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SAN JUAN, P. R.

BUREAU OF SUPPLIES, PRINTING, AND TRANSPORTATION

1925

ORGANIZATION OF A BUREAU OF PLAGUE PREVENTION IN PORTO RICO

By A. L. CARRIÓN, M. D.

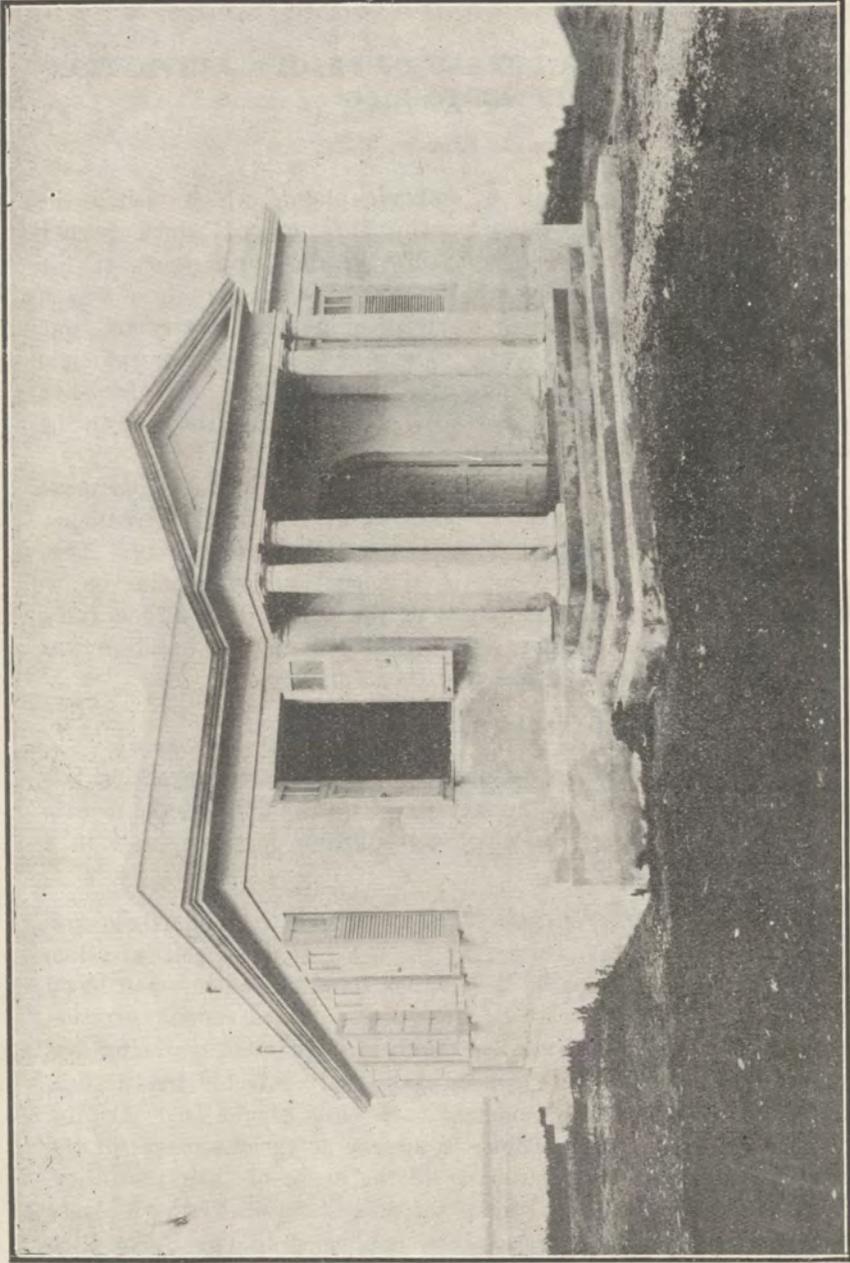
During the last epidemic of bubonic plague which visited the Island there were thirty-three persons infected, of whom twenty died; the Government spent \$500,000 in the suppression of the disease; an intense panic swept all over the Island; there was a great business depression and a strict quarantine obstructed our commerce for more than a year. The results of the first epidemic of plague in the year 1912 were even worse. There were fifty-five cases in that instance with a mortality of 65 per cent, the quarantine lasting one year and four months.

The circumstances clearly demanded that the Health Department do its utmost to prevent another outbreak of this dreadful pestilence in Porto Rico. With this in view a new "Bureau of Plague Prevention" was created last year. A spacious and commodious building was planned to lodge the offices of the bureau and a laboratory for the examination of rats. The construction of this building was begun in May, 1924, and it has just been completed.

ORGANIZATION OF THE WORK

Fundamental Principles.—Our plans for plague prevention are based on a careful study of the manner of transmission of the disease to man and of the ways in which an epidemic may originate in a locality.

Transmission of the Disease to Man.—Plague is primarily a murine disease which is transmitted by the flea. It is a blood infection. After a rat dies of plague its fleas which have sucked infected blood migrate conveying the disease to a new host. When rodent infection has spread considerably and the number of infected parasites has increased to a large extent, man is accidentally infected by the flea. It is worthy of note at this moment that while plague is developing in the species, dead rats continue to appear at various places of the locality without any explanation as to the cause of their mortality. This phenomenon, which has been observed systematically in all places where plague has occurred, has been confirmed in the Porto Rico epidemics.



A spacious and commodious building has been constructed to lodge the offices of the Bureau and laboratory for the examination of rats.

