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MAR.
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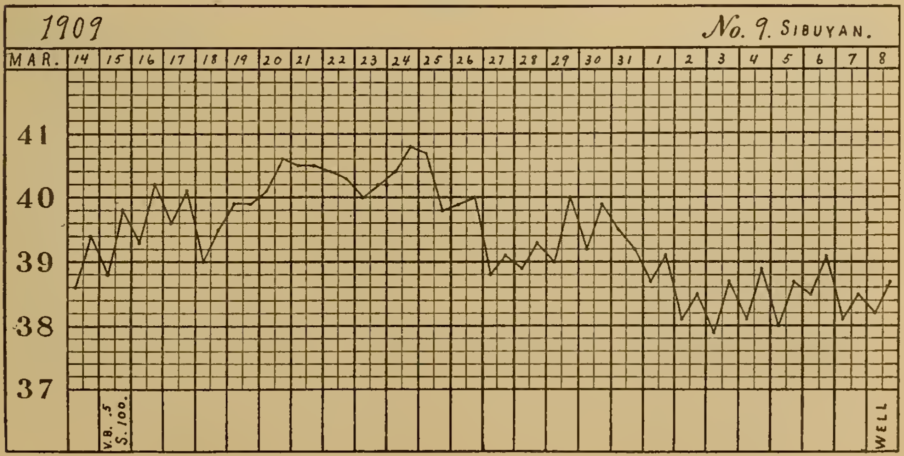
V B .5
S 50.
WELL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No. 9. Sibuyan.
MAR.
14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
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V.B. .5
S. 100.
WELL


1909
No. 10. BATANES
JUNE 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
41
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39
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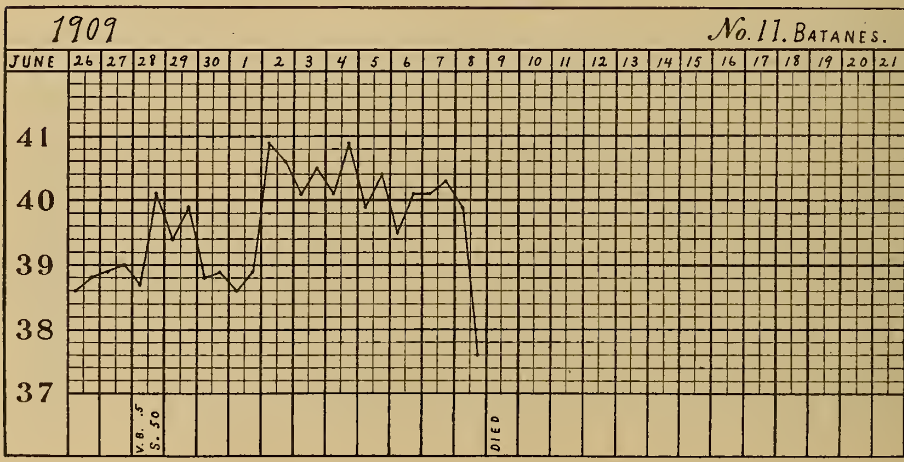
37
V.B..5
DIED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No. 11. BATANES.
JUNE 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
41
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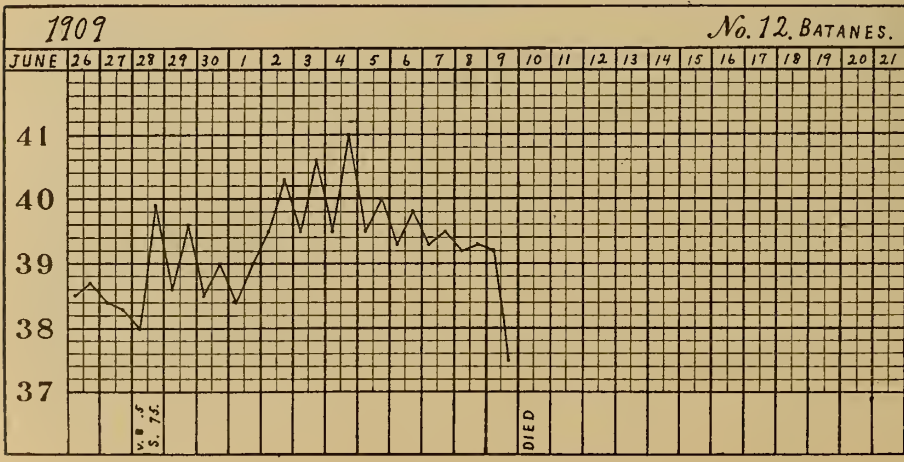
V.B. .5
S. 50
DIED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No. 12. BATANES.
JUNE 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
41
40
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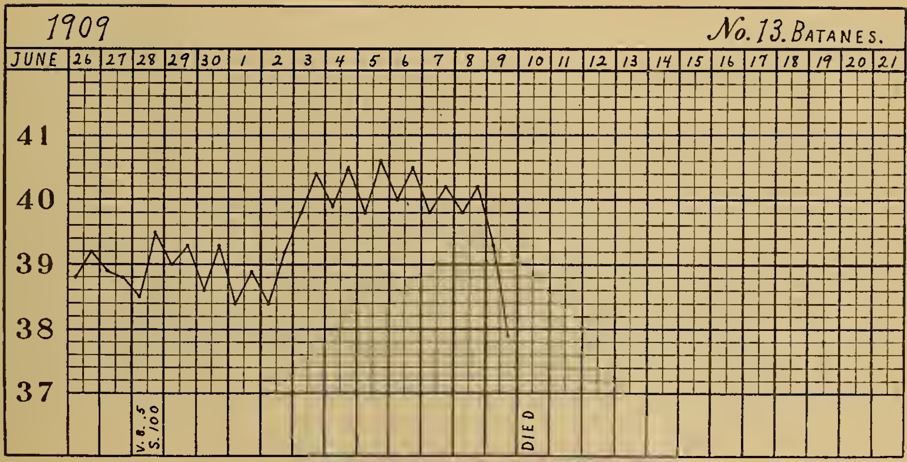
38
37
V.B. .5
S. 75.
DIED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No. 13. BATANES.
JUNE
41
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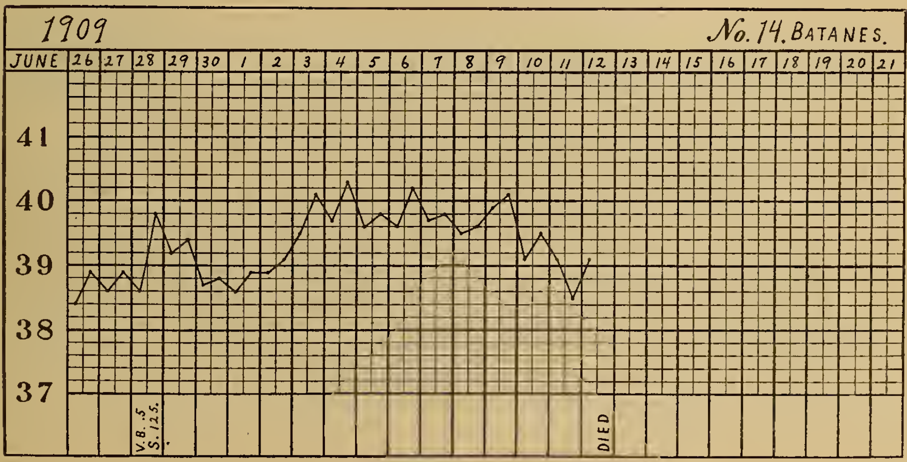
V.B. .5
S. 100
DIED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JUNE
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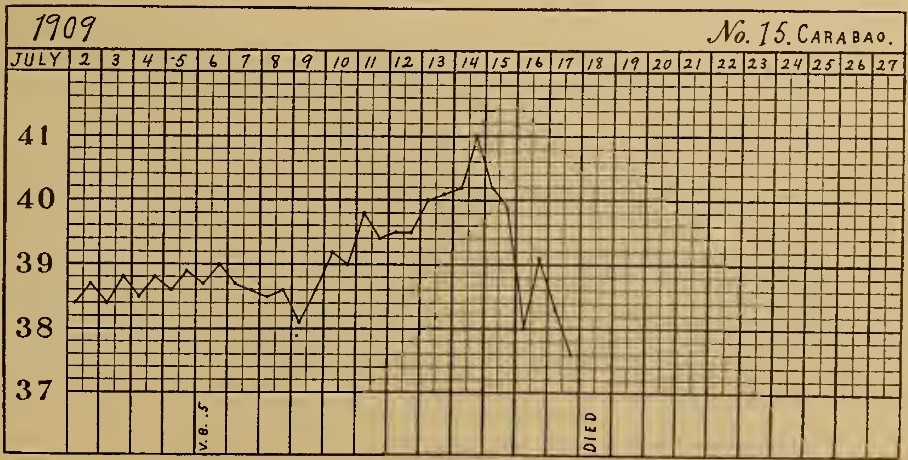
V.B. .5
S. 125.
DIED


