

- CONCERNING THE CARRYING OF THE LEPROSY
BACILLUS BY INSECTS *

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The question whether insects transmit leprosy, or at least whether they can carry the bacillus to a distance, is of importance in the epidemiology of this disease. Many investigations have been made on this question in all parts of the world, as is to be seen in the comprehensive reviews of Klingmüller and Graham-Smith. During the leper census in certain districts of the Miyagi Province I took the opportunity of observing and studying the relation between the leprosy organism and insects (flies, fleas and lice). No detailed investigation of this question has been made in Japan except those of Sugai and Mononobe, and mine has brought to light interesting findings on many points. The following is a brief summary of a much longer publication [in Japanese.]

I. FLIES IN THE ROOMS OF LEPERS AND IN NEIGHBORING HOUSES

1.—*In patients' rooms in the leprosarium.*—This question was dealt with by Sugai and Mononobe in 1909-1911. Mononobe found that of 15 flies caught in patients' rooms of a leprosarium 13 (86

TABLE 1.—*Findings in flies caught in rooms of patients.*

Flies caught in rooms:	Number of flies caught	Flies containing bacilli	
		Number	Per cent
1. Of severe cases in leprosarium	447	118	26.4
2. Of mild cases in leprosarium	896	41	4.6
Total	1,343	159	11.8
3. Of patients living at home ...	1,786	41	2.3

* Translation of the author's German summary appended to the Japanese article in *La Lepro* 3 (1932) No. 1, Suppl. p. 5, with interpolations distinguished by brackets.

per cent) harbored leprosy bacilli. He found, further, that flies which had been fed leprosy material experimentally discharged feces which contained uninjured bacilli for five to six days.

I collected 4,339 flies, mostly *Musca domestica*, in 13 rooms in the Second Government Leprosarium at Aomori, 13 private houses of lepers in certain districts of Miyagi Province, and 16 houses near those of leper families—the distance separating the houses being at least 20 meters—and found that 217 of these insects (5 per cent) contained leprosy bacilli in their bodies. [The figures for the flies caught in rooms of patients, both in the leprosarium and in private houses, are given in Table 1.]

TABLE 2.—Relation between type of case and occurrence of bacilli in flies.

Designation of case	Type of leprosy	Bacilli in nasal secretion	Flies with bacilli, per cent
k	N-1	—	None
h	N-2	—	0.6
l	N-3	—	None
f	N-3	++	0.8
e	N-3	+++	2.2
g	C-2	+	0.4
d	C-3	+++	5.3
j	C2-N2	+	1.0
b	C2-N2	+	5.8
a	C2-N2	+++	4.7
c	C3-N3	+++	6.2
i	C3-N2	—	2.5

2. *In patients' rooms in residences.*—The low percentage of bacillus-containing flies found in the private houses (Item 3 of Table 1), is explained on the ground that the sick-rooms of the private residences are not as strictly secluded as in leprosaria. However, the figures for the individual houses differ, and generally speaking are in relation to the severity and the form of the lesions. The following table illustrates this relation, severe cases with open wounds discharging more bacilli.

3. *In patients' residences and neighboring houses.*—[This section of the summary consists mainly of a table which gives the findings in flies taken from the houses of several patients in each of four dis-

tricts, and from several houses of neighbors in each district. Of the total of 12 patients' houses, bacilli were found in flies from 10; out of the 1,697 flies from these 12 houses 41 (2.3 per cent) showed bacilli, the individual percentages ranging from 0.6 to 6.0. From 16 neighboring houses the flies were all negative in 8 instances; 1,049 flies gave 16 (1.5 per cent) which were positive. There was a striking apparent regional variation in this, for 7 of the negative neighboring houses were the entire 7 tested in District S.-M., and the 2 negative patients' houses also here. Again, in one district 2.3 per cent of the flies from the 5 neighboring houses were positive, while the 11 houses in the three other districts gave only 0.9 per cent positive.]

