

tries silenced, and the wheels of their commerce obstructed at many points—Alabama has been safely and serenely protected, her protection being the proudest trophy that could be laid on the tomb of Jerome Cochran.

The scope of "state medicine" is practically boundless. With a complete and cooperative public health system—one extending in logical continuity from counties to nation—the principles of sanitary science could be enforced and taught in every educational institution of the land, from the humblest rural school to the most renowned university, thus securing the sturdiest physical and broadest mental growth and development of which the youth of the country are susceptible; the foul atmospheres of overcrowded workshops could be kept fresh and pure, thereby supplying the toilers with an abundance of that life-giving element without which the best work can not be done; the strength of arms digging out mineral and metallic wealth deep down in the bowels of the earth could be upheld and reinforced; the hygienic rights of helpless victims paying the penalties of crimes in the prisons of the country could be guarded and defended; crowded counting houses, where busy brains are often forgetful of the needs of the body, could be rendered safe and salubrious; our soldiers and sailors could be protected from the ravages of diseases frequently more fatal than the carnage of battle; yea, the light and the teachings of modern sanitary science could illuminate and fortify every home of the land and, like a good angel, could turn away from happy families the untimely visits of the "pale messenger."

These and much more can state medicine do to place the standard of physical manhood and womanhood on a higher, purer and better plane.

SANITATION IN THE CANAL ZONE.*

W. C. GORGAS, M.D.

Colonel and Assistant Surgeon-General U. S. Army; Chief Sanitary Officer, Canal Zone.
ANCON, CANAL ZONE.

Being a working doctor and one not accustomed to addressing audiences, I must ask your indulgence in making the attempt. Indeed, I would never have thought of making this address, except that your dean, Dr. Polk, assured me that some account of our sanitary work at Panama would be acceptable. And I can see that an outline of the sanitary work at Panama might be of use to men just being graduated into our profession, as an illustration of a new avenue of useful work in the way of tropical sanitation that has developed in the last eight or ten years.

Great advances have been made in this line of work in that period, due to important discoveries made just prior to that time, and the English and Americans have done a great deal of useful work in sanitation in their tropical colonial possessions. The discovery that the bite of a certain species of mosquito is the only means of transmitting yellow fever has enabled our sanitary workers in the tropics greatly to improve the health conditions of the whites who are necessarily employed there.

When we took possession of Cuba in 1898, the great sanitary problem was the control of yellow fever. The discovery made in 1901 by the Army Medical Board, composed of Drs. Reed, Carroll, Lazear and Agramonte,

after we had been in Cuba about two years, enabled the sanitary authorities to rid that island of yellow fever. The island remained free for three years. I must not neglect to say that Dr. Coles Finlary had deduced the theory that the *Stegomyia* conveyed yellow fever, and he had in many papers steadily maintained that theory since 1881.

The government was then turned over to the Cubans, political discussions arose, governmental administration became more or less lax, and yellow fever reappeared. Last year the United States again assumed control; the same sanitary methods were reapplied and yellow fever has again disappeared. It is now generally recognized that yellow fever can be controlled by sanitary measures based on the knowledge that the *Stegomyia* mosquito alone conveys this disease. This has been demonstrated a number of times in various parts of the western hemisphere.

The control of yellow fever in Cuba was important, not alone for the protection of our own people down there, but more for the protection of the United States against this disease. Cuba is so situated commercially with regard to our gulf coast that, as long as she was infected with yellow fever, she was a constant menace to our gulf states, and to the United States generally, and she actually did give us yellow fever many times. This ability to control yellow fever by simple and inexpensive measures attracted a great deal of attention. After the announcement by the army board of the discovery they had made, our sanitary work in Havana had to be entirely reorganized, in order to adapt it to the conditions made evident by this discovery. It was, of course, of vital importance to us, and after much thought and discussion we evolved plans looking to the carrying out of three classes of work.

First, the rendering of all non-immunes immune by giving them a light attack of yellow fever. In a population such as Havana has, you know the native is not liable to yellow fever, and is spoken of as being immune. The stranger is the only one liable to this disease, and is known as a non-immune.