Origin of an Epidemic.—Plague may be imported through rats brought in by ships coming from infected ports. This fact is universally accepted. Another theory to account for the origin of plague in a locality is that an outbreak may develop from a latent infection in the rat. A rodent affected with chronic plague might be considered as a germ carrier. Under proper conditions the infection would become acute giving rise to an epizootic and to human infection; or the diseased animal might fall a prey to a susceptible healthy one producing an acute infection in the latter.

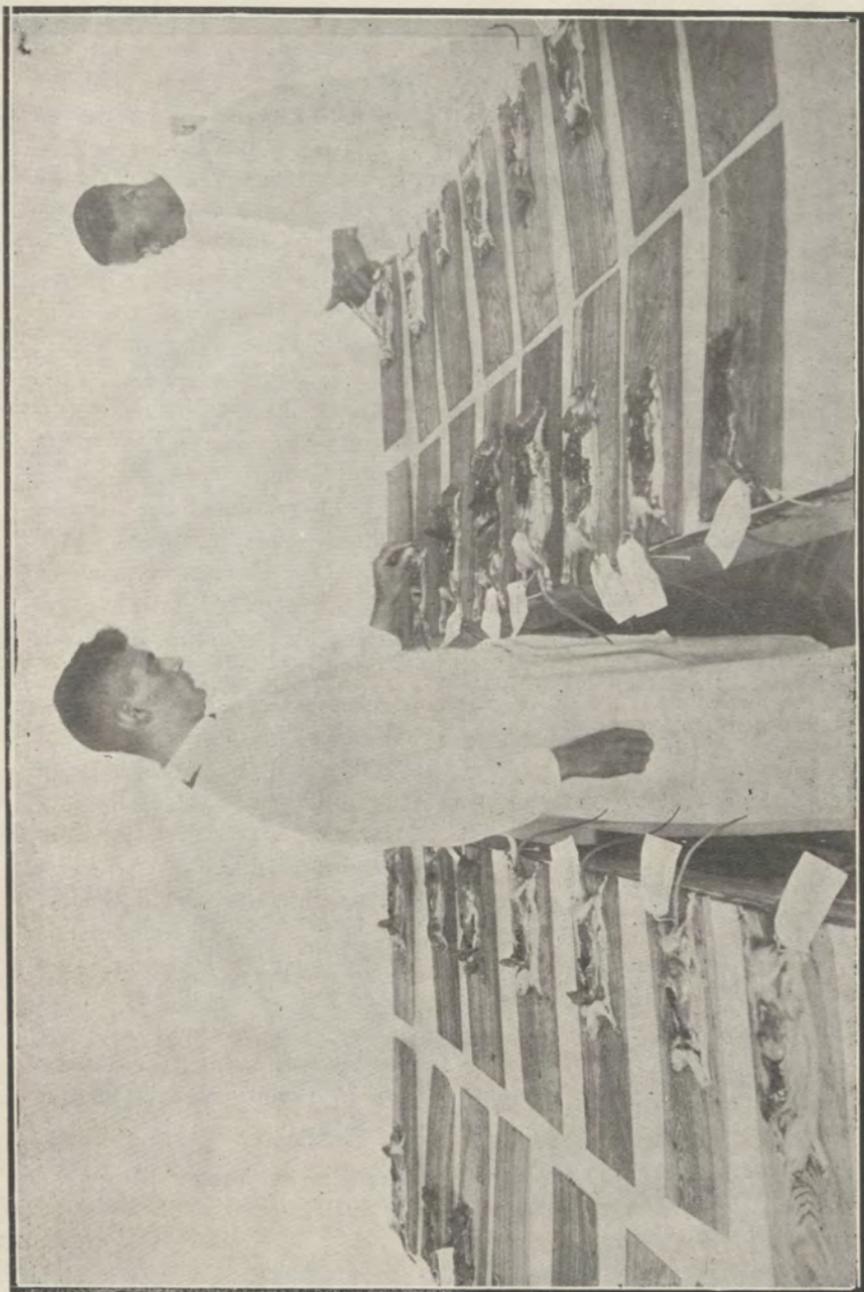
This last theory has met with a great deal of opposition. No authority rejects the possibility of a chronic murine infection. "The Indian Plague Commission encountered a considerable number of cases among 'mus rattus' in the Punjab villages of Kasel and Dhand. . .", yet, "no evidence was forthcoming to show that this chronic rat-plague had anything to do with the recurrence of acute Plague among the rats,"¹ and most authors have concluded that chronic Plague bears no influence in the propagation of the disease. Such chronic cases, moreover, are far from being frequent. "We have diligently sought for chronic Plague," says George W. McCoy, "among the rats in San Francisco, but . . . invariably with a negative result." "Only one case was found among the many hundreds of plague rats examined by the Indian Plague Commission in Bombay." So far as we are concerned it may be positively asserted that no chronic-plague rat has been encountered in the course of any of our epidemics or thereafter. It may be added that the period elapsed between the two outbreaks was too long (nine years) to justify any presumption that the epidemic of 1921 was in any way related to the first outbreak of plague in Porto Rico in 1912.

The consensus of opinion is evidently against the second theory. In the development of our plans, accordingly, a greater importance has been conferred to the probability of an imported infection. No measure has been neglected, however, to avoid the possibility of an outbreak arising from chronic plague among the rodents.

A knowledge of the preceding principles has led to the taking of measures necessary for the prevention of plague in this Island. These measures may be summed up as follows:

1. Preventing the importation of murine or human plague;
2. Rat-proofing and flea-proofing;
3. Deratization;
4. Rat examination;

¹"The Technique of the Laboratory Examination of Rats for Plague," by Geo. W. McCoy, page 7.