1909
No. 15. CARABAO.
JULY
41
40
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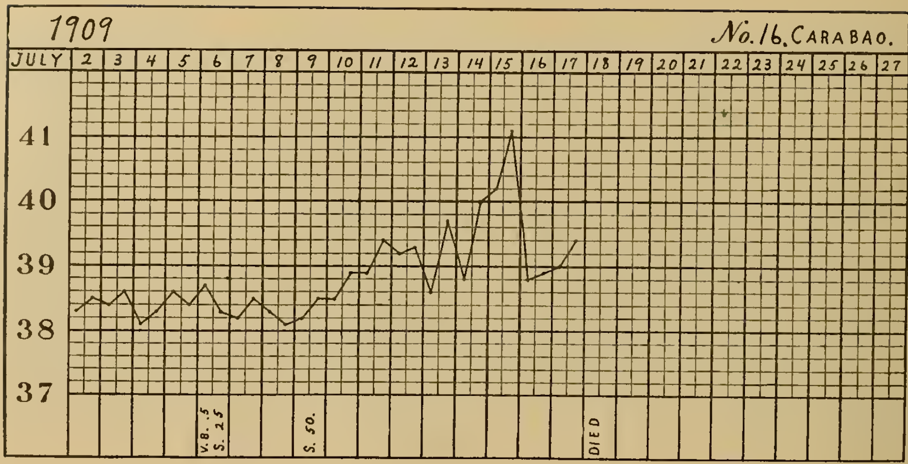
37
V.B. .5
DIED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JULY
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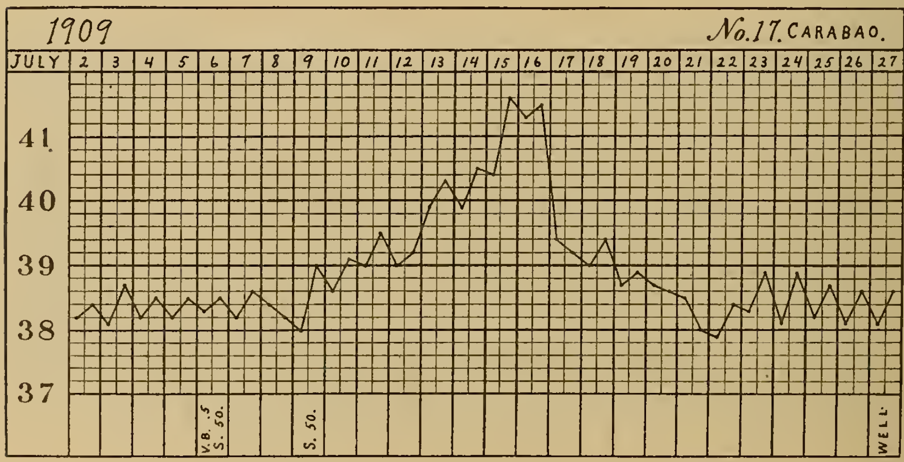
V.B. .5
S. 25
S. 50.
DIED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JULY
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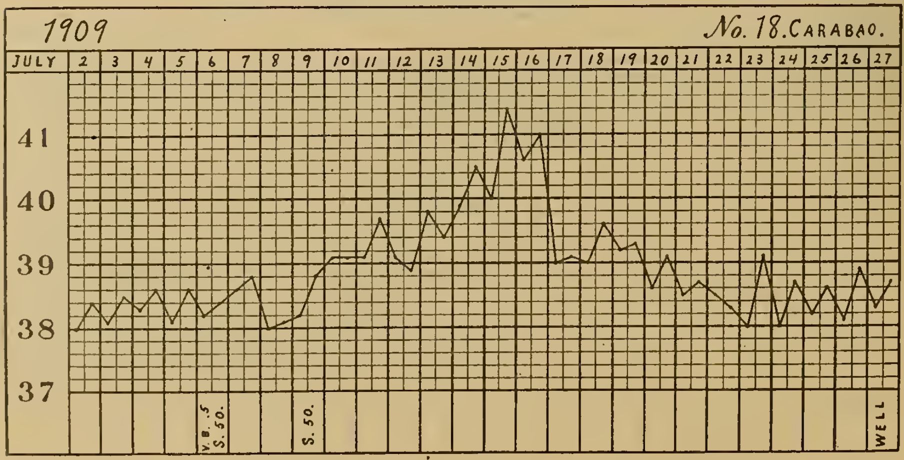
V.B. .5
S. 50.
S. 50.
WELL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JULY
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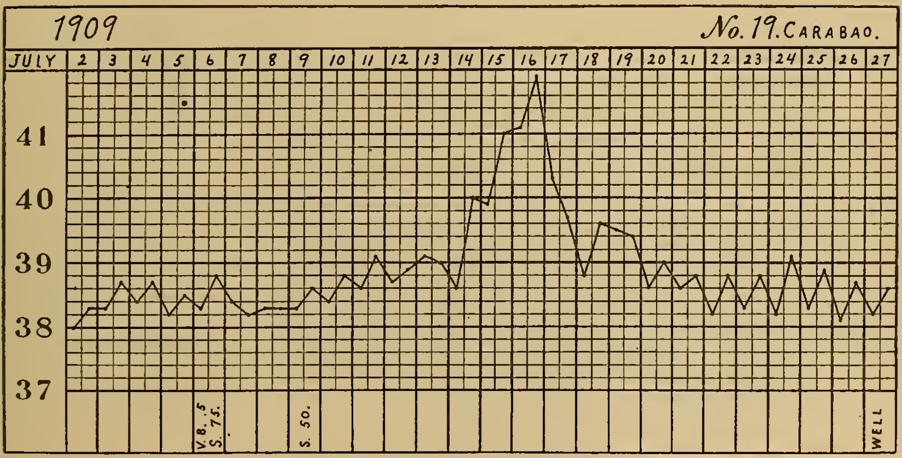
V.B. .5
S. 50.
S. 50.
WELL


1909
No. 19. CARABAO.
JULY 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
41
40
39
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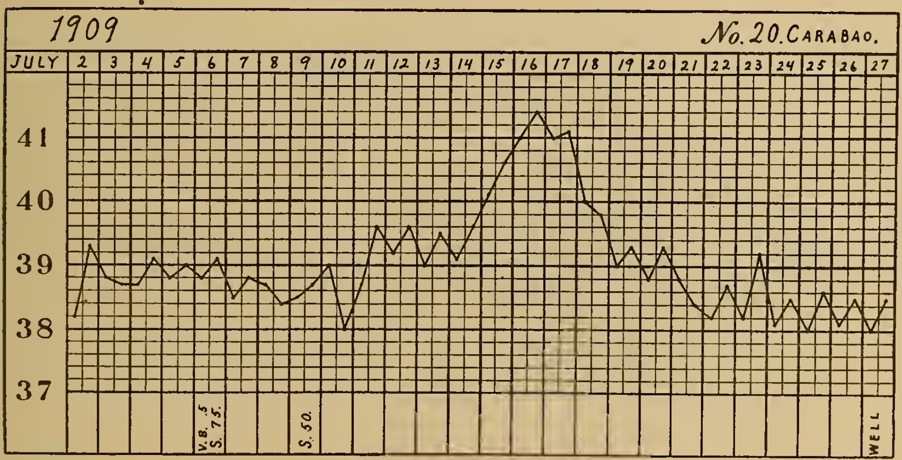
37
V.B. .5
S. 75.
S. 50.
WELL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No. 20. CARABAO.
JULY 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
41
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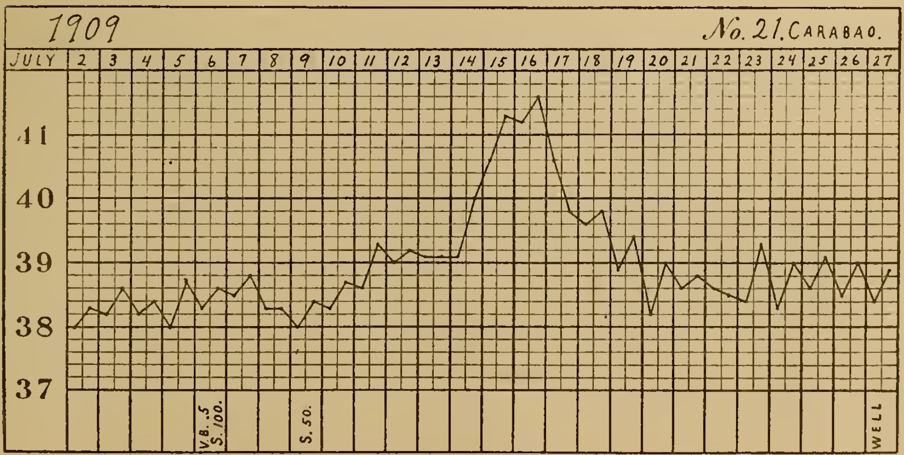
V.B. .5
S. 75.
S. 50.
WELL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No. 21. CARABAO.
JULY 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
41
40
39
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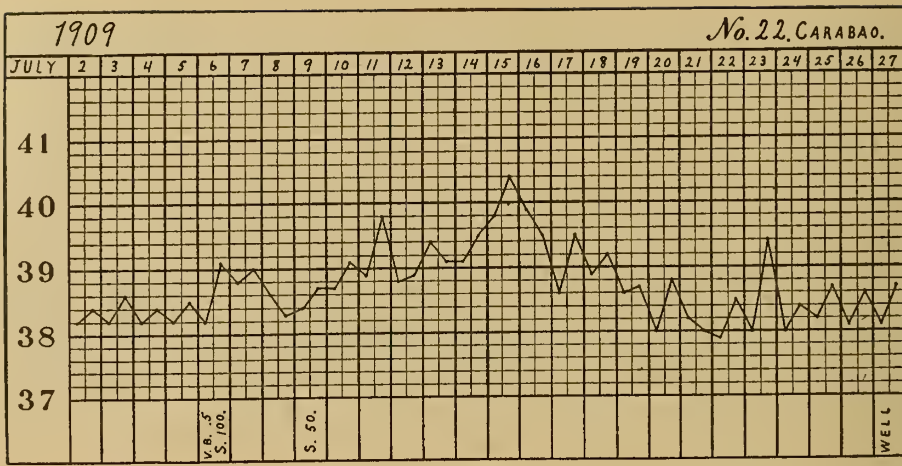
37
V.B. .5
S. 100.
S. 50.
WELL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JULY
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40
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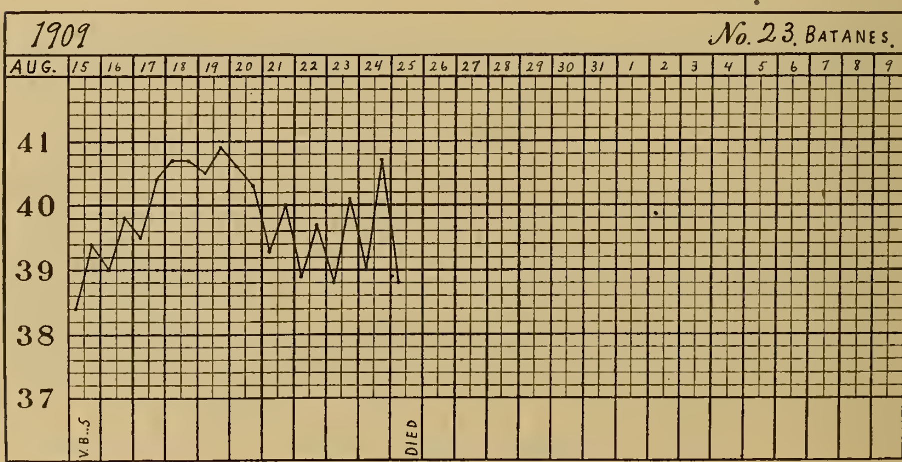
37
V.B. .5
S. 100.
S. 50.
WELL