Second, the destruction of all *Stegomyia* mosquitoes that had, by biting yellow fever patients, become infected with yellow fever.

Third, the destruction of all *Stegomyia* mosquitoes.

We were agreed that the first method—that of rendering non-immunes immune—was the one that would most probably lead to success. After a fair trial, however, we convinced ourselves that yellow fever given intentionally by the bite of a mosquito could not with certainty be controlled, and that if this method was used on a sufficiently large scale to render the non-immune population immune it would cause a considerable number of deaths. We were not warranted, therefore, in pushing this branch of the work.

When we left Cuba after the disappearance of yellow fever, we were inclined to think that results had been obtained principally by the destruction of the infected *Stegomyia*, but further experience at Panama has convinced me that the important element is the destruction of the *Stegomyia* generally. I merely mention this as showing how practical work and experience entirely change well-grounded theories.

We took possession of the canal at Panama in the spring of 1904. The experience of our predecessors, who had built the railroad and attempted to build the canal, was ample to convince us that unless we could protect our force against yellow fever and malaria we

* Address to the graduating class, 1907, in the Cornell University Medical College.

would be unable to accomplish the work. Such sanitary measures, then, as would control these two diseases, were the necessary preliminaries toward starting the construction of the canal. From the former records of the work there, we could see that if we could control these two diseases we could keep our forces in about as good condition as if they were at work in the United States. The conditions on the isthmus were radically different from those in Havana. At Panama we have the canal stretching north and south for fifty miles, with good-sized towns, Panama and Colon, at each end. About half of the population of the zone is concentrated in these two towns, and the other half, consisting principally of laborers, is scattered along the fifty miles of canal. From our experience in Cuba, we could see that the question of yellow fever pertained to these two towns, and was much the same problem as we had faced in Havana. We knew that if we could rid these two towns of yellow fever the laboring forces living in the country districts along the canal would very easily be freed from infection, but the question of protecting from malaria this force of 40,000 people scattered along the line of the canal through a country district was something with which, so far, we had had no experience.

I shall not discuss the work of the sanitary department generally, but just that directly pertaining to the control of malaria and yellow fever. About three-fourths of the expenditures of the sanitary department have no very intimate relation to the control of these diseases, but pertain to the care of the sick, disposal of night soil, disposal of garbage, examination of food supplies, and kindred matters pertaining to general conditions. We concentrated our energies at first on the question of yellow fever, though the work along all lines was pushed as much as possible. We took possession of the canal zone in May, 1904, and the last case of yellow fever occurred in December, 1905; that is, it took us about sixteen months to get rid of yellow fever. In Havana, we commenced special yellow fever work in September of the same year; that is, it took us seven months to get rid of the disease. I was chagrined and disappointed at this lack of as prompt results at Panama as I had expected and hoped for.

During 1905, while we were having yellow fever, our force on the isthmus was much demoralized thereby. It was difficult to get men to come down, and when they did come they were generally panic stricken and left us. This fear affected all ranks of employes from the highest to the lowest, and, while there were hundreds of exceptions and plenty of plucky men who were not affected by the prevailing panic, we could readily see that if the conditions as they existed in 1905 were to continue the canal would never be finished. I think I can look back now and plainly see the causes that prevented our work from being as prompt at Panama as it had been at Havana.

At Havana we were under military rule, with only one man, the governor general, to consult, and this man, fortunately for us, one who had had years of training as a doctor and who was thoroughly competent to judge fairly all sanitary matters—General Wood. The sanitary department had been established in Havana and had been running some two years when the yellow fever work was commenced. The department was, therefore, thoroughly organized in all its branches, and it took simply an order from the central office to turn all its energies in any given direction.

In Panama there was an absence of all these condi-

tions. The authority was not so concentrated, and the department had to be built up from the beginning, with an entire lack of personnel and supplies of all kinds and the machinery for getting them, and, in addition, we were seven days' sail from our base of supplies. We foresaw these conditions to a considerable extent when we started and endeavored to meet them as far as possible.