The rodents are outstretched, tacked upon shingles and dissected for examination. The appearance of gross lesions is mainly depended upon for diagnosis.

5. Enlisting public coöperation;
6. Notification and inspection of suspicious illnesses or deaths;
7. Keeping a good provision of anti-plague vaccine and serum.

PREVENTING THE IMPORTATION OF MURINE OR HUMAN PLAGUE

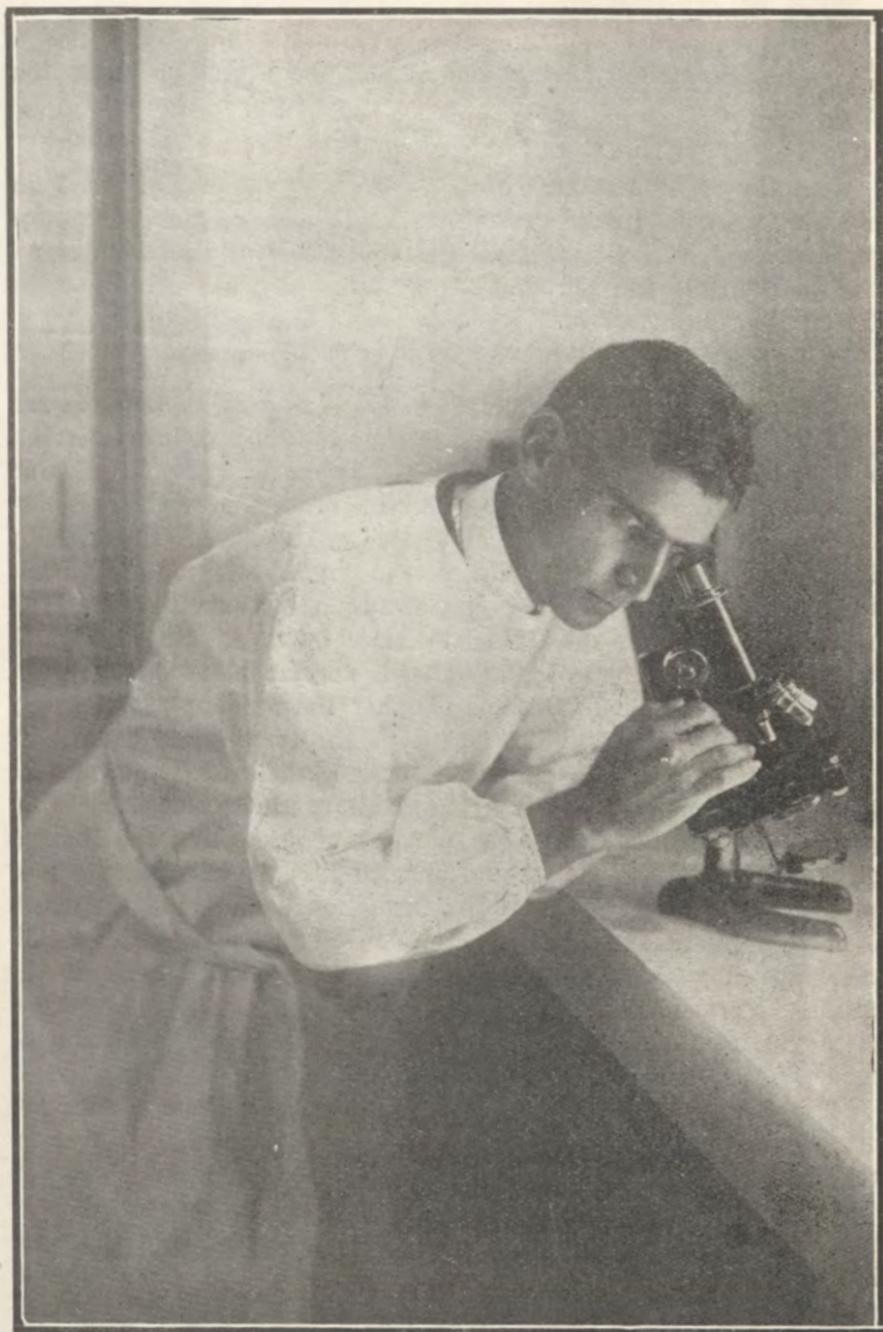
The United States Public Health Officers at the port of San Juan are constantly at work to prevent, as far as possible, the importation of plague. It is their business to examine carefully all immigrants and to fumigate and put under quarantine all ships arriving from infected ports.

RAT-PROOFING AND FLEA-PROOFING

The health regulations numbers 3, 12, 15 and 28 as compiled and proclaimed in January 3, 1921, established the rat-proof requirements for the construction of buildings in the Island of Porto Rico. Rat-proofing consists in creating such adverse conditions to the existence of the rodents that they will not be able to survive. William Colby Rucker,² in his article "The Eradication and Prevention of Bubonic Plague," speaks of the great importance of rat-proofing. "Of all anti-plague measures yet devised by man," says he, "the one which is of greatest and most lasting value is permanent rat-proofing. A rat-proof city shall not fall from plague. Rat-proofing acts not only as a means of plague eradication; it is the fortification against its subsequent attacks. The subject is therefore of great importance to the general public both from the sanitary and commercial view points. Rat-proofing serves the purpose of protecting the inmates of the building from plague and of excluding the rat from its food supply and habitation. It is the insulation against the rat which is to be applied as a general measure in all plague-infectible localities, especially those which have suffered from predations of the disease. Permanent rat-proofing costs money but it must be regarded as plague insurance both from the commercial and the humanitarian aspect."

