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Epidemiology of Bancroftian Filariasis in Nagate and Abumize Villages, Nagasaki Prefecture, Especially in Relation to Vector Mosquitoes

2. Endemicity of filariasis*

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長崎県長手，鎧瀬両部落におけるバンクロフト糸状虫症の疫学的研究，特に伝搬蚊との関係について．
2．糸状虫症の浸淫状況． 和田義人，長崎大学医学部医動物学教室（主任：大森南三郎教授）

Introduction

Bancroftian filariasis is widely distributed in southwestern parts of Shikoku Island, western to southern parts of Kyushu, and Ryukyus. The incidence is rather low in Shikoku, while it is fairly higher in Kyushu especially in coastal areas and adjacent islands, and is much higher in Ryukyus. Generally speaking, however, the incidences become progressively higher towards the south, although small but highly endemic focuses are scattered in places.

Omori (1962) made a review on the role of Japanese mosquitoes in the transmission of malayan and bancroftian filariasis, in which he concluded that the most important vector mosquitoes of bancroftian filariasis are *C. p. pallens* in Japan and *C. p. fatigans* in Ryukyus and next one only in Japan may be *Aedes togoi*. Field observations on the transmissibility of mosquitoes of the *pipiens* group have been made by the members of our Department, Oshima (1955), Nagatomo (1961), Omori et al. (1962). However, on the role of *Aedes togoi* as a vector of the disease precise field observations have hardly been carried out because of difficulty to find out such community where *Aedes togoi* is breeding abundantly and also filariasis is fairly or highly endemic.

The author made a preliminary filaria survey in coastal villages in Fukue Island to find out some villages in one of which more detailed investigations could be carried out on the epidemiology of filariasis due to *C. p. pallens*, and in another one of which the role of *Aedes togoi* in relation to the disease could be made clear. In consequence he chose the following two villages to be suitable to the purposes.

The special features of the two villages are as follows : Nagate is very high in the endemicity of filariasis for Nagasaki Prefecture ; has as many breeding places of *C. p. pallens* as usually seen in highly endemic villages; has scanty breeding places of semi-tide-water pools for *Ae. togoi*. Abumize is moderate in the endemicity; has rather scanty

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breeding places of *C. p. pallens* ; has a vast number of semi-tide-water pools on the seashore.

At the two villages he started since April of 1961 to study on the epidemiology of filariasis in relation to the vector mosquitoes, on the ecology and transmissibility of mosquitoes in question, and on the control of the disease by means of only controlling the vector mosquitoes. In the present paper he deals with the results of investigations on the epidemiology of the disease in the two villages.

Before going further, the author wishes to express his sincere thanks to Prof. Nanzaburo Omori of the Department of Medical Zoology, Nagasaki University School of Medicine for his constant leadership and encouragement. Thanks are due to the member of the Department of Medical Zoology and also to Mr. K. Ono of Fukue City Office who were helpful throughout the field work.

Preliminary examinations in Fukue Island

Fukue Island is the largest one of the Goto-Islands of Nagasaki Prefecture and is about 100km west off Nagasaki City. The Island is one of highly endemic areas of filariasis in the prefecture. The villages are scattered mostly in coastal areas around the Island. The incidences of filariasis appeared to be varied fairly with villages.

Among the villages, six ones were chosen for the preliminary blood examination for filariae with the results shown in Table 1. The blood of 20mm^3 was taken on a slide from the ear-lobe of persons assembled in each village at night from 9 to 12 p. m. The films on the slide were dried and stained by Giemsa's solution.

Of the six villages, the two, Nagate and Abumize Villages, were chosen for further examinations as mentioned above. Nagate Village is located near seaside having only a few semi-tide-water collections on its seashore, and no paddy fields, while many cess-pools, ditches, and fertilizer pits suitable for the breeding of *C.p. pallens*. The villagers are mostly engaged in farming growing mainly sweet potato, and a few of them are in fishing. Abumize is located nearer sea-coast having long and rather wide rocky seashore with a great number of semi-tide-water pools, while no paddy fields, and rather fewer breeding places of *C.p. pallens* because of the absorbable sandy soil. The villagers are engaged in agriculture and some are in fishing.

Results of filariasis survey in Nagate and Abumize Villages

Blood examinations for filariae were made with all persons above one year old baby

Table 1 Preliminary blood examination for microfilariae with some persons of several villages in Fukue Island, Nagasaki Prefecture, in December, 1960.

Village	Topography	Main occupation	No. persons examined	No. (%) of positives
Nagate	Hill-side near sea-coast	Farming	133	22(16.5)
Shimosakiyama	Among hills near sea-coast	Farming	270	19(7.0)
Kamisakiyama	Among hills	Farming	229	27(11.8)
Abumize	Sea-coast	Farming	52	4(7.7)
Osako	Foot-hill	Farming	119	1(0.8)
Aka-shima	Islet	Fishery	99	0(0.0)

Table 2 Results of blood examinations with all persons in Nagate and Abumize Villages.