From our experience in Havana we had concluded that the principal element in our success there was the destruction of the infected mosquitoes, not laying enough stress on the important part played by the destruction of the non-infected *Stegomyia* mosquitoes, which was pushed along at the same time. We hoped that in small areas, such as were covered by the cities of Panama and Colon, in a few months we could kill off all the infected mosquitoes, but we found that this was not successful. With the myriads of *Stegomyia* breeding everywhere in these towns, many mosquitoes would become infected from every man sick with yellow fever, and that a certain number of these mosquitoes would always escape our fumigating brigades. It would be impossible to fumigate more extensively than we did in the city of Panama in 1905. We had about four hundred men engaged in this work, and they went over the whole town three times, fumigating every house in the town, besides fumigating every block each time a case of yellow fever occurred in that block. In this work we used something like 200,000 pounds of pyrethrum and 400,000 pounds of sulphur, besides a large quantity of other fumigating materials.

The mosquito work consists in doing away with all breeding places of the *Stegomyia calopus*; that is, screening and covering every water receptacle in the city so that mosquitoes can not breed. Such work necessarily takes time to show results, and it was well on into 1905 before the *Stegomyia* were so decreased in numbers as to allow our fumigating processes to be effective.

Malaria being transmitted by the *Anopheles* mosquito, we endeavored to stamp out this disease by entirely different methods. The *Anopheles* breeds in clean water where grass and algae grow; it is, therefore, a mosquito almost altogether of country districts. It is not much of a traveler, in general not flying further than one or two hundred yards. Therefore, if we could destroy its breeding places within two hundred yards of our camps and villages we would have protection for our laborers along the line of the canal. We did not attempt to do anything with the swamps and breeding places which were at a greater distance than this from the camps and villages and dwelling houses.

At the same time we screened all houses with wire netting, urged the people generally to use mosquito bars, explaining the object to them, and also furnished quinin, advising that three grains be taken every day. This was done with the expectation of having the men in such condition that the parasite of malaria would not thrive in the blood when introduced. By far the most important of these measures is that of destroying the breeding places, and this is successfully done by surface and sub-soil drainage. This greatly decreased the number of breeding places, but with our tremendous rainfall and luxuriant tropical vegetation the ditches themselves would gradually fill with grass and would have to be cleaned out about every two weeks to keep them useful and to keep the mosquitoes from breeding in them. This was a heavy expense. We found it very much

cheaper to concrete the ditches, so that the grass would not grow.

We are now subsoiling wherever we can. This seems to be the ideal method of *Anopheles* extinction. The title drain is put in, covered with broken rock, and, if desired, this is covered with soil. This leaves a perfectly smooth surface, dry, and giving no opportunity whatever for the mosquitoes to breed. Even with a concrete ditch it requires considerable work to keep it swept out so that small pools will not form where mosquitoes may breed.

We think now that we have successfully accomplished the objects with which we started in three years ago—the control of yellow fever and malaria. We have had no yellow fever anywhere on the isthmus for more than a year. We believe that in the towns of Panama and Colon the *Stegomyia* have been reduced in numbers, in fact, almost exterminated, that yellow fever would not spread if introduced. We, however, maintain a rigid quarantine against the infected points around us and thus endeavor to prevent the introduction of infection.

Malaria has been so controlled that the sick rate of our total force in the month of April, 1907, was less than seventeen per thousand; that is, out of every thousand men at work on the canal we had on an average during the month only seventeen sick in hospitals each day. Among 6,000 Americans in the employ of the commission, including some 1,200 American women and children, the families of these employes, we have but little sickness of any kind, and their general appearance is fully as vigorous and robust as that of the same number of people in the United States.

During the year 1906 our death rate from disease among American employes was less than four per thousand. We believe that we have demonstrated that the tropical diseases, yellow fever and malaria, can be entirely controlled in the Canal Zone, and will not interfere with the construction of the canal. Of course, other problems may arise, in fact have arisen, but they are not of such a character as to interfere materially with the work.