The ordinary inspectors of the Insular Health Department have always endeavored to have the people comply with the rat-proofing requirements and they have been successful, in a general way, in this respect. We consider the problem so essential, however, that we are urgently planning to obtain an old-time experienced inspector in rat-proofing for this special work in our bureau. It is our aim to reach the greatest possible perfection as far as rat-proofing is concerned, keeping our eyes constantly open to any possible defect

² Assistant Surgeon General, Public Health and Marine Hospital Service.



In positive cases the microscope generally reveals the presence of bipolar bacilli in the smears.

which might exist anywhere and especially along the waterfront of San Juan, including the wharves and warehouses. This is undoubtedly the zone that is mostly exposed to plague infection on account of its geographical position, as shown from our last epidemics.

DERATIZATION

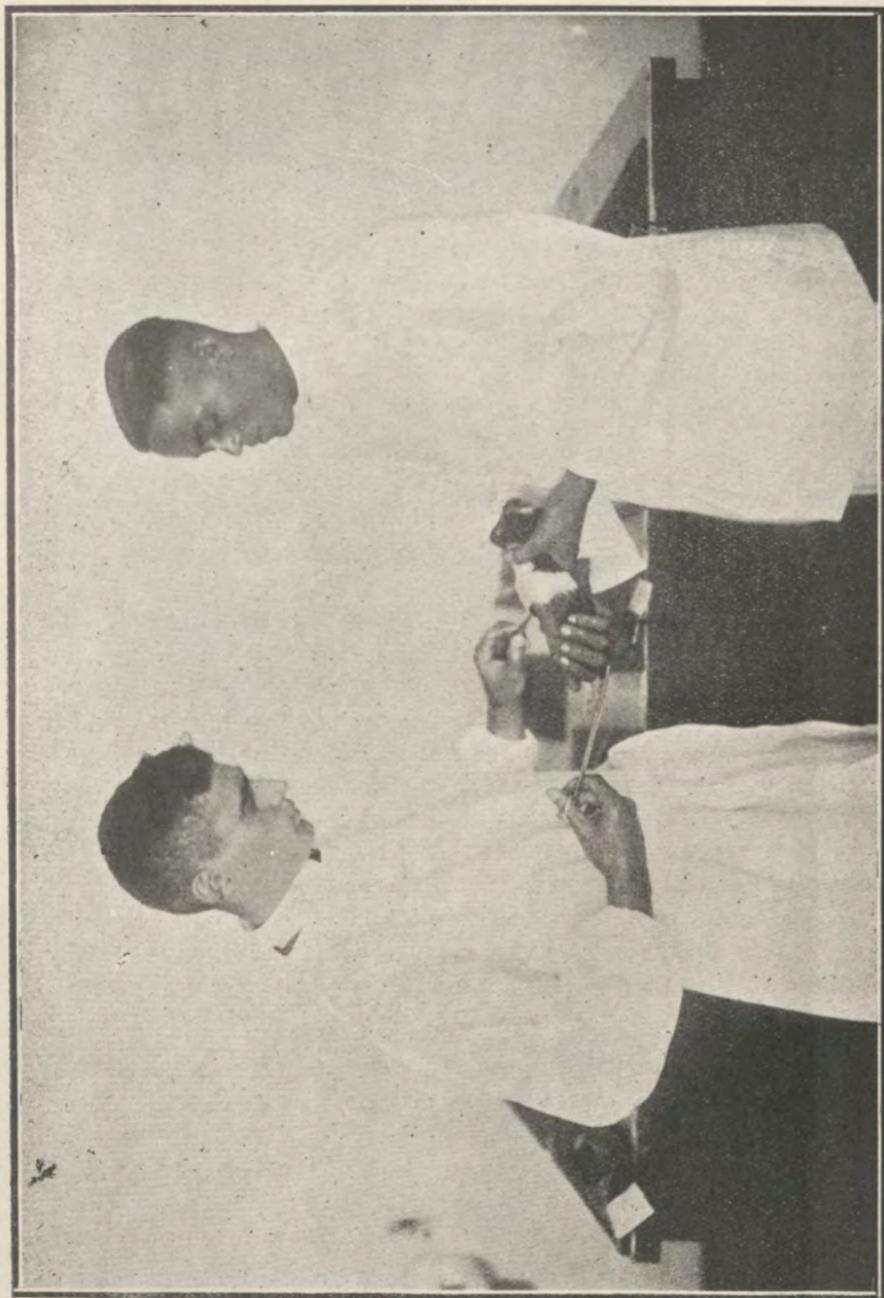
"The eradication of bubonic plague means the eradication of rodents." "It is probably impossible to absolutely exterminate the species in a given city, but this is not absolutely necessary to the eradication of plague. If the rat population is kept within fairly few limits and is not congested, rat plague will die out from purely natural causes. Or, should it be introduced into a sparse and scattered rodent community, the disease will soon exhaust the material necessary for its perpetuation."³ During the Porto Rico epidemics (1912-1921) the campaign against the rodents in San Juan greatly reduced their number, but the rat population of the city was far from being extinguished; yet there is no question as to the decided influence which the decrease in the number of rats exercised upon the suppression of plague in this city.

The deratization plan followed by us has varied in intensity according to the likelihood of infection in different localities. As already established at the beginning of this article, the greatest danger of plague infection in Porto Rico lies in the possible immigration of plague rats. It is of the first importance, therefore, to guard seaports against this contingency. With this end in view we have organized permanent deratizing posts in all important seaports, and chiefly at the Capital, which has been the port of entry on two different occasions. In other inland towns where infection occurred in 1912 and 1921 the anti-murine campaign has been limited to short periods of two or three months a year, the aim being to avoid any possible outbreak arising from chronic plague among the rats.