Village	Date	No. of all presons	Blood taken per person (mm^3)	Microfilarial positives	
				No.	%
Abumize	Aug., 1961	84	20	7	8.3
Nagate	Aug., 1961	577	60	81	14.0
Nagate	Sept., 1962	571	30	71	12.4

(referred to as examinations for all persons hereafter). The examinations for all persons were made in Abumize in August, 1961 and in Nagate in August, 1961 and again in September, 1962 with the results as shown in Table 2. The microfilarial incidence was moderate in Abumize, and fairly higher in Nagate. In Nagate Village, however, the incidence somewhat decreased in percentage in 1962, as will be stated later.

1) Results of the survey at Nagate Village

The numbers and percentages of microfilarial positives found in Nagate in 1961 are given by age group and sex in Table 3 and Fig. 1. Of 577 persons examined, 81 persons or 14.0% were found positive. The incidence is rather high for the endemic area in Nagasaki Prefecture in general. The percentage for the male is significantly higher than for the female. Higher incidence for the male has been also reported by some authors, for instance, Oshima (1955) and Nagatomo (1961). The latter author supposed the reason to be due to the custom of the youth having spent the night in group in club houses rarely using mosquito-nets. In Nagate Village, there has been no such a custom and consequently the reason is unknown now, but it may perhaps be due to the difference in susceptibility or in frequency of contacts with infective mosquitoes between

Table 3 Microfilarial incidence in Nagate Village by age group and sex, 1961.

Age group	Male		Female		Total	
	Persons examined	No. (%) of positives	Persons examined	No. (%) of positives	Persons examined	No. (%) of positives
1 — 4	26	0(0.0)	24	0(0.0)	50	0(0.0)
5 — 9	42	2(4.8)	52	3(5.8)	94	5(5.3)
10 — 19	63	10(15.9)	67	5(7.5)	130	15(11.5)
20 — 29	25	7(28.0)	32	2(6.3)	57	9(15.8)
30 — 39	31	7(22.6)	42	5(11.9)	73	12(16.4)
40 — 49	25	8(32.0)	29	7(24.1)	54	15(27.8)
50 — 59	18	8(44.4)	24	5(20.8)	42	13(31.0)
60 — 69	18	4(22.2)	23	3(13.0)	41	7(17.1)
70 —	17	1(5.9)	19	4(21.1)	36	5(13.9)
Total	265	47(17.7)	312	34(10.9)	577	81(14.0)

the sexes, as supposed by Beye et al. (1961).

The youngest positive is a girl of 6 years old and the oldest is a woman of 78. The percentages of the positives vary with the age group, becoming higher with advance in age, reaching a peak in 40—49 or 50—59 age group, decreasing thereafter. The high incidences in age groups of 40—49 and 50—59 may be to a certain degree due to the active infection especially in males by the much oftener exposure to mosquitoes by the heavy labor even in the night-time to support their families for some years just after the War. The lower percentages in old ages may be due to the infection immunity.

Oral examinations for filarial symptoms were made with the all persons in Nagate Village in 1961. The results are given by age group in Table 4. The persons examined are 571, of which 59 or 10.3% are positive for symptoms. The percentage is rather high for the endemic area in general in Nagasaki Prefecture as same as in the case of the microfilarial incidence. Lymphangitis is much common and begins with 20 or above years old. Chyluria

Fig. 1 60% confidence intervals of the population percentages for the percentage positives for microfilariae by age group and sex, in Nagate Village, 1961.