The bacilli in the bodies of the flies showed mostly the typical rod forms and were sometimes granular. The number in individual flies varied from a single pair in a microscopic field to massive conglomerations of bacilli. [A plate accompanying the original (Japanese) article shows four colored drawings of microscopic fields showing bacilli found in the intestinal tracts of flies from leprous environments.]

TABLE 3.—*Bacilli in flies fed on leprous material.*

Variety of flies	Number examined	Number positive	Per cent positive
<i>Capilliphara lata</i>	10	6	60.0
<i>Lucilia argyrocephala</i>	98	44	44.9
<i>Musca domestica</i>	53	16	30.2
<i>Fannia canicularis</i>	78	8	10.3
Total	239	74	31.0

4. *Bacilli on the bodies of flies.*—The flies caught in the rooms of the leprosarium were put into test-tubes in lots of 10, and washed by shaking with water. The sediment in each of these tubes was made into one preparation. [According to the table given, of the 74 lots of flies (total 740 flies) from the rooms of severe cases, 4 lots (5.4 per cent) were positive, while of 360 lots (total 3,600 flies) from the rooms of milder cases only four (1.1 per cent) were positive.] It is concluded that fewer bacilli are found on the surface of the flies than inside them.

II. FEEDING EXPERIMENTS WITH FLIES

1. *Leprosy bacilli in the bodies of flies.*—For this experiment four varieties of flies were employed. The flies were first washed with

sterile water and after a 12 hours feeding with leproma pulp rich in bacilli, plus syrup, were fed in another container with bacillus-free material. Every 24 hours thereafter I examined for lepra bacilli in their bodies. The results are tabulated.

2. *Persistence of the bacilli in the flies.*—[A table shows the findings in flies examined at various intervals after feeding them with infected material.]

The bacilli that adhered to the surface of the flies had disappeared completely after 3 days. They were seen in the feces to the end of the second day.

TABLE 4.—*Findings in flies at different intervals after feeding.*

Time after feeding in hours	Number of flies examined	Flies containing bacilli	Per cent positiva
24	224	88	32.3
48	40	6	15.0
72	61	5	8.2
96	41	2	4.9
120	48	0	—
144	8	0	—

III. FLY LARVAE

Larvae fed with leprous material also harbored bacilli in their bodies, at least for 144 hours after the feeding with contaminated food.

Further, by the breeding of 13 larvae, which descended from flies infected with leprous material, 8 new flies were gotten of which one contained fairly many acid-fast rods.

Among 310 fly larvae collected from the sewers of [four] leprous families I found 16 which contained acid-fast bacilli, probably lepra bacilli. [Details by case are given in table not reproduced here.]

IV. PULEX IRRITANS

Sugai and Mononobe reported that they had never found lepra bacilli in fleas and lice from lepers. However, among 1,784 fleas caught in the patients' rooms in the leprosarium I found bacilli 20 times (1.2 per cent), and among 354 caught in rooms of private houses of lepers found them 6 times (1.7 per cent.) The bacilli in the bodies of the fleas were always of degenerated form.

V. PEDICULUS CORPORIS

In none of 42 lice parasitizing 8 lepers (*Lepra mixta* 5, *L. tuberosa* 1, and *L. nervorum* 2), could bacilli be found.

[Comment.—In Japan the study of saprophytic acid-fast bacilli has advanced of late. Bacilli of this kind are sometimes found even in fecal matter, so it may be that not all of the acid-fast bacilli found in a latrine of a leper's house are leprosy bacilli. However, I believe that the greater part of those discovered by Asami may be regarded as leprosy bacilli, because of the fact that they are not generally found in latrines of non-lepers' houses.

Materials for the experiments by feeding and by contamination of flies were gotten from the lesions of lepers and are therefore beyond doubt as regards identification. However, in order to decide whether or not the acid-fast bacilli adhering to a fly caught in a non-leper's house are all leprosy bacilli further control studies are needed. Such investigations, it is understood, Asami intends to carry out at the first opportunity.—M. OTA.]