Campaign at San Juan.—San Juan has been divided into four zones. Zone No. 1 comprises the waterfront and commercial districts, including the wharves, warehouses, the railroad station, etc. This is undoubtedly the most dangerous section of the city from the standpoint of plague infection. Zone No. 2 embraces that portion of San Juan situated within the old city walls. Puerta de Tierra and Santurce form zones numbers 3 and 4, respectively.

To each zone has been assigned a brigade consisting of a foreman and a number of rat-trappers which varies according to the im-

³ From "The Eradication and Prevention of Bubonic Plague," by William Colby Rucker.



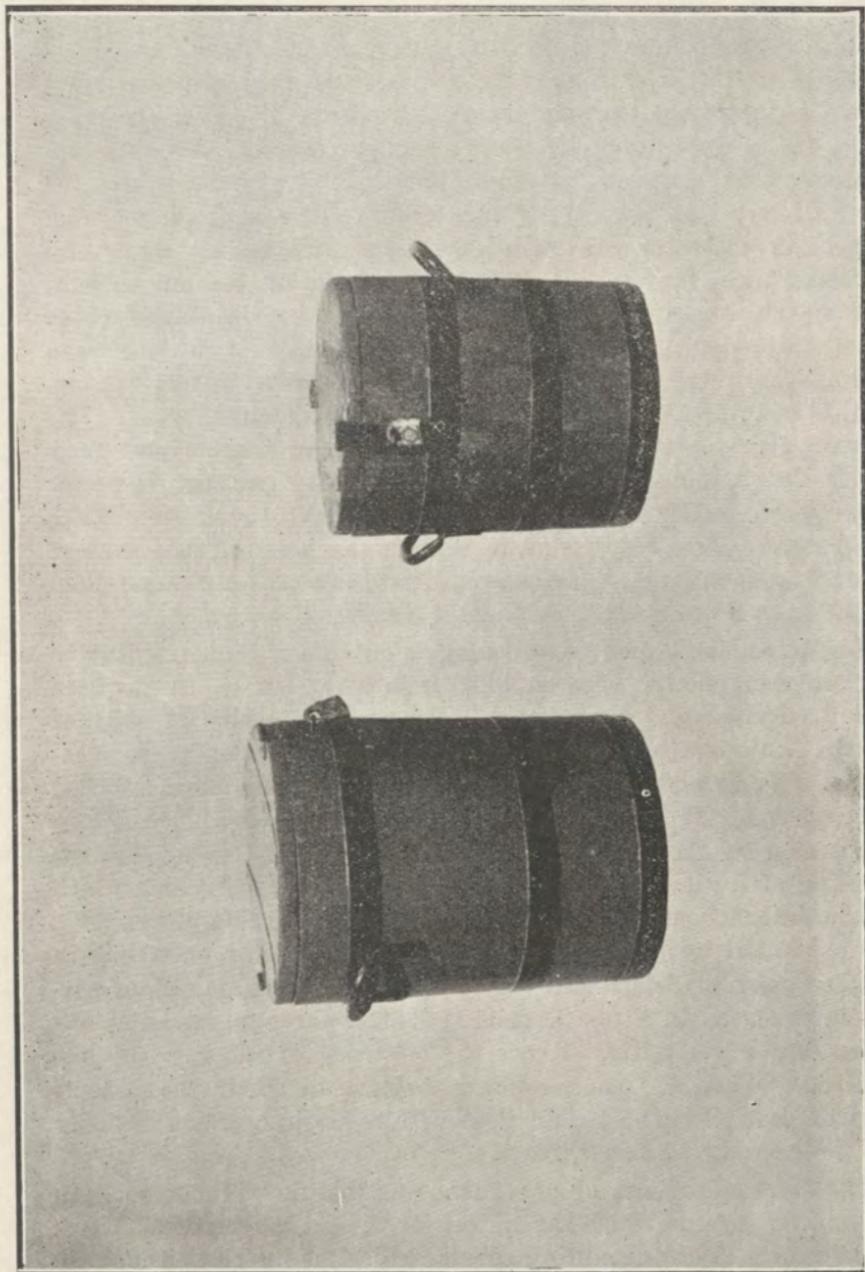
Guinea-pig inoculation is required for the purpose of confirmation of diagnosis.

portance and extension of the place. A supervising inspector has charge of the foremen and makes regular rounds of inspection.

The rat-trappers are engaged to work eight hours per day. They are given seventy-five traps each and they are held responsible for them. Early in the morning these men set out to collect the traps at the places where they were left the night before. The rats captured are brought to the "counting office" of the bureau where the record of each man is carefully registered. The rest of the morning is spent in a careful washing of the traps with boiling water and preparing them for use. We are habitually using coconut as bait. It is a very attractive food to the species and its cleanliness makes it most convenient. In the afternoon the workers meet in the bureau yard and are there kept for any possible emergency until 2:30 p. m. At this hour each brigade is directed to an appointed zone. The foremen are responsible for the traps of their brigade and their proper distribution. They receive instructions from the inspector and they give orders in turn to the men under their charge. Fifty rats per week have been found to be a reasonable minimum average for a rat-trapper, and those keeping lower records for more than two successive weeks are permanently dismissed.