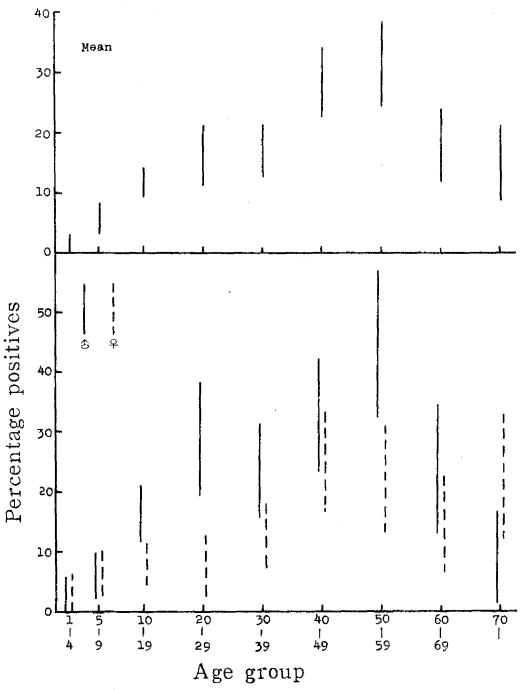


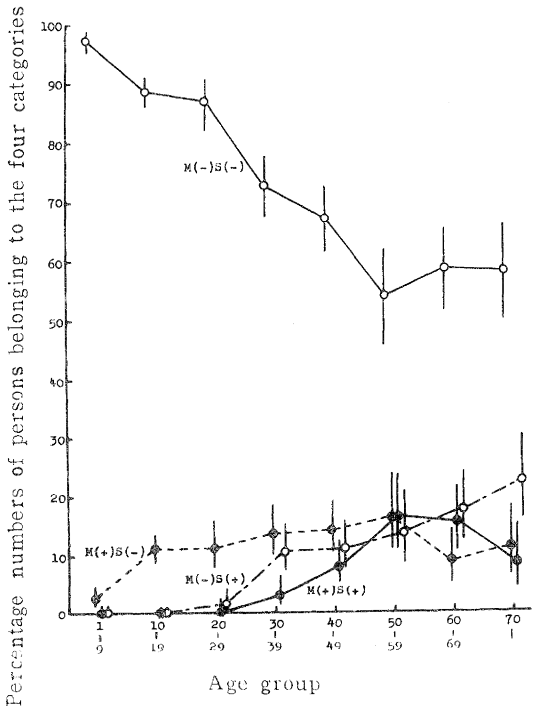
Table 4 Number of persons with clinical signs of filariasis by age group in Nagate Village, 1961. L, C, and H mean lymphangitis, chyluria, and hydrocele respectively.

Age group	No. of persons examined	No. of persons with symptoms			
		L	C	H	Total No. (%)
1 — 9	117				0(0.0)
10 — 19	143				0(0.0)
20 — 29	62	1			1(1.6)
30 — 39	66	8	2		9(13.6)
40 — 49	64	9	1	4	12(18.8)
50 — 59	37	11	4	2	11(29.7)
60 — 69	46	14	5	6	15(32.6)
70 —	36	7	1	6	11(30.6)
Total	571	50	13	18	59(10.3)

is the least and begins with a little older years. Hydrocele is fairly common and begins with a little more older years. Old villagers say that persons having clinical signs have been decreased in number in recent years and now elephantiasis is scaracely observed, though this sign has been not rarely observed several decades ago. This may support the opinion that filariasis infection had been very active in the far past.

The states of endemicity of filariasis in Nagate Village may be seen more clearly in Fig. 2 in which are illustrated the 60% confidence intervals of population percentages for the percentage numbers of persons by age group belonging to the four categories in combination of occurrence (+) or absence (−) of microfilariae (M) and symptoms (S): M(−) S(−), M(+) S(−), M(+) S(+), and M(−) S(+). The trend of the change in the percentage component by age group is well demonstrated by the curve for each category. The percentage number of persons for both microfilariae and symptoms negative or the percentage component M (−) S (−) against the all persons decreases with the advance in age till the 50 −59 age group, while thereafter it remains roughly on the same level at a little less than 60%, showing that more than 40% of these old persons must have experienced the disease during their life time.

Fig 2 60% confidence intervals of the population percentages for the percentage numbers of persons by age group belonging to four categories combined by the occurrence of microfilaria and symptom: M(−) S(−), M(+) S(−), M(+) S(+), and M(−) S(+) in Nagate Village, 1961.



From the trend of the curves for the percentage numbers for M(+) S(−), M(+) S(+), and M(−) S(+), and from the relations among them the historical changes in the intensity of filariasis infection may be understandable. In this connection, in the previous report the author tried to explain the same subject using the triangular graph method and came to a conclusion that :

In recent years or 16 years after the end of the War, especially for some years just after the War, the living conditions of villagers including returners were the worst and caused an active infection of the disease.

In the past or during the War period of about 8 years including the China Incidence and World War II, most males and many females of young and middle ages having been the highest in the microfiiarial incidence moved out from the village reducing the intensity of infection in the home village.

In the far past or for about 50 years before the outbreak of the China Incidence (the then 15 to 50 years old persons are now in 39 to 74 ages), very active infections seem to have been continued in the village, probably nearly as same as in most of the filariasis endemic villages in the prefecture.

The historical periods described above are

referred to hereafter as : Recent years or postwar period, past years or War period, far past years or prewar period.

Now, in the Fig. 2, the curve for M (+) S (−) covers evenly all over the age groups, rising in percentage, however, very slowly towards 50−59 age group. This shows that in recent years fairly active infection has been taking place for persons of every age group, but more repeatedly for old age groups. The curve for M(+)S(+) begins at as late as 30−39 age group becoming higher and reaches maximum in 50−59 ages decreasing thereafter. The very low percentage in 30−39 ages may be due to the reduced intensity of infection during War period to the then younger remainder in the village. High percentage in 50−59 may be to a certain degree due to much oftener exposure to the mosquitoes especially in males including returners for some years just after the War as stated above. The progressive rise of M (−) S (+) curve towards the older ages shows an active infection in the far past or in the prewar period.