For the last sixteen months pneumonia has been very fatal among our negro laborers, being confined almost entirely to this class of labor. It affects the whites very seldom. The disease seems to be on the decline now, and I look on it as epidemic in character, a good deal as it occurs in New York and Chicago. We are endeavoring to meet this by making the general sanitary conditions of our laborers better with regard to food, clothing, and so forth.

I am inclined to think that the advances made in recent years in tropical sanitation will have a much wider and more far-reaching effect than freeing Havana of yellow fever or enabling us to build the Panama Canal. I think the sanitarian can now show that any population coming into the tropics can protect itself against these two diseases by measures that are both simple and inexpensive; that with these two diseases eliminated life in the tropics for the Anglo-Saxon will be more healthful than in the temperate zones; that gradually, within the next two or three centuries, tropical countries, which offer a much greater return for man's labor than do the temperate zones, will be settled up by the white races, and that again the centers of wealth, civilization and population will be in the tropics, as they were in the dawn of man's history, rather than in the temperate zones, as at present.

Original Articles

DIGESTIVE DISORDERS IN PULMONARY TUBERCULOSIS.*

JAMES R. ARNEILL, M.D.
DENVER.

During the past ten years I have been greatly interested in enteroptosis and have been on the lookout for this condition in my patients of all classes. The frequency of this anatomic peculiarity in slender patients, suffering with malnutrition, psycho-neuroses and tuberculosis, is decidedly impressive. Most examinations of tuberculous patients do not include an examination of the abdomen. If one palpates carefully for the kidneys, Stiller's sign, and the contracted colon; tests the succussion sounds in the stomach, or inflates it and the large intestines, he will find in a surprising number of cases evidence of enteroptosis. Woods Hutchison remarks that those people who are unusually tall are apt to develop tuberculosis. To my notion, it isn't a question of tallness alone, but of tallness combined with slenderness. Such people are very frequently enteroptotic and are decidedly prone to suffer with malnutrition, psycho-neuroses and all sorts of functional disorders of the stomach and bowels. They are usually below par and anemic, always ailing and taking tonics, and eternally suffering with digestive complaints and a bizarre collection of nervous disorders. A great many of our tuberculous patients are duplicates of these ill-nourished, anemic, psycho-neurotic, constipated, mucous colitic, dyspeptic, enteroptotic wrecks, except that in addition there are present a few symptoms dependent on the diseased lung, such as fever, cough and expectoration. The treatment most effective in one is often very useful in the other. This consists essentially of fresh air, absolute rest in some, extremely generous feeding, attention to the skin and bowels, optimistic suggestion, and isolation, modified isolation, or diversion and exercise. In many cases it will be wise to employ medicine, such as increasing doses of tincture of nux vomica up to forty or fifty drops three times daily before meals, iron in the form of Bland's mass, arsenic, sometimes hydrochloric acid, and at other times alkalies, etc. These patients are often suffering from the effects of starvation. Eliminating one article of food after another, they finally limit themselves to toast and tea or malted milk.

The chemistry of the stomach may be normal, or it may show a hypo- or hyperchlorhydria, or may vary from day to day. The mucous membrane is likely to be hypersensitive; in fact, the entire nervous system is usually oversensitive. There may be diminished motility of the stomach. This class of cases is usually helped by Eddyism or psychotherapy; optimistic suggestion and persuasion should occupy a prominent place in the treatment, to dissipate the various phobias. If need be, analyze the stomach contents in order to assure the patient that she is able to digest a generous diet and that only her fears prevent her doing so. Considerable distress may be present at first, but if she grins and bears it, presently, as a result of improved nutrition, the motor and secretory powers of the digestive organs increase, constipation is relieved, nerve tone improves, the nervous system becomes decidedly less sensitive, the vicious circle

* Read in the Section on Practice of Medicine of the American Medical Association, at the Fifty-eighth Annual Session, held at Atlantic City, June, 1907.