1909
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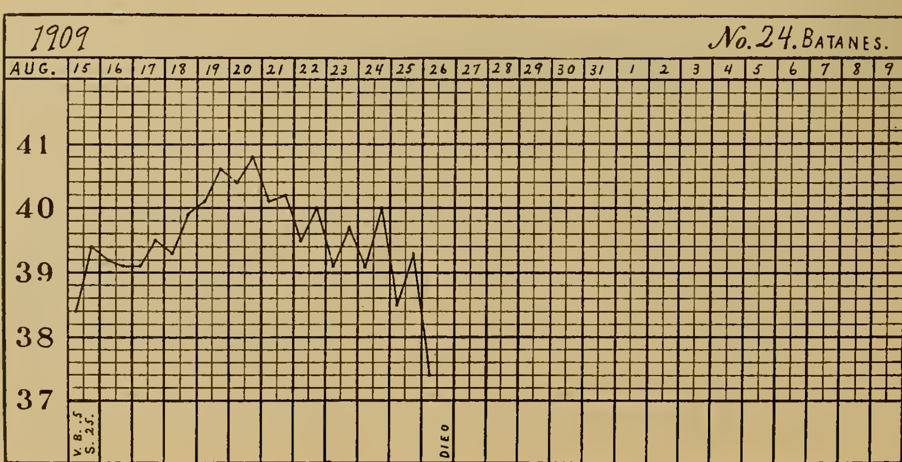
AUG.
41
40
39
38
37
V.B. .5
DIED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AUG.
41
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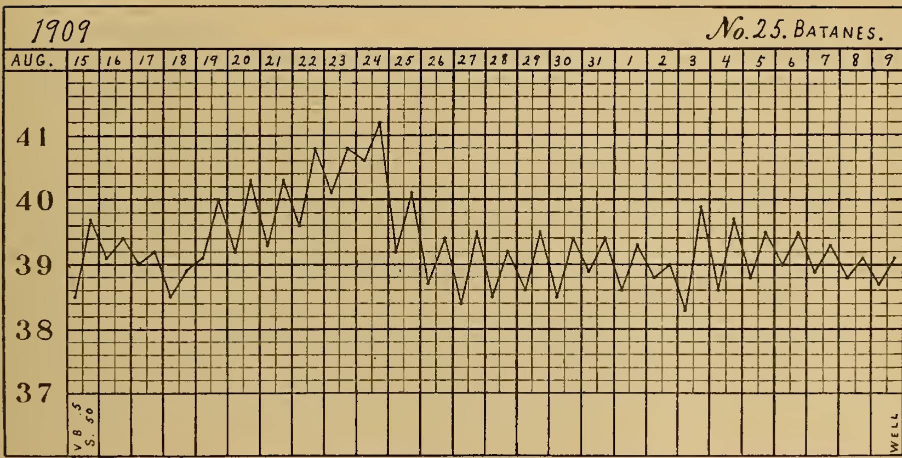
37
V.B. .5
S. 25.
DIED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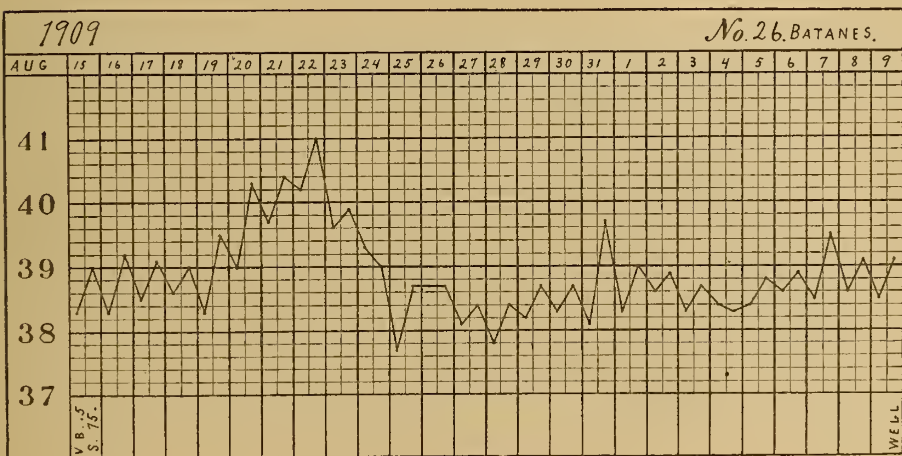
No. 25. BATANES.
AUG.
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
38
37
V B .5
S. 50
WELL