The distribution pattern of houses having various numbers of microfilarial carriers in Nagate Village is illustrated in Fig.3. In the eastern part of the village, the incidence of filariasis is apparently higher, where collections of sewage are more abundantly found providing very favorable breeding sites of *C. p. pallens*. Such a distribution pattern of positive houses seems to have a relation to the domestic habit of the mosquito.

The maximum and mean numbers of microfilariae by age group and sex in 60mm^3 blood of the positives in Nagate Village in 1961 are tabulated in Table 5, showing that the greater mean numbers of microfilariae seem to be seen more frequently in younger or middle age groups in both sexes. The heavily infected ones are, however, found irrespectively of age and sex, suggesting that in certain houses repeated and family infections were taking place.

The mean numbers of microfilariae of carriers having been found by ones, twos, and threes or more in a house in Nagate are

Fig. 3 Distribution pattern of houses having various numbers of microfilarial carriers in Nagate Village, 1961. Marks ○, ⊖, ⊕, and ● indicate houses having 0, 1, 2, and 3 or more carriers respectively.

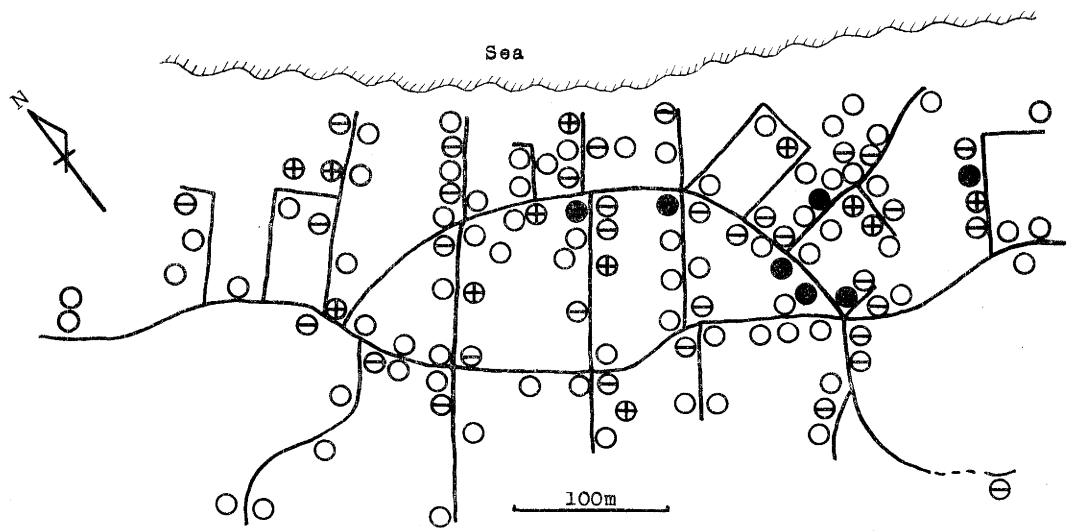


Table 5 Maximum and mean numbers of microfilariae in 60mm³ blood of the positives by age group and sex, in Nagate Village, 1961.

Age group	Male			Female		
	No. of positives	No. of microfilariae		No. of positives	No. of microfilariae	
		Max.	Mean		Max.	Mean
5 – 9	2	562	282	3	301	117
10 – 19	10	242	66	5	494	115
20 – 29	7	22	12	2	104	82
30 – 39	7	530	176	5	164	62
40 – 49	8	494	120	7	171	46
50 – 59	8	139	45	5	228	91
60 – 69	4	131	40	3	33	19
70 –	1	15	15	4	338	101
Total	47	562	86	34	494	78

compared in Table 6. It is apparent from the table that the more the carriers in a house are, the higher the microfilarial density in an average is. An extreme example is seen in Table 7 in a family. The family has much heavily infected carriers as many as 4 which is the greatest for the village. These facts imply the occurrence of the family infection as will be examined in the following.

Frequency distributions of the number of families having various numbers of carriers in each family size in Nagate in 1961 is shown in Table 8. There were 126 houses or families in total, of which 53 (42%) had or more one carriers, i.e. 33, 13, 6, and 1 houses had 1, 2, 3, and 4 carriers respectively.

If it is supposed that the filarial infection takes place by chance, the numbers of houses having serial numbers of carriers in each family size will follow a binomial distribution. Then, in Table 9, goodness-of-fit of the

Table 6 Mean number of microfilariae in 60mm³ blood of carriers who were found by ones, twos, and threes or more in a house respectively in Nagate Village, 1961.

No. of carriers in a house	Total No. of carriers	Mean No. of microfilariae
1	33	56
2	26	78
⟫ 3	22	127
Total	81	82

Table 7 Number of microfilariae (Mf) in 60mm³ blood of members in a family having the greatest number of carriers in Nagate Village, 1961.