To protect these men from contagion in case a plague rodent be captured everyone has been supplied with a rat box which has been specially devised for this purpose. The average murine capacity of this box is twenty. In one of its corners there is a tin pocket containing a small bottle with chloroform. A loop has been attached to the cover of the box and a piece of cotton placed within this loop is saturated with chloroform every time the box is opened for the admission of a rat. We have made a number of experiments which confirm the conclusion that fleas are very sensitive to chloroform. We have submitted this insect to a definite amount of the anesthetic in a limited space of determined capacity. Under these conditions narcosis is produced in a few seconds and after three minutes not one of the fleas is left alive. Hence the efficiency of the rat box just described. When the contrivance is opened to admit the rodents captured in a given house, all fleas within the box, if not actually dead, will surely be anesthetized.

The great advantage of our method is that it will not spoil in any way the tags on which the address of the rat is recorded. Kerosine and other liquid depulizing agents render the inscription illegible very often and we have had considerable trouble at times in reading it.



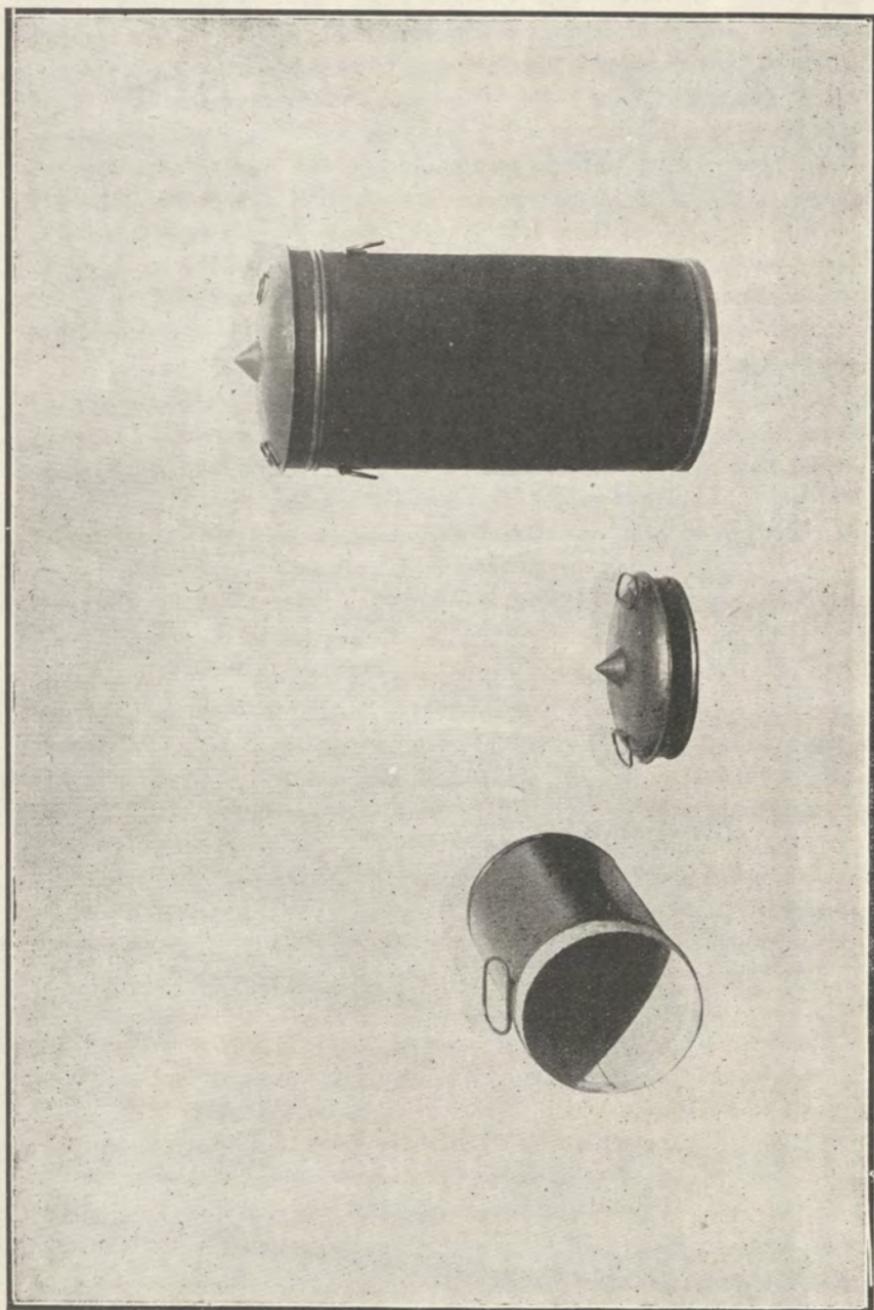
A special contrivance has been devised for the transportation of dead rodents from distant towns. The apparatus is made in two different sizes.

Campaign at Other Seaports.—There are considerably fewer chances of plague importation through other ports of the Island. Permanent deratization is being carried on in Ponce, Mayagüez and Arecibo. In organizing these campaigns, however, we have tried to be practical in all respects so as to avoid any unnecessary waste of time and money. A danger zone including the water front district, wharves and the adjacent commercial section has been carefully marked out in each of these towns and the campaign has been limited to those places. The number of men employed to do the work varies according to the extension of the zone in each case and they are under the supervision of the local health officers. Their duties differ in no respect from those described above.

Campaign in Towns Where Plague Occurred in Past Epidemics.—Deratization has been extended to Río Piedras, Carolina, Caguas, Manatí, Bayamón, Juncos, Fajardo and Guaynabo which were infected either in 1912 or 1921. Campaigns lasting two or three months are carried on at each of these towns in succession every year under the supervision of an inspector of the bureau or an experienced foreman. Rat-trapping is conducted along the same methods described above, enough men being employed in each case in accordance with the size of the locality.