1909
No. 26. BATANES.
AUG
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
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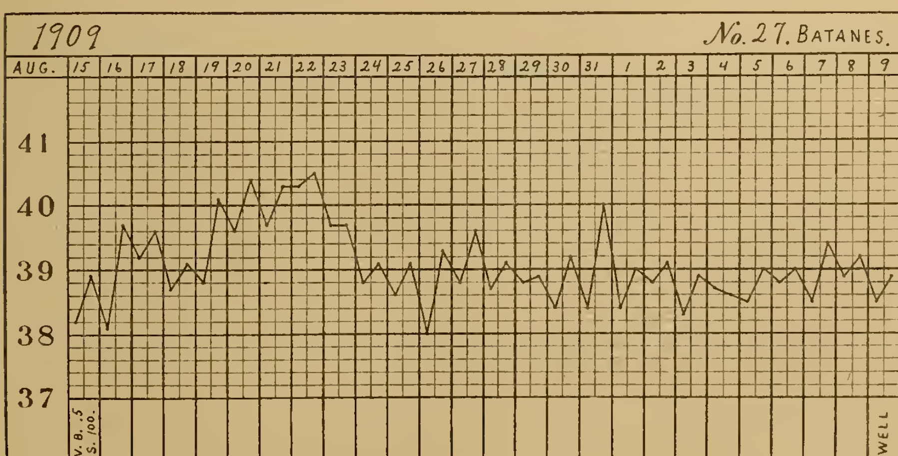
37
V B .5
S. 75.
WELL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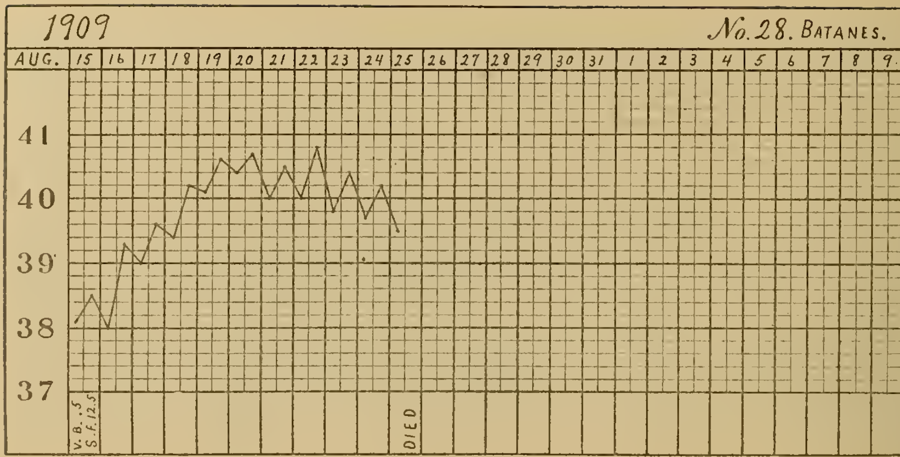
AUG.
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
41
40
39
38
37
V. B. .5
S. 100.
WELL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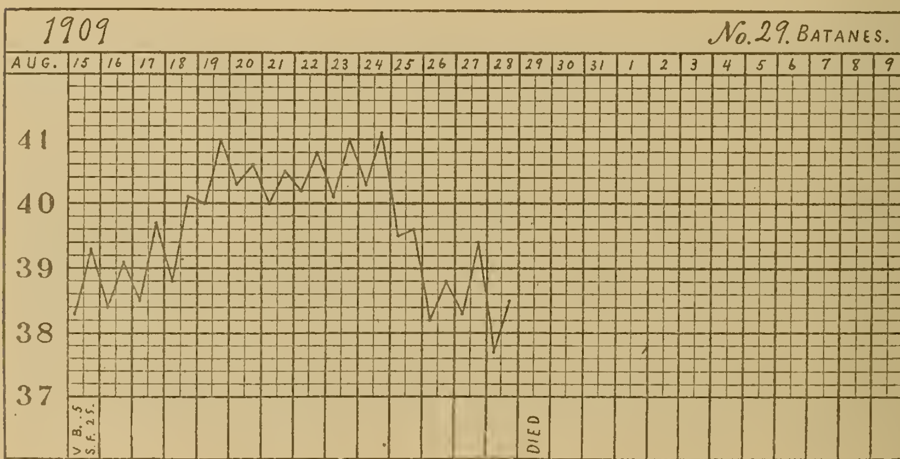
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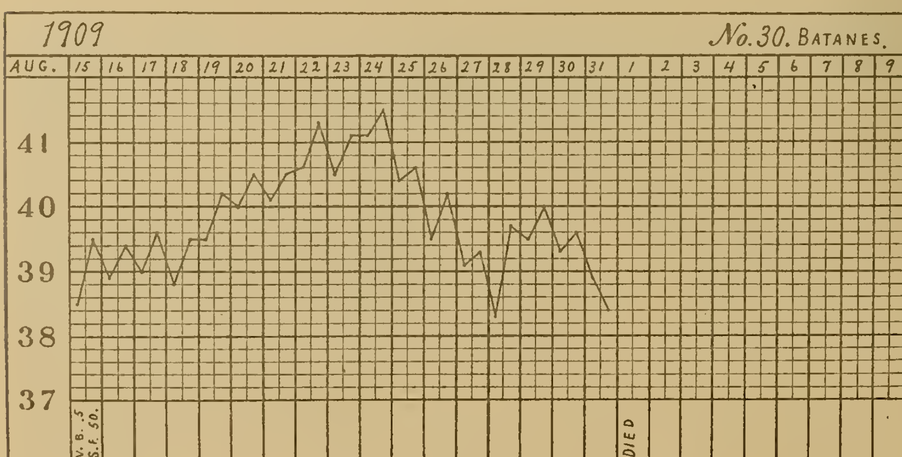
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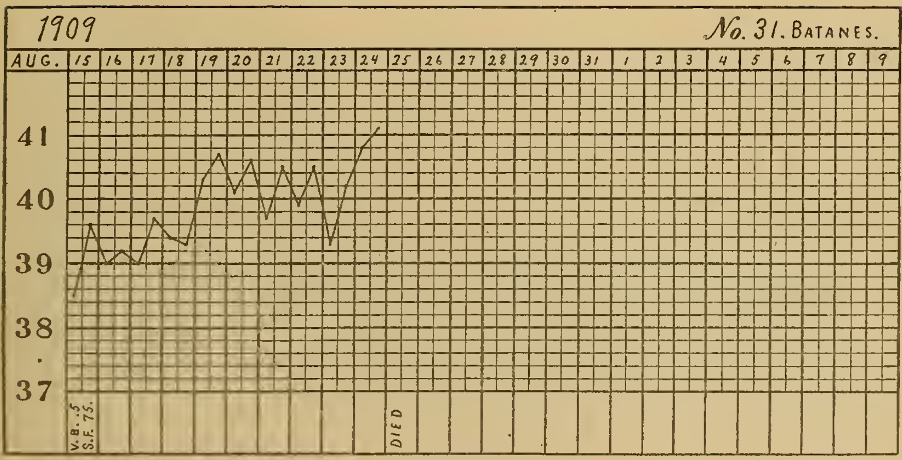
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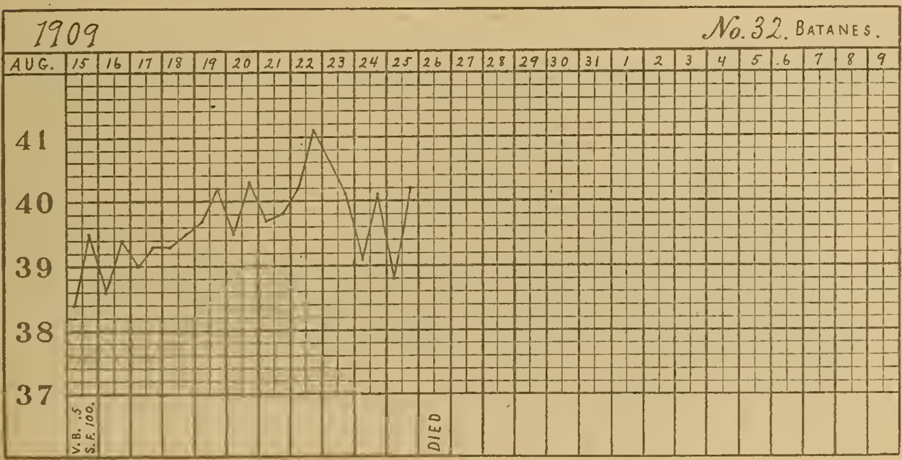
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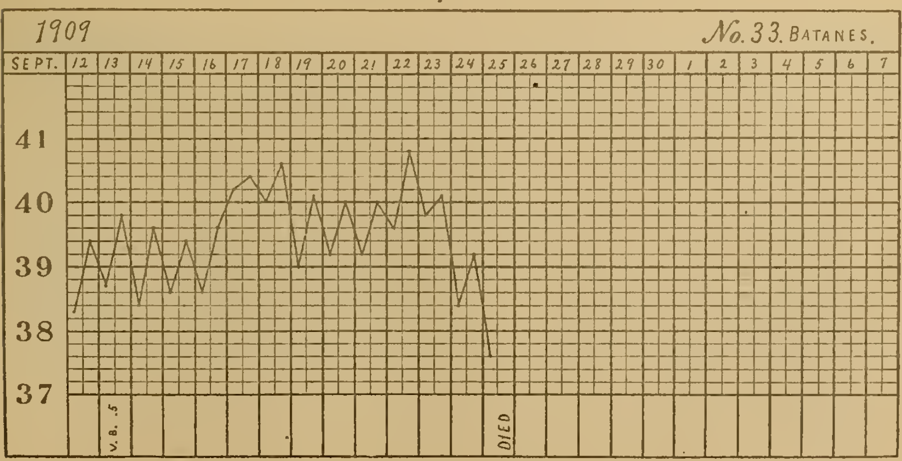