Age	Sex	No. of Mf
6	♀	301
7	♂	562
9	♂	0
12	♂	0
14	♂	132
44	♀	0
49	♂	494

Table 8 Frequency distribution of the number of families having the indicated number of carriers in each family size, in Nagate Village, 1961.

Size of family	No. of carriers in a family					No. of families	No. of persons examined	No. of carriers
	0	1	2	3	4			
1	9	3	—	—	—	12	12	3
2	13	2	1	—	—	16	32	4
3	11	4	0	0	—	15	45	4
4	8	5	4	3	0	20	80	22
5	12	5	2	1	0	20	100	12
6	6	4	2	1	0	13	78	11
7	8	5	2	0	1	16	112	13
8	5	2	1	1	0	9	72	7
9	1	2	1	0	0	4	36	4
10	0	1	0	0	0	1	10	1
Total	73	33	13	6	1	126	577	81

hypothetical number of families under the above assumption to the observed number shown in total of Table 8 is tested. Here, the probability in the binomial distribution or microfilarial incidence is 14.0%.

Chi-squared obtained is 5.58, which does not show a significant departure at 5% level from the hypothetical distribution, but the probability lies between 0.05 and 0.10. This implies that family infections are taking place though not significantly, and that in any villages where higher microfilarial incidences than in Nagate may be found significant family infections should be observed as will be discussed later.

In Nagate Village, all persons were examined for microfilariae in August, 1961 and again in Saptember, 1962, as already stated. During the period, some persons moved as shown in Table 10. With 540 persons, who did not move, the results of blood examination were compared in Table 11. The number of persons turned positive was 3, while the number of those

Table 9 Test of goodness-of-fit of the hypothetical number of families calculated under the assumption of binomial distribution to the observed number shown in total in Table 8.

No. of carriers in a family	0	1	2	3	4	5	Total	X^2-test
Observed No. of families	73	33	13	6	1	0	126	$X^2=5.58$
Hypothetical No. of families	66.71	41.87	13.78	3.10	0.49	0.06	126.01	Df=2
Daviation	6.29	−8.87	−0.78	3.35			−0.01	$0.05<P<0.10$

Table 10 Movement of persons in Nagate Village during 1961 and 1962.

Subject	No. of persons
Population in 1961	577
Emigrated	33
Died	4
Immigrated	21
Born	10
Not moved	540
Population in 1962	571

Table 11 Comparison in numbers of microfilarial positives and negatives between 1961 and 1962, in Nagate Village.

1962 \ 1961	Positives	Negatives	Total
Positives	66	3	69
Negatives	14	457	471
Total	80	460	540

turned negative was 14.

Further blood examination was mde in May, 1963 with the 17 persons, 14 of which were positive in 1961 and negative in 1962, while the remaining 3 were negative in 1961 and positive in 1962. The numbers of microfilariae in them are given in Table 12.

Because of only a half volume of blood being taken in 1962, the disappearance of microfilariae in most of the 14 persons was doubtful. However, the facts that most of them were negative for filariee in 60mm³ blood on the last examination inspite of no drugs having been administered may show the natural disappearance of microfilariae during the period of nineteen months during which no transmission of the disease has been taking place by the reason as shown in the remarks in Table 12. The control of vector mosquitoes were made by the residual spraying with 5% DDT emulsion on June 6, 1962 and by weekly applications of Diazinon emulsion to tha breeding places of *C. p. pallens*. The detailed account of the control of vector mosquitoes and its effect will be reported in the later report of the series.

Table 12. Disappearance or appearance of microfilariae in some persons during the observation period of 21 months.

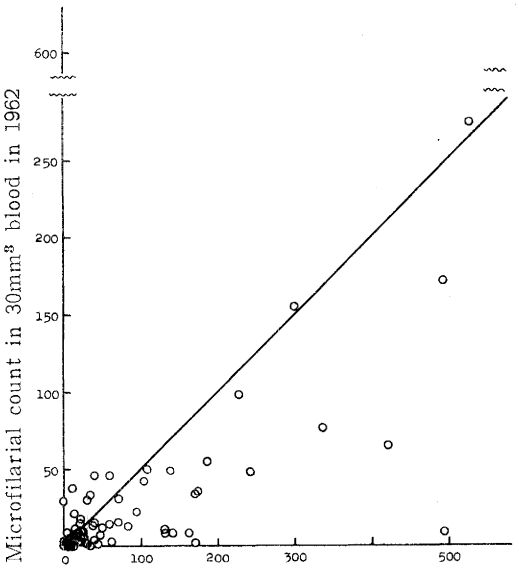
Individual No.	Age	Sex	No. of microfilariae		
			60mm³ in Aug. 1961	30mm³ in Sept. 1962	60mm³ in May 1963
1	12	♂	12	0	0
2	17	♂	2	0	0
3	24	♂	2	0	0
4	28	♂	15	0	emigrated
5	33	♂	2	0	0
6	45	♂	2	0	0
7	50	♂	1	0	0
8	59	♂	9	0	0
9	64	♂	6	0	5
10	33	♀	16	0	7
11	50	♀	1	0	0
12	54	♀	9	0	0
13	68	♀	33	0	0
14	78	♀	1	0	0
15	66	♂	0	1	0
16	14	♀	0	1	emigrated
17	41	♀	0	29	0

Remarks : No transmission of filariasis may be taken place after October of 1961 through May of 1962, because of low temperature, and subsequent control of vector mosquitoes, although no drugs were being entirely administered.