Rat-transportation.—A special contrivance has been devised for the transportation of dead rats from distant towns. This contrivance has been built after the pattern of an ice-cream freezer. The outer portion, which is cylindrical in form, is made of wood and is closed on top by a tightly fitting cover. It has a pair of locks to prevent its being opened except with its own keys. Within this enclosure is found a smaller galvanized tin container for the rats, which is held in a central position by special devices. The empty space around the container is filled with ice and common salt so as to keep the temperature of the dead rodents low. The apparatus is made in two different sizes, the average murine capacity being seventy-five and one hundred, respectively. We have been using it very successfully for more than a year. It preserves the rats over forty-eight hours in good condition to be examined; it is absolutely flea-proof; it has a nice, clean, non-repulsive appearance, and its transportation is not objectionable to the express company.

Other Methods of Rat Extermination.—Rat-trapping, as just described, serves a double purpose. It reduces the vermin population and it offers an opportunity to discover plague in the laboratory while the disease is breaking out among the rodents. We are using



Galvanized tin containers (large and small).

sulphur fumigation as a more radical supplementary measure when necessary. Under the suffocating atmosphere resulting from the sulphur combustion, the rodents run for their lives out of their abodes, but they soon fall victims to the poisonous substance, and when fumigation is over they are found dead scattered over the floors.

Rat poisoning is in common use in many houses in San Juan and other cities of the Island. We do not like this method under ordinary circumstances because it kills the rodents at unknown places checking all opportunities for post-mortem examination. Their decomposition, furthermore, produces a very annoying and offensive odor; and, lastly, the poisons used are liable to harm hens and other domestic animals.

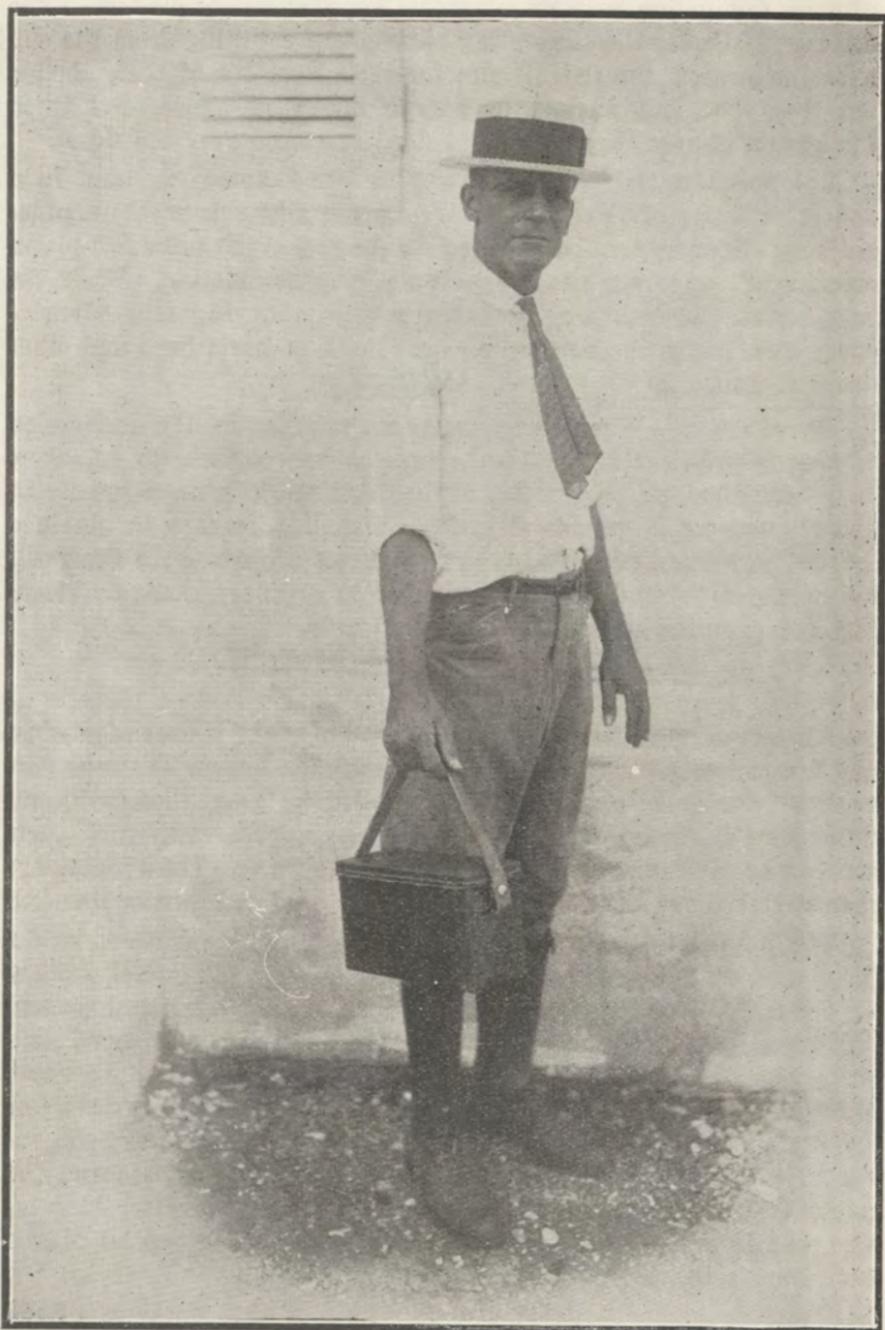
Depulization.—When an epidemic has once set in, the destruction of fleas is pre-eminent among the eradicated measures to be taken. In a campaign for prevention, anti-murine work is more important and requires much greater attention. Depulization may be obtained by the destruction of the hosts; or by direct killing of the flea itself by means of (a) pulicides (kerosine), (b) ordinary domestic cleaning, (c) depulization of domestic pets.