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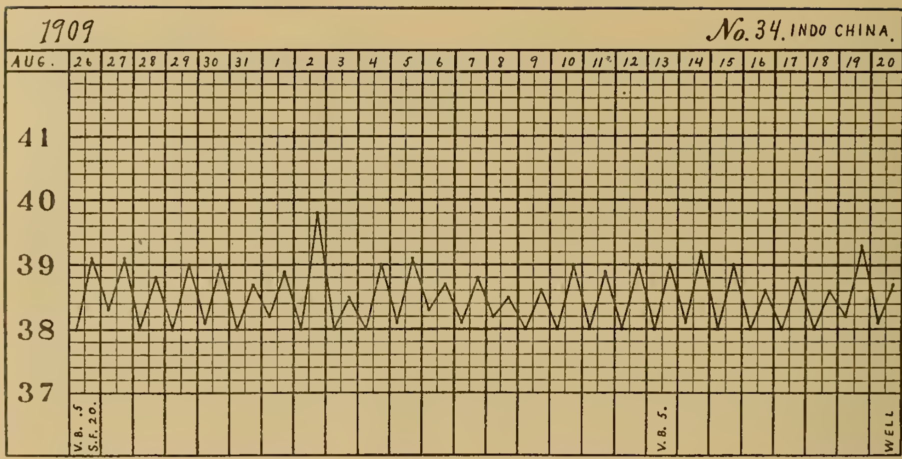
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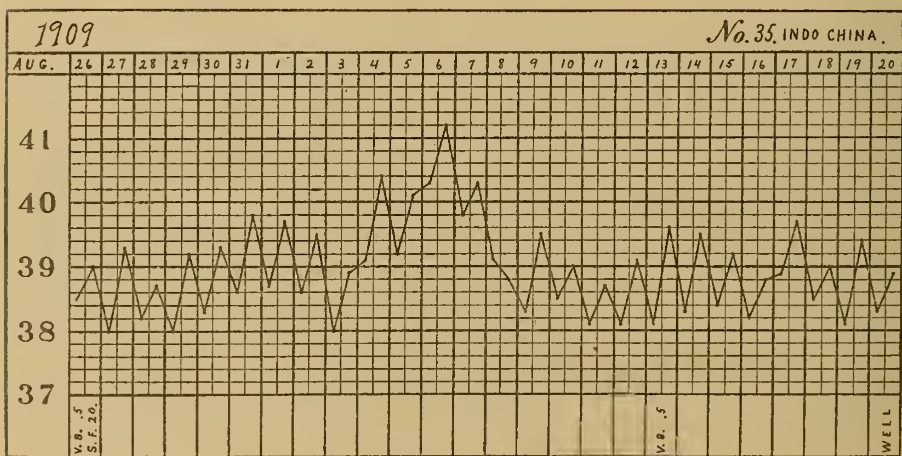
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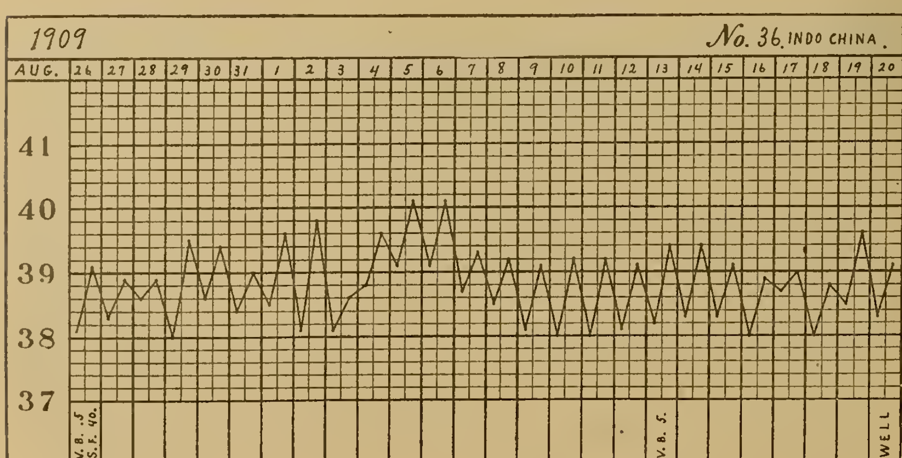
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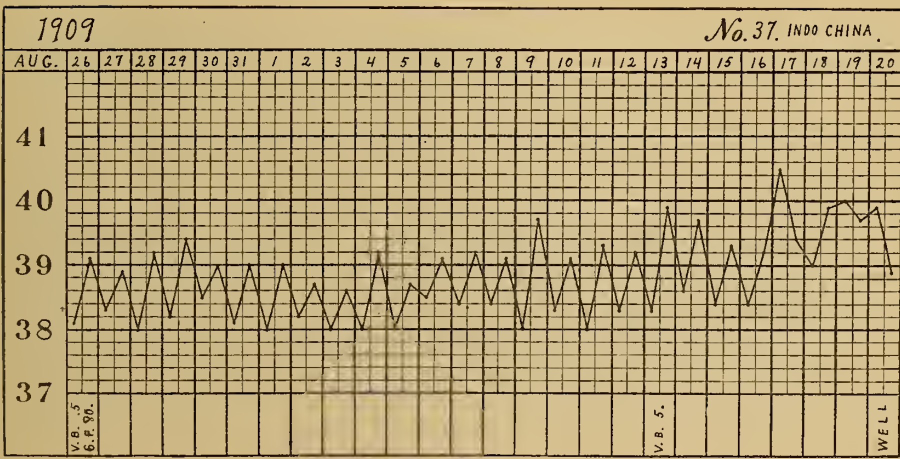
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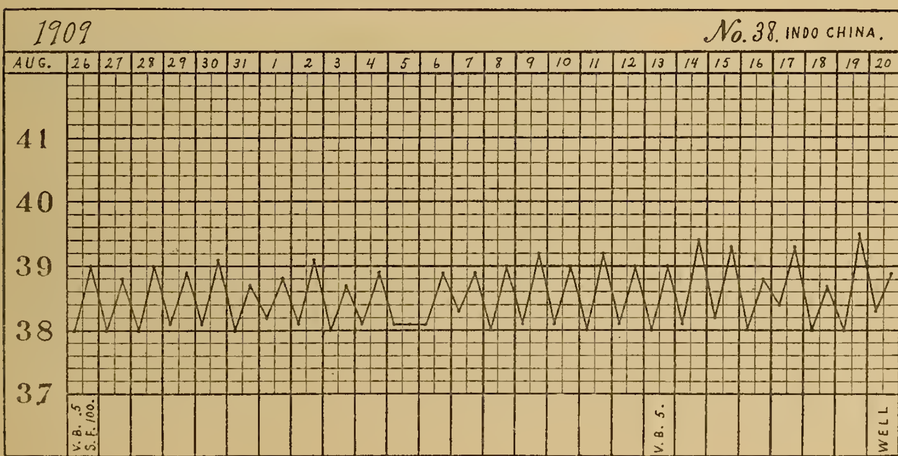
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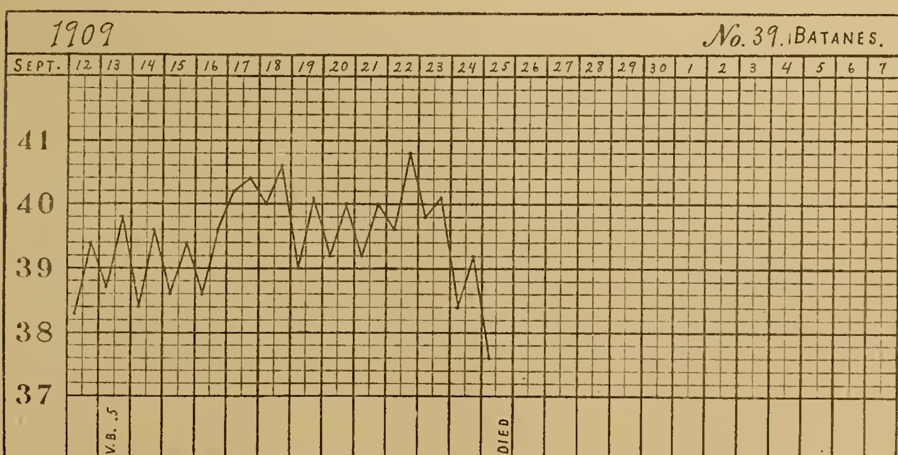
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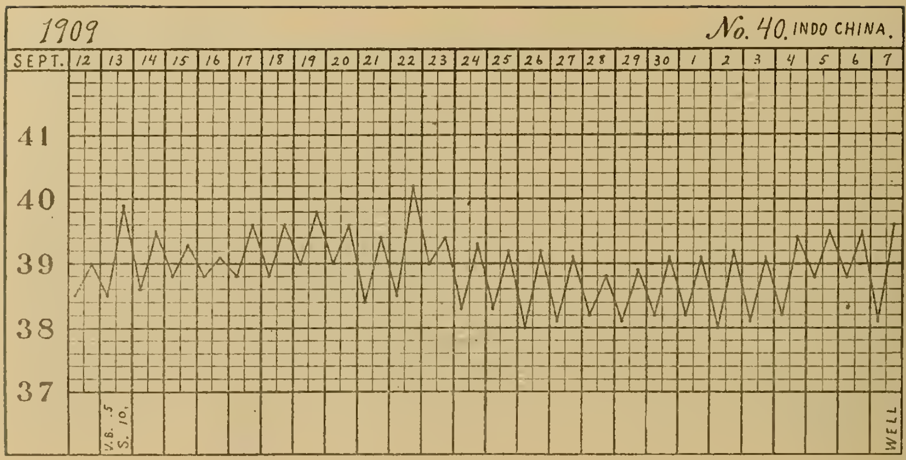
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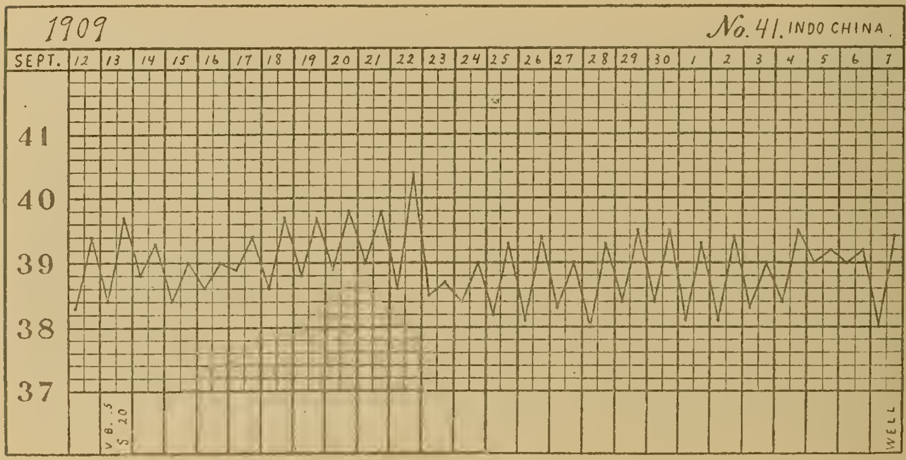
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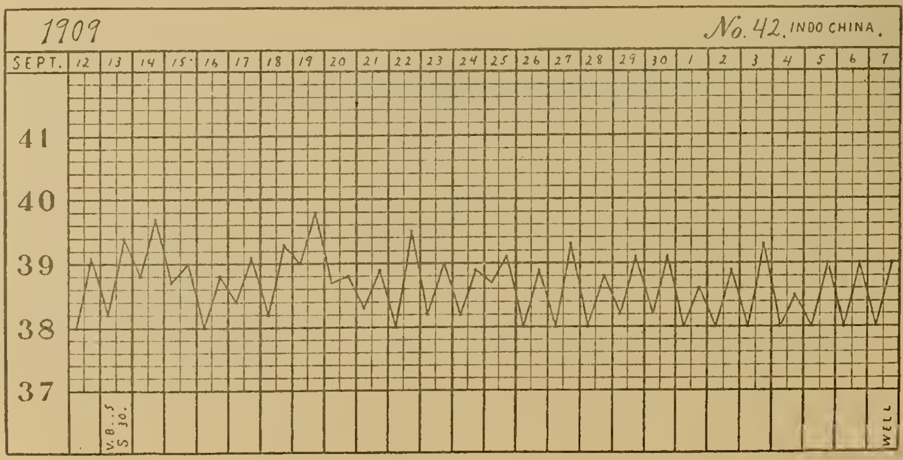