The microfilarial counts of positives in 1961 are compared with those of the same persons in 1962 in Fig. 4. It is of interest that in many

Fig. 4 Comparison of the microfilarial counts of the same persons between 1961 and 1962 in Nagate Village.

The line shows the same microfilarial density between 1961 and 1962.



positives the counts decreased during the period having been kept off from the bite of mosquitoes. In a few persons, however, the counts somewhat increased probably bacause of their being repeatedly infected shortly before the first examination.

2) Result of the survey in Abumize Village

All persons in Abumize Village were examined for microfilariae in 1961. The results obtained are given by age group and sex in Table 13. Of 84 persons examined, 7 or 8.3% were found positive, five males and two females. The age distribution of positives seems somewhat different from that in the above mentioned village (cf. Table 3 and Fig. 1) in the point that there are few positives in younger age groups, showing that the transmission of filariasis must have been much inactive in recent years. The reason of the inactivity is thought to have been related to the history of the establishment of the village.

The village, now consisting of 20 houses, had only a few houses about 40 years ago. The others were built during some 30 years thereafter by the immigrants from nearby villages, Kami-Sakiyama and Shimo-Sakiyama (cf. Table 1). Therefore, almost all of the filaria patients in the village seem to be positive immigrants and few of them seem to have been infected after moving in the village.

Table 13. Microfilarial incidence in Abumize Village by age group and sex.

Age group	Male		Female		Total	
	Persons examined	No. (%) of positives	Persons examined	No. (%) of positives	Persons examined	No. (%) of positives
1 — 9	7	0 (0.0)	13	0 (0.0)	20	0 (0.0)
10 — 19	12	0 (0.0)	14	1 (7.1)	26	1 (3.8)
20 — 29	2	0 (0.0)	1	0 (0.0)	3	0 (0.0)
30 — 39	1	0 (0.0)	6	0 (0.0)	7	0 (0.0)
40 — 49	6	1 (16.7)	10	0 (0.0)	16	1 (6.3)
50 — 59	6	3 (50.0)	3	1 (33.3)	9	4 (44.4)
60 —	2	1 (50.0)	1	0 (0.0)	3	1 (33.3)
Total	36	5 (13.9)	48	2 (4.2)	84	7 (8.3)

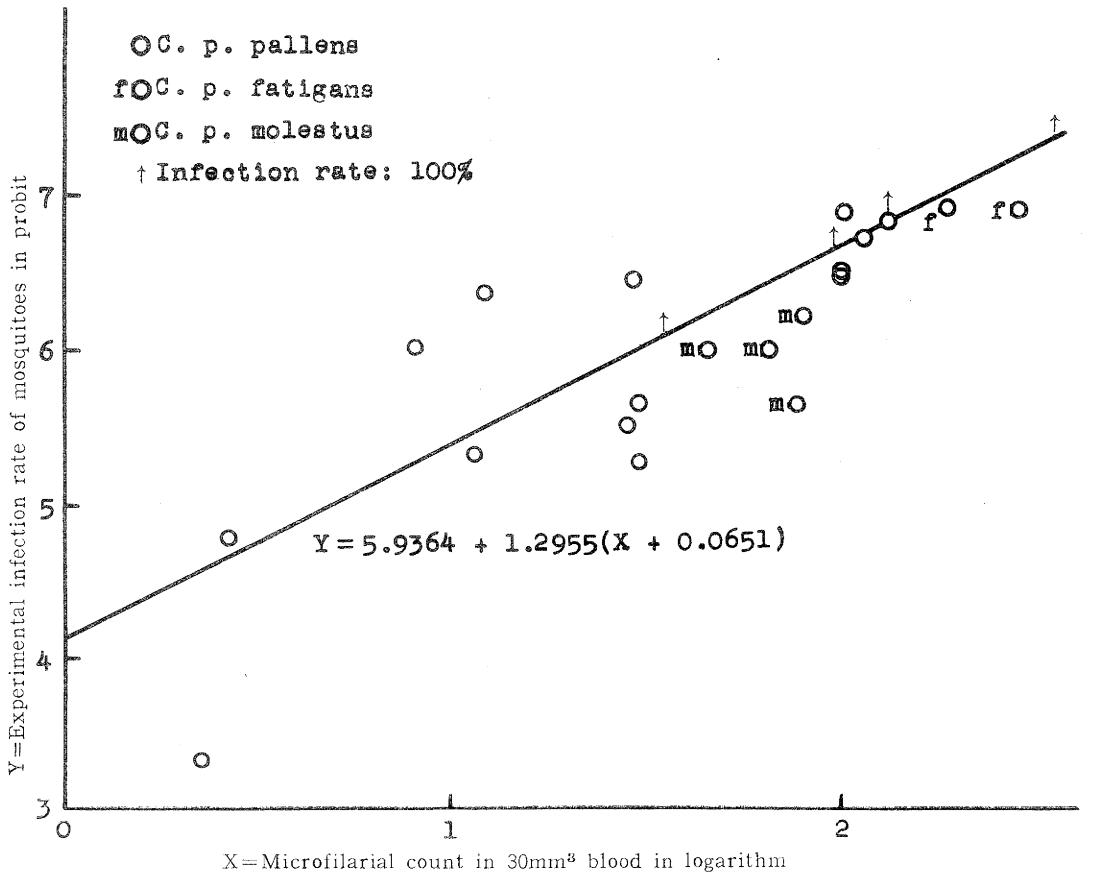
The familial aggregation of infection is proved to be not significant. The reason is uncertain to be due whether to the rather low microfilarial incidence or to the transmissibility of an abundant mosquito species, *Aedes togoi*. Examination of the subject are now in progress.