RAT EXAMINATION

All rats arriving at the bureau are taken to the preparation room and are properly classified into the five groups known as "*mus norvegicus*", "*mus rattus*", "*mus alexandrinus*", "*mus musculus*", and "*mongoose*". Laboratory attendants make records concerning their source and any other data pertaining to the work. The rodents are then stretched out, tacked upon shingles and dissected for examination.

The appearance of gross lesions is mainly depended upon for diagnosis. Sub-cutaneous congestion; buboes at the inguinal, axillary or cervical regions; enlarged, soft, dark-colored liver and spleen, and pleural effusion are carefully sought for; and also any lesion suspicious of chronic plague. Microscopical examination of tissue smears and guinea-pig inoculation are required for the purpose of confirmation of the diagnosis. In positive cases the microscope generally reveals the presence of bipolar bacilli in the smears and the guinea-pig, which dies on the third to the ninth day after inoculation, will show very characteristic lesions from which typical plague bacilli are recovered in great numbers.

Every inoculated animal is put within a tin container fifteen inches in diameter and eighteen inches high. A screen cover keeps it free from flies and other insects. After inoculation is made the



Every rat-trapper has been supplied with a rat box specially devised for the purpose.

guinea-pigs are taken to an observation room at a short distance from the laboratory. An abundant supply of food is furnished every day and they are kept under the best hygienic conditions possible. Proper blanks prepared beforehand are filled out with the necessary data concerning each animal under observation.

ENLISTING PUBLIC COÖPERATION

We are fully convinced that no measure taken by the Health Department would be successful unless every citizen in Porto Rico can be gotten to do his part in plague prevention. This will require no great effort or sacrifice. There are some elementary principles concerning the prophylaxis of plague which are very simple and yet a knowledge of them would help in a very effective way to check infection especially while it is breaking out among the rats. It should be generally known that "man's safety from the disease lies in the exclusion of the rodents and his parasites. This is the basis of all preventive work. If man can live in rodent-free surroundings he need have no fear of plague, because if there be no rodents there can be no rodent parasites, and for all practical purposes the flea may be considered as the common vector of the disease from rodent to rodent and from rodent to man." "The prevention of bubonic plague therefore means the eradication of rodents." There is a very important fact that must be firmly impressed upon the mind of every inhabitant of Porto Rico and it is that a mortality of any consideration among the rats without an accountable cause is very suspicious evidence of the inception of plague in the locality. This fact should be reported immediately by the observer to the nearest health office.

The Bureau of Plague Prevention has undertaken the task of spreading the foregoing information through different means. Clear and concise charts have been printed to be posted at convenient places so that the people may read them without effort. These charts are specially sent to the public schools and the teachers are required to give lectures on them. Cards containing similar legends are distributed among the homes in towns where preventive work is being done. In San Juan the people are urged through these cards to notify the bureau whenever suspicion is found as to the presence of rodents in their homes.

One of the most effective means to stir public interest in this connection is by means of moving pictures. An excellent film entitled "The Rat Menace", showing the destructive work which the rodents do and the part they play in the spreading of disease, has



Within this enclosure is found a smaller galvanized tin container for the rats which is held in a central position by special devices.



A tin pocket in one of its corners contains a small bottle with chloroform.
A piece of cotton is placed in a loop attached to cover of box.

just been received and will soon be exhibited in San Juan and other towns. Special slides have been prepared containing instructions relative to plague prophylaxis to be exhibited also between the films. The movies undoubtedly offer a most practical opportunity to arouse public interest to these important health problems and we are planning to develop our activities to a greater extent along this line.

The press is rendering very valuable service to the bureau. Articles and notes are published quite frequently on the subject of plague prevention and the people are urged to comply with the suggestions of the Health Department.

NOTIFICATION AND INSPECTION OF SUSPICIOUS ILLNESSES AND DEATHS

After plague has been introduced into a locality, obviously the sooner the disease is discovered the easier it will be to suppress it. Every doctor in Porto Rico should bear in mind that the Island is constantly exposed to a fresh outbreak of plague and they should always be on the alert for suspicious symptoms. Any patient developing hyper-acute, general disturbances with very high fever, marked intoxication, serious bubonic or pneumonic symptoms coupled with a rapid course of the disease, must be considered suspicious of plague and the case should be at once reported to the health authorities. If the diagnosis of plague is not established early enough, the infection will spread more and more in the locality and it will easily gain a foot-hold in surrounding towns and may be expected to reach out into the interior of the Island. In his report about the Porto Rico epidemic of 1912, Dr. Richard H. Greel says, "Plague was determined present in San Juan on June 19, 1912, at which time thirteen human cases or more had actually occurred". The result was that the infection was given the chance to invade some other inland territory. Our Bureau of Plague Prevention is sending out circular letters at regular intervals every year bringing these facts to the attention of all doctors to the end that no case revealing the aforesaid symptoms be overlooked.

KEEPING A GOOD PROVISION OF ANTI-PLAGUE VACCINE AND SERUM

Yersin's serum is being extensively used against plague infection. In 1921, large doses given intravenously were administered at the Quarantine Hospital in San Juan with apparently very satisfactory results. The Health Department at present keeps on hand a good quantity of this product for any emergency. A plentiful supply of Haffkine's vaccine is also kept in stock for the same purpose.