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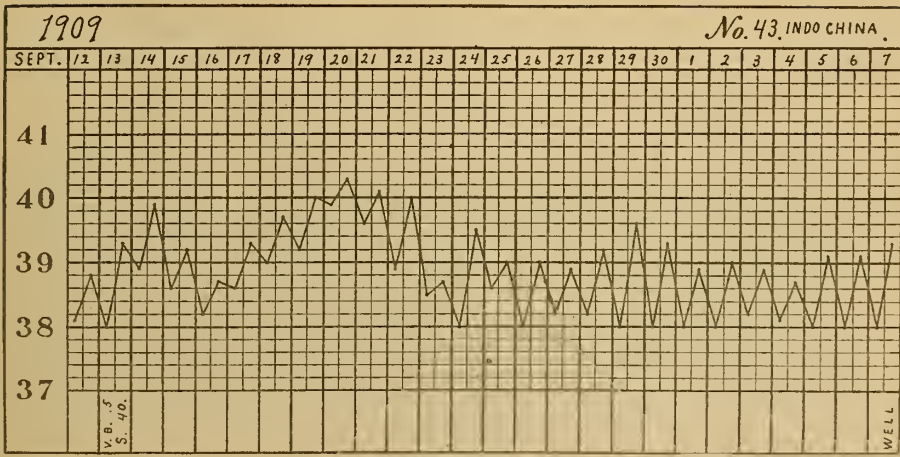
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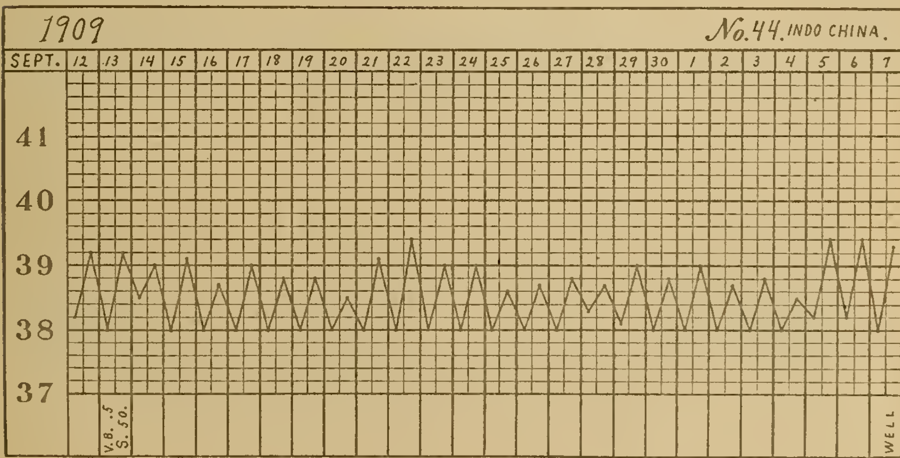
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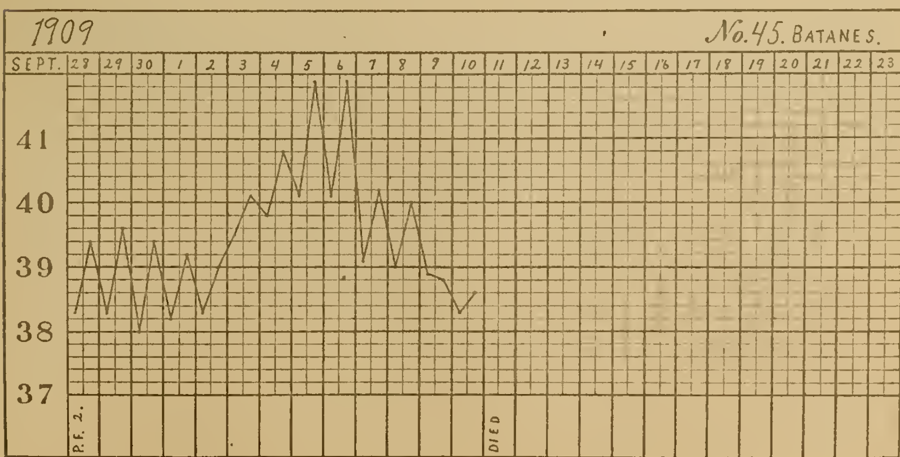
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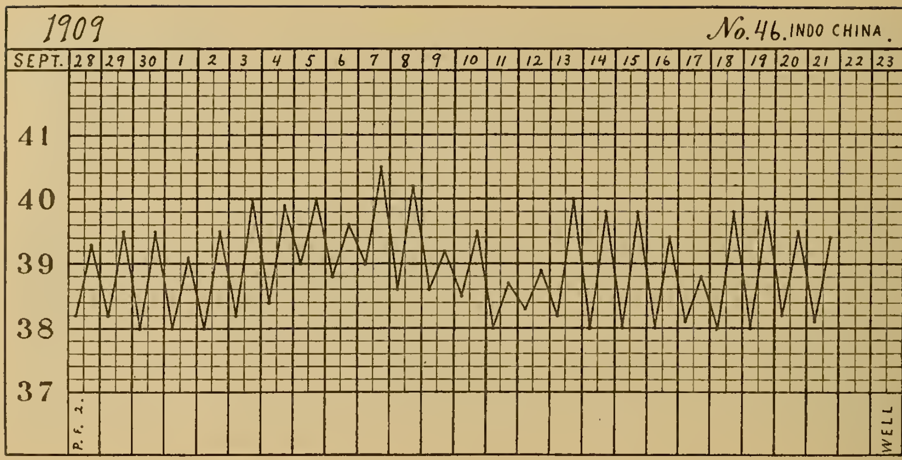
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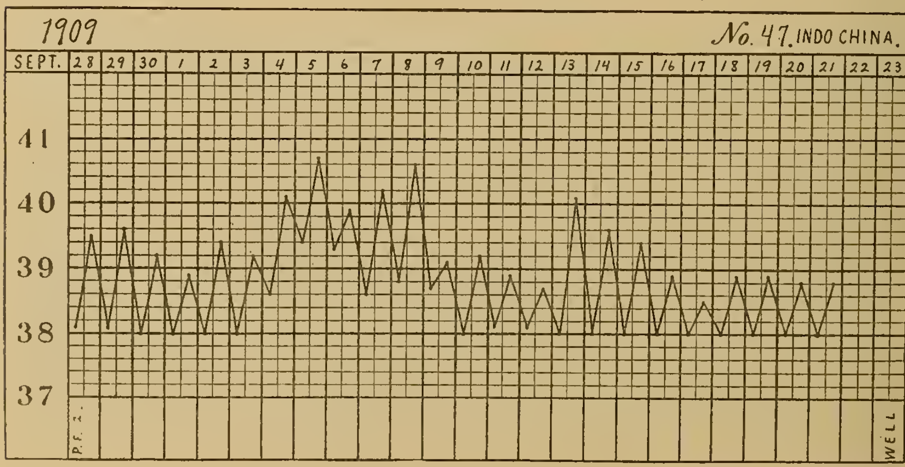
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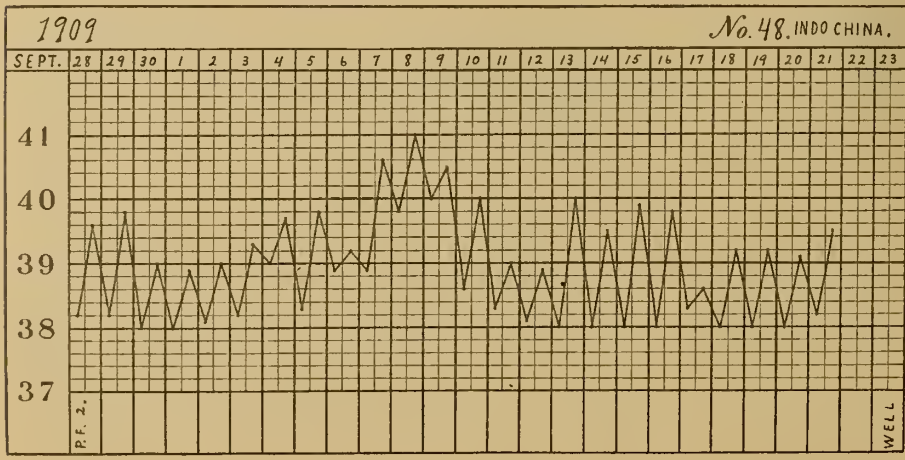
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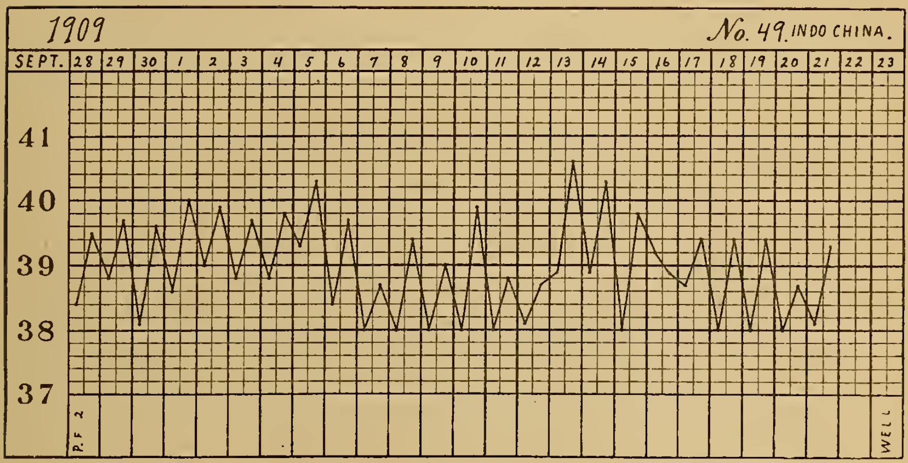
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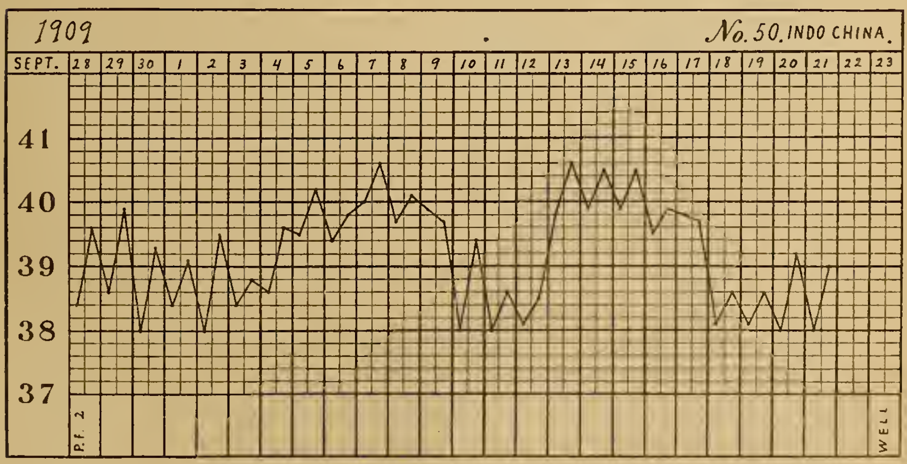
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TUBERCULOSIS IN THE PHILIPPINE ISLANDS.[1]