Considerations on the filarial infectivity of persons to mosquitoes in a community.

The frequency distribution of selected microfilarial levels in a population seems to provide the clear picture of the occurrence of microfilariae as pointed out by Kessel (1957). Sasa et al. (1959) indicated the frequency distributions against the microfilarial counts of carriers shown in logarithmic units and Omori et al. (1962) in cube root units. The methods are useful to grasp the general tendency of the distribution. However, the comparison of the results of different experiments is difficult especially in the minimum side of the microfilarial level when different amounts of blood were taken in each examination. Thereupon, the author devised a new method by which it will be capable to compare the frequency distributions based on the different blood volume.

Frequency distributions are expected to be comparable when plotted against the tentative microfilarial levels which are set up for the ranges of the expected infection rates of mosquitoes fed on the carriers having adequate

Fig. 5 Relation between the experimental infection rates in probit of mosquitoes and the microfilarial counts in 30mm³ blood of carries in logarithm.
Data are from Fujisaki (1958), Omori (1958), and Omori (unpublished).



numbers of microfilariae to get the rates.

As a procedure to gain the final comparative illustration, the relation between the experimental infection rates of mosquitoes and the microfilarial counts in 30mm³ blood of carriers were examined in Fig. 5, from the data of our Department. Three forms of *C. pipiens* group seem to have similar susceptibilities, so that all data are put together. As the relation seems linear, the regression equation is calculated as seen in the figure.

From the equation it is capable to get the expected infection rates of mosquitoes to be fed on carriers having various microfilarial counts as shown in Table 14. Then, the tentative microfilarial levels are set up for the selected ranges of expected infection rates as given in Table 15.

Now, the comparison was made in Fig. 6 with the frequency distributions shown in percentage of persons being in the levels, to the whole populations examined in different

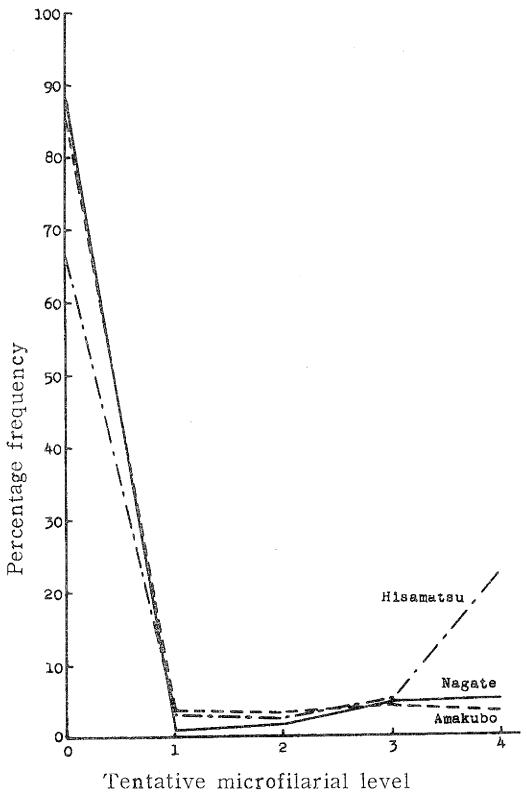
Table 14 Microfilarial counts of carriers to be obtained for the expected experimental infection rates of mosquitoes having been fed on them, culculated from equation given in Fig. 5.

