

Investigation of Jute Imports As Potential Plague Source

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SEVERAL plague outbreaks along the west coast of South America over the past 20 years have been traced to infected fleas found in shipments of jute bags from India (1,2). It has been demonstrated also that infected *Xenopsylla cheopis* fleas can survive and transmit their infection after being trapped in bags for 30 days or more under optimum conditions of temperature and humidity (3). Since the United States imports from India approximately 350,000 tons of jute products annually, the possibility of plague introduction through this medium seemed to warrant investigation.

Between August 1949 and March 1951 the quarantine stations at San Francisco, Calif., and San Juan, P. R., conducted systematic examinations of all jute imports to determine whether or not evidence could be found of flea infestation. At San Francisco studies were conducted also to determine the survival rate and the longevity of *X. cheopis* under conditions as they prevail in the baling and shipping of jute products.

Methods Employed

At San Francisco shipments of jute from India consist principally of bolts of hessian cloth in large bales and arrive at weekly or bi-weekly intervals. Through the cooperation of

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the importers random bales were selected. The wrappers were removed and random bolts of the jute cloth were taken out for examination. The wrappers and the jute cloth were unraveled, shaken, and brushed over a white bed sheet. These brushings were assiduously searched with high-power magnifying glasses for insects or parts thereof, and the inspectors were constantly alert to detect any insect movement. To test the keenness of the inspectors' perception, on several occasions known numbers of dead fleas were scattered about in the jute debris which had been searched previously with negative results. Upon reexamination of this debris the inspectors recovered all of the fleas which had been deposited.

Three hundred and seventy-six examinations were made of wrappers and samples of jute cloth aggregating 152,000 yards taken from 880 random bolts removed from 179 random bales. Any insects or particles suspected of being parts of insects were collected and delivered for identification to F. M. Prince, entomologist, at the Western Branch Communicable Disease Center Laboratory. No fleas, alive or dead, were found nor were any parts of fleas identified by microscopic examination.

At San Juan the jute imports consist principally of manufactured bags or gunny sacks. The examinations there included a microscopic search for fleas in all of the material shaken and brushed from the bags. The brushings were thinly spread over white paper which had been coated with a film of castor oil and tacked to light plywood for ease of handling. The low-power objective of a wide-field microscope was employed, using a very bright focusing light to illuminate the field. The examinations and identifications were made by an entomologist. The wrappers of 67 bales and a total of 4,994 bags were examined. One hundred and eighteen insects were found, of which 89 were alive, but all were identified as being of genera and species indigenous to Puerto Rico; none of these insects were fleas.

Observations on Vitality of *X. Cheopis*

In the study of the longevity and survival rate of *X. cheopis* under actual conditions of

processing and overseas shipment, conducted by the San Francisco station, the fleas were furnished by the Western CDC Laboratory. On September 15, 1949, 30 live, well-fed, noninfected *X. cheopis* were placed in each of two 9- by 14-inch cotton bags, which then were securely closed. One bag was placed between layers of jute about midway in a bale, and the second was placed under the first layer of jute. The bale was then wrapped, pressed in an electrically powered baler, sewed, and bound with flat metal strips. It was loaded in a cargo hold of a vessel of the Pacific Far East Line bound for Manila, Hong Kong, and Okinawa, and return. When this vessel returned to San Francisco 49 days later, November 3, 1949, the bags of fleas were removed and examined at the laboratory. From one bag 29 fleas were recovered and from the other, 28 fleas; all were dead. The 3 missing fleas were presumed to have escaped before the bags were tied prior to shipment.

On November 10, 1949, 150 live, well-fed, noninfected fleas were placed in a small cotton bag containing a small amount of wood shavings. The bag was secured, placed in a cardboard container and encased in a wooden box. This was placed in the hold of a vessel of the Matson Navigation Company bound for the Hawaiian Islands. Upon return of the vessel to San Francisco on December 3, after a voyage of 23 days, the box was removed and 146 fleas were recovered; all were dead. Four of the original 150 fleas were unaccounted for. Upon microscopic examination, the bodies of the recovered fleas did not appear to be undernourished, and it is believed that death was not due to starvation.

On December 15, 1949, 100 well-fed, noninfected fleas were put in a wooden box in which two freshly cut apples were placed to supply moisture. This box was shipped on a round trip to the Hawaiian Islands in the hold of a vessel, and 22 days later, upon return to San Francisco, 100 fleas were recovered from the box; all were dead.

Effect of Extreme Pressure on *X. Cheopis*

Tests were performed also at San Francisco, through the cooperation of the Western CDC

Laboratory and one of the importers, to determine how much the pressure of the baling process may contribute toward the mortality of the fleas trapped inside the bales. Three cotton bags each containing 25 *X. cheopis* were placed at different levels inside a bale of jute wrappers which was then compressed under a pressure of about 8,000 pounds—less than the pressure normally employed in the commercial baling of hessian cloth. That experiment was performed on two occasions, November 15 and December 15, 1949, with practically the same results. At the end of 10 minutes following the application of the pressure by the electrically powered mechanical baler, approximately 33 percent of the fleas were found dead; at the end of 1 hour 50 percent were dead and at the end of 72 hours more than 75 percent were dead. These observations seem to indicate that the pressure exerted in the baling process is an important factor in reducing the chances of survival of fleas trapped within bales of jute products.

Conclusions

The variations of temperature and humidity in surface vessels, incident to changing latitudes and passage through various ocean currents, are inimical to the rat flea in the absence of its natural host. Its survival is further jeopardized when trapped in jute and subjected to the pressure exerted in the baling process. If well-nourished, noninfected fleas have little chance of survival under these conditions, plague-infected fleas should be expected to have even less chance because of the additional hazard of the bacterial process causing obstruction of the stomach. Due to this blockage, the average length of life of *X. cheopis*, after being infected with plague, is only 14.5 days under relatively favorable conditions (4).

Past experience with the tremendous annual importations of jute cloth and bags and the observations presented in this report seem to validate the statement made by the Public Health Service in 1937, that "While it may not be without the realm of possibility that, under favorable meteorological conditions, fleas with-

out a host can serve as reservoirs of plague infection, carry it over long distances and later, under favorable conditions, transmit the disease, such danger is probably insignificant in comparison with the danger from infected fleas carried by rats" (5).

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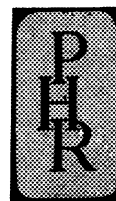
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