By Eugene R. Whitmore.[2]

(*From the Biological Laboratory, Bureau of Science, Manila, P. I.*)

Tuberculosis in its spread over the earth has not spared any nation or any climate, and the Philippine Islands have not been an exception to the rule. While cholera exists a large part of the time, and plague has occasionally appeared here, tuberculosis is always present, and causes far more suffering and many more deaths than any other disease.

The death rate from tuberculosis in Manila is 5 per 1,000. In the year 1906–7, one-sixth of all deaths in Manila were from tuberculosis, and one-seventh were from tuberculosis of the lungs The following table compiled from the reports of the Director of Health shows the deaths from tuberculosis in Manila since 1903.

Period.	Population.[a]	Deaths.	Deaths from tuberculosis.	Deaths from pulmonary tuberculosis.
September 1, 1903, to August 31, 1904	219,941	10,781	1,153	958
September 1, 1904, to August 31, 1905	219,941	9,731	1,246	1,121
July 1, 1905, to June 30, 1906	219,941	9,486	1,355	1,209
July 1, 1906, to June 30, 1907	223,542	8,251	1,296	1,148
July 1, 1907, to June 30, 1908	223,542	9,351	1,222	1,076

[a] Population for 1904, 1905 and 1906 is from the official census of Manila for 1903. Population for 1907 and 1908 is from the health census for 1907.

It is not easy to get satisfactory statistics of the prevalence of tuberculosis in the Philippines outside of Manila, but since the conditions which lead to the high death rate from tuberculosis in Manila do not exist to the same extent in the provinces, it is quite possible that tuberculosis is not as prevalent in the provinces as it is in Manila; however, we know that it is a very common disease throughout the Islands.

[1] Read at the Meeting of the Manila Medical Society, August 9, 1909.

[2] Captain, Medical Corps, United States Army; detailed to Biological Laboratory, Bureau of Science, Manila, P. I.

An important factor in the prevalence of tuberculosis here is the insanitary condition under which the people live. The majority of houses are greatly overcrowded, and at night all doors and windows are closed and the house is made as tight as it is possible to make a native bamboo structure. No precautions are taken to prevent contagion and it is not uncommon for ten to fifteen people to live and sleep in a small house of one room; sometimes from one to five of these people have tuberculosis and are coughing and spitting about the house so that all the inmates are constantly exposed to infection. Underfeeding also predisposes to the disease by lowering the resistance of the individual, but it can probably be truly said of the Philippines that "without the house, tuberculosis would not exist."

In 100 autopsies at the Philippine Medical School tuberculous lesions were found in 35.

The Bureau of Health of Manila is taking energetic steps to prevent the spread of tuberculosis. Overcrowding is prohibited, light and ventilation have been provided for, antispitting ordinances have been passed, and an active educational campaign is being carried out through the public schools and the daily press. It is also proposed to open a free dispensary in the city of Manila for tuberculous cases, and to erect one or more "tent colonies" for the open-air treatment of tuberculosis.

I am informed by the chief veterinarian of the Bureau of Agriculture that tuberculosis is very rare among the cattle in the Philippines—so rare as to be almost unknown, and also that tuberculosis is unknown among the carabaos, pigs, and goats. Furthermore, the natives drink little milk and eat little butter, and what milk they do drink is mainly derived from carabaos and goats. Still, surgical tuberculosis in man is by no means uncommon. In 1,400 surgical cases in St. Paul's Hospital, Manila, there have been 30 cases of joint tuberculosis, 27 cases of bone tuberculosis, and 32 cases of cervical and axillary gland tuberculosis. Among 732 patients in the University Hospital of this city there have been 5 cases of bone tuberculosis and 18 of cervical and axillary gland tuberculosis.

In the dispensary at the University Hospital for the year July 1, 1908, to June 30, 1909, there were 6,650 cases, of which 1,882 were surgical. Of 84 cases of chronic bone and joint disease 30 were instances of tuberculosis of the bones and joints. Of 92 cases of adenitis, 63 showed tuberculous lesions of the cervical and axillary glands.

Summing up the available (reliable) statistics on surgical tuberculosis in Manila, we obtain 187 cases of bone, joint, and gland tuberculosis out of a total of 4,014 surgical cases; i. e., a percentage of 4.65. This is certainly not a lower percentage than is found in Europe and

America. It is not possible to get any statistics on the amount of surgical as compared to medical tuberculosis, as comparatively few of the cases of pulmonary tuberculosis here are admitted to the hospitals. It has been considered by many writers that bone, joint and gland tuberculosis are produced by an infection with the bovine bacillus; the extreme rarity of tuberculosis in cattle in the Philippine Islands, together with the frequency of these types of infection in man, certainly speak against such a view.

Tuberculosis of the testicle is rather common in Manila—10 cases having been admitted to St. Paul's and 2 to the University Hospital. Doctor Saleeby of the latter institute informs me that tuberculosis of the mesenteric glands is unusually common here.

The following table shows the number of patients suffering with pulmonary tuberculosis during each of the past four years in Bilibid Prison, where over 3,000 prisoners are constantly confined.

	July 1, 1905, to June 30, 1906.	July 1, 1906, to June 30, 1907.	July 1, 1907, to June 30, 1908.	July 1, 1908, to June 30, 1909.
Remaining from previous year	100	153	153	156
Admitted	188	91	124	192
Died	84	40	58	86
Discharged	39	49	62	137
Released	12	2	1	1
Remaining for next year	153	153	156	124

Hygiene and diet are at present the chief factors in the treatment of tuberculosis, and, while specific treatment should logically form the basis, it has as yet shown no results which would entitle it to this position.

It would probably fill a volume even to mention the substances that have been advised in the specific treatment of tuberculosis. A few that are probably forgotten by most of us to-day are tannin, lead acetate, garlic, hydrogen sulphide, carbon dioxide, corrosive sublimate, boric acid, borax, carbolic acid, fluorides, camphor, etc. It generally happens that the amount of space devoted to the discussion of any of the specifics is inversely proportional to the length of time which has elapsed since the specific action was suggested. In order to test, in a comparative way, some of the more recently suggested specifics in the treatment of tuberculosis, I selected one hundred adult males who were suffering from pulmonary tuberculosis and were confined in the tuberculosis wards of the hospital at Bilibid Prison.

None of our cases were in the first stage; 80 were in the second;

and 20 were in the third stage of the disease. None of the cases showed any signs of syphilis.

The tubercle bacillus was found in the sputum of each patient before he was subjected to treatment, and von Pirquet's skin test was made on each. During the progress of the work, every man's temperature was taken twice a day, all were weighed once a week, and the sputum was examined once a month.

With regard to diet, clothing, habits of living and sleeping rooms, the patients were all under practically identical conditions. Hygienic and dietetic treatment are carried out with all patients in the hospital, and in April, 1909, a roof ward was opened, where the patients have protection from the sun and rain but are exposed to unobstructed air circulation from all sides.

An attempt was made to determine whether or not the method of complement fixation offers a means of differentiating between infection with the bovine and with the human type of the tubercle bacillus.

Twenty-eight of the 100 cases of pulmonary tuberculosis, 2 cases of bone tuberculosis, and 3 strong, healthy men were tested in regard to this point. Tubercle bacilli were present in the sputum of all the cases of pulmonary tuberculosis, and all of the cases of tuberculosis gave a positive skin reaction. The skin test was negative on all of the normal men. The blood serum of each man was tested for complement fixation with both human and bovine tuberculins (old) in the usual way with the usual controls (old tuberculins were used, as filtrates were not at hand[3]).

In the preliminary tests it was found that our tuberculins in dilution of 1 to 14 never gave fixation of complement when mixed with inactivated normal human serum diluted 1 to 5, using a hæmolytic system of goat corpuscles (5 per cent emulsion), anti-goat-rabbit serum and fresh guinea pig complement diluted 1 to 10.

The hæmolytic amboceptor was of such strength that 1 cubic centimeter of a 1 to 1,200 dilution completely hæmolyzed 1 cubic centimeter of corpuscle emulsion in the presence of 0.1 cubic centimeter of fresh guinea pig complement. As I was working with human sera it was not practical to obtain large amounts of serum, so I used 0.5 cubic centimeter of the serum dilution as suggested by Simon.[4] The above dilutions were employed throughout the work, using two dissolving doses of the hæmolytic amboceptor.

[3] Détre's differential skin test is made with filtrates of bouillion cultures of human and bovine tubercle bacilli. (*Wien. klin. Wchnsch.* (1908), 21, 173, 1410.)

[4] *Journ. Exper. Med.* (1908), 10, 673.

The following table shows the results of these tests:

Serum. Number.	Human tuberculin.	Bovine tuberculin.	Condition of person from whom serum was taken.
1	—	—	Normal.
2	—	—	Do.
3	tr.	slt.	Normal. Physician working in tuberculosis wards.
4	+	+ + +	Tuberculosis of bones of ankle, sinus, recovering. Had recovered 6 months later.
5	tr.	slt.	Tuberculosis of bones of ankle, no sinus, stationary, condition unchanged one year later.
6	—	—	Pulmonary tuberculosis.
7	slt.	+	Do.
8	tr.	slt.	Do.
9	slt.	[illegible]	Do.
10	+	—	Do.
11	+	—	Do.
12	+	slt.	Do.
13	slt.	—	Do.
14	slt.	+	Do.
15	—	slt.	Do.
16	+	slt.	Do.
17	+ +	+ + +	Do.
18	slt.	+	Do.
19	+	+ +	Do.
20	+ +	+ + +	Do.
21	+	+ +	Do.
22	+	+ + +	Do.
23	+		Do.
24	+ +	+ + +	Do.
25	+ +	+	Do.
26	—	+	Do.
27	+ +	+ + +	Do.
28	+	+ + +	Do.
29	+	+	Do.
30	+ + +	+ + +	Do.
31	—	—	Do.
32	—	+	Do.
33	+ +	—	Do.

— = No blocking of hæmolysis.
tr = trace of blocking of hæmolysis.
slt = slight blocking of hæmolysis.
\+ = partial blocking of hæmolysis.
\+ + = nearly complete blocking of hæmolysis.
\+ + + = complete blocking of hæmolysis.

Excepting Nos. 10, 11, 32 and 33, there is fair correspondence between the degree of fixation of each serum with the two tuberculins.

The skin test was always made with both tuberculins and the bovine variety usually gave the stronger reaction, while the human seemed to give as marked fixation of complement as did the bovine.

The tuberculins used in these experiments had been in stock in the laboratory for a long time and the human tuberculin yielded only a slight skin reaction, while the bovine gave a well-marked one. Since both tuberculins yielded equally strong fixation of complement with the tuberculous sera, we believe that the experiments indicate that the substances in the tuberculins which are concerned with the fixation of complement reaction are not identical with those calling forth the cutaneous reaction.

It is seen from the table that the two tuberculins yielded approximately the same degree of fixation of complement with the various tuberculous sera and therefore the method is not an aid in differentiating the two types of infections. This can only be done by the isolation of the infecting organism in pure culture followed by a careful study of its cultural characteristics and pathogenicity for animals.

The cases treated were divided into five series of 20 cases each. They were, as nearly as possible, so assigned that the men of one series were in approximately the same physical condition and the same stage of the disease as were the men in any other series.

The first of the five series was further divided into two groups (A and B), receiving tuberculins by mouth and hypodermically, respectively.

The second series of twenty men was given succinimide of mercury according to the method of Wright [5] of the United States Navy.

The third series was given atoxyl or the similar compounds, soamin and arsacetin, intramuscularly.

The fourth series was given cinnamate of mercury intramuscularly. The cinnamate of mercury was made at my request by Doctor Bacon of the chemical laboratory of this Bureau. I hoped in this single drug to combine whatever of value there might be in both the Landerer and Wright methods of treatment. Landerer's idea was that the cinnamic acid caused a leucocytosis and set up an aseptic inflammation about the tuberculous focus resulting in cicatrization of the latter. He used chiefly sodium cinnamate (hetol) and preferred intravenous injection, although he used intramuscular injections almost exclusively for children. He considered that the intramuscular injections were of far less value than the intravenous, and that they were useless in severe cases. Landerer used small doses—25 milligrams, or rarely 50 milligrams as the maximum dose—while certain French writers have reported good results from using much larger doses.

Series 1, 2, 3, and 4 received no other medicinal treatment except an occasional cathartic or sedative cough mixture.

[5] *New York Med. Jour.* (1908), 88, 385, and *U. S. Naval Med. Bull.* Wash. (1908), 2, 1.

Series 5 was a control and the men were given the usual hospital treatment according to the individual case.

No patient was discharged as recovered until his cough had stopped, signs of an active lesion had disappeared and the sputum had been found negative for tubercle bacilli at least twice.[6]

During six months' treatment of these cases there have been twenty-one recoveries and nineteen deaths. Five men have been released from prison, leaving 55 of the cases still in the hospital.

The following table shows the number of recoveries, deaths and patients still in the hospital:

Series.	Died.	Returned to duty.	Remaining in hospital.	Number released, and condition on release.
1. Tuberculin:				
A. By mouth	0	3	5	1 gained 6 pounds.
B. Hypodermically	1	3	6	1 lost 8 pounds.
Total for tuberculin series	1	6	11	2.
2. Succinimide of mercury	7	3	10	
3. Atoxyl	5	2	10	1 gained 38 pounds in 35 days; 1 gained 1 pound; 1 lost 4 pounds.
4. Cinnamate of mercury	2	6	12	
5. Control cases	4	4	12	
Total	19	21	55	5.

From this table it is seen that the series treated with tuberculin and with cinnamate of mercury give the highest recovery rate; 6 of 20 cases, or 30 per cent in each instance.

The succinimide of mercury gives the highest death rate, with atoxyl and the control series following. The succinimide of mercury gives a recovery rate of 3 in 20 cases which is less than the control series, 4 in 20.

[6] When tubercle bacilli could not be found in the sputum by the ordinary method of examination, I have made use of the ligroin and antiformin methods. I now prefer a combination of the two methods as being clean, accurate and rapid. The sputum is treated with ten to fifteen times its volume of a 20 per cent solution of antiformin, a strongly alkaline solution of sodium hypochlorite with a content of about 4.2 per cent free chlorine. After standing until the sputum becomes homogeneous and fluid, about 2 cubic centimeters of ligroin are added and the mixture is shaken until a thorough emulsion is formed. Then the mixture is heated to 60° F. on a water bath until the ligroin has separated in a layer on top of the mixture. Several loops of the material in the limiting layer immediately at the lower border of the layer of ligroin are spread upon a warmed slide and fixed and stained in the usual way. It is often possible to find tubercle bacilli readily in a sputum by this method when they can not be found by the ordinary method of preparing the smear.

The attempt was made to give the succinimide of mercury, as advised by Wright, in doses of one-fifth of a grain every other day for fifteen doses, then two-fifths of a grain every four days for fifteen doses, then three-fifths of a grain once a week; but we very soon found that our cases would not stand that much mercury. In this connection it is well to remember that one-fifth of a grain of succinimide of mercury contains the same amount of the metal as one-eighth of a grain of bichloride of mercury, so we were not giving very large doses. Still our patients could not stand that amount of succinimide.

Possibly the succinimide does not cause as much induration and soreness at the site of injection, but it does not seem to have any other advantage over bichloride of mercury.

Thirty-eight of our cases had fever above 100° at the time treatment was started. Fifteen of these fever cases have died, while only 4 have died of the 62 patients who had normal temperature or fever of less than 100° when treatment was started. Only one man who had fever above 100° when treatment was started has been discharged as recovered. Of the remaining cases who had fever above 100°, 3 have remained stationary in weight, 11 have lost and 10 have gained weight.

From this short series it would seem that tuberculin had given the best results with one death and six recoveries; cinnamate of mercury next with two deaths and six recoveries; the control series next with four deaths and four recoveries; atoxyl next with five deaths and two recoveries; succinimide of mercury last with seven deaths and three recoveries; or possibly atoxyl and succinimide of mercury should change places.

We can not draw conclusions from so few cases, but it is evident that none of the methods of treatment we used is of very great value in the treatment of tuberculosis among the natives of the Philippines.

At a later date we hope to be able to give a full report of the final result in this series of one hundred cases.

I take this opportunity of thanking Dr. W. A. Christensen, physician at Bilibid Prison, for valuable assistance rendered throughout the work.

NOTICE.

The president of the American Gynecological Society has appointed a committee to report at the next annual meeting in Washington, on the present status of obstetrical teaching in Europe and America, and to recommend improvements in the scope and character of the teaching of obstetrics in America.

The committee consists of the professors of obstetrics in Columbia University, University of Pennsylvania, Harvard, Jefferson Medical College, Johns Hopkins University, Cornell University and the University of Chicago.

Communications from anyone interested in the subject will be gladly received by the chairman of the committee, Dr. B. C. Hirst, 1821 Spruce street, Philadelphia, Pennsylvania.

REVIEW.

Practical Bacteriology, Blood work, and Animal Parasitology. By E. R. Stitt, A. B., Ph. G., M. D. Cloth, pages XI–294, 86 illustrations, $1.50 net. Philadelphia; P. Blakiston's Son & Co., 1909.

In this little volume of less than 300 pages Doctor Stitt has given clinical methods for laboratory diagnosis such as is required of the average medical man.

This book is especially adapted for use by physicians in the tropics, where there are few well-equipped clinical laboratories, where every man must do most of his own laboratory work and must improvise most of his apparatus and where comparatively few books are available for reference. Doctor Stitt's large experience in the tropics makes his writing from that standpoint of great value. The key at the beginning of each chapter on study and identification of bacteria is a great help in practical work, especially to the man who has not had the advantage of laboratory training.

The four parts on bacteriology, study of the blood, animal parasitology, and clinical bacteriology and animal parasitology of the various body fluids and organs, are accurate, concise and practical treatises on the various subjects named. Blank leaves for notes have been put in at the end of each part.

The illustrations are good and the printing is well done on good paper. The book contains a large amount of information that is not contained in text-books, or is scattered through a number of books. Very few errors have crept into the work and it can be heartily recommended as a practical laboratory guide.

E. R. W.

INDEX.

[NOTE.—The heavy-faced type is used in this index only in cases where the species is new, that is, pertaining to this year.]

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