Expected infection rates (%) of mosquitoes	Microfilarial counts of carriers			
	in 1mm³ blood	in 20mm³ blood	in 30mm³ blood	in 60mm³ blood
10	0.0167	0.334	0.501	1.002
20	0.0366	0.732	1.098	2.196
30	0.0641	1.282	1.923	3.846
40	0.1040	2.080	3.120	6.240
50	0.1629	3.258	4.887	9.774
60	0.2559	5.118	7.677	15.354
70	0.4140	8.280	12.420	24.840
80	0.7278	14.558	21.834	43.668
90	1.5890	31.780	47.670	95.340

Table 15 Ranges in the integral number of microfilarial counts in carriers to be obtained for the expected experimental infection rates of mosquitoes shown in the given ranges or the selected levels.

Tentative microfilarial level	Expected infection rates (%) of mosquitoes	Microfilarial counts of carriers		
		in 20mm³ blood	in 30mm³ blood	in 60mm³ blood
0	0 – 20	0	0 – 1	0 – 2
1	20 – 40	1 – 2	2 – 3	3 – 6
2	40 – 60	3 – 5	4 – 7	7 – 15
3	60 – 80	6 – 14	8 – 21	16 – 43
4	80 –	15 –	22 –	44 –

Fig. 6 Comparison of the frequency distribution in percentage of persons being in tentative microfilarial levels to the total persons examined in Nagate Village with those in Amakubo (Nagatomo, 1961) and Hisamatsu (Omori et al., 1962).



three villages. The frequency distributions for Nagate and Amakuboare much similar showing that the intensities of filariasis infection may be nearly the same. The frequency distribution for Hisamatsu, however, is quite different from those for the above two villages. The percentage for level zero is lower and that for level 4 is markedly higher. This shows that in the last village the infection is taking place in much more intensive grade.

The frequency distribution against the levels is thought to represent the distribution of filarial infectivity of persons to mosquitoes in a community. Therefore, the averaged level may be called an index of filarial infectivity of persons to mosquitoes in a community. The indices are 0.38, 0.37, and 1.14 for Nagate, Amakubo, and Hisamatsu Villages respectively being well in line with the above statements. The index is thought to have a close relation to the natural infection rate of mosquitoes in a community. The conception may be applicable to the infectivity of persons in a patient's house within a community. In Nagate Village, natural infection rates in patient's houses are found to be more closely related to the indices thus obtained than to the microfilarial incidences or the mean microfilarial densities in the respective houses.

Considerations on the family infection

In Nagate Village where the microfilarial incidence is 14.0%, familial aggregation of carriers was roughly demonstrated and higher microfilarial densities were found in houses having more carriers. Here, it is of interest to refer to the papers by the other authors dealing with the same subject. In Aogashima where microfilarial incidence was 12.9%, no significant familial aggregation of carriers was found (Hayashi, et al.,1959), while in Amakubo Village where the incidence was as high as 17.2%, it was proved to be strongly significant (Nagatomo, 1961).

From these data, the familial aggregation may be said to be proved significant when the microfilarial incidence of a community becomes higher than 15% or so, as far as the house mosquito, *C. p. pallens* is concerned in the transmission of the disease.

Summary

Epidemiological studies on the bancroftian filariasis, especially in relation to the vector mosquitoes, *C. p. pallens* and *Aedes togoi* were started in Nagate and Abumize Villages in 1960 and are in continuation. In this report, the endemicity of the disease is mainly dealt with.

1) In Nagate Village :

Of all 577 persons examined for microfilariae

in August of 1961, 81 or 14.0% were found positive. The male is significantly higher in the incidence than the female. The percentage positives is low in 5—9 ages, becoming higher with age, reaching a peak in 40—49 and 50—59 ages, and decreasing thereafter. All the 571 persons were examined orally for filarial symtoms and 59 or 10.3% were found positive for any filarial symptoms. Lymphangitis begins in 20—29 ages and is the commonest, chyluria in a little older ages and the least, and hydrocele in a little more older ages and fairly common.

The states of filarial endemicity were examined through the trend of the curves for the percentage numbers of persons belonging to the four categories by age group : M(−) S(−), M(+)S(−), M(+) S(+), and M(−) S(+). The M(−)S(−) curve falls with the advance in age till the 50 — 59 ages, remaining thereafter roughly on a level a little less than 60%, showing that more than 40% of villagers have to experience the disease in their life time. The M(+) S(−) curve covers evenly all over the age groups, increasing very slowly towards 50—59 age group, showing that in recent years fairly active infection has been taking place. The M(+) S(+) curve begins at 30 — 39 ages with a very low percentage showing the reduced intensity of infection during the China Incidence and World War II for the then younger remainder in the village, and rises in 50—59 ages probably owing to much oftener exposure to mosquitoes especially in males including returners for some years just after the War. The M(−)S(+) curve progressively rises towards the older ages showing an active infection for some 50 years before the outbreak of the China Incidence.

The houses having microfilarial carriers are distributed more concentrately in the eastern part of the village, where are found many collections of sewage suitable for the breeding of *C. p. pallens*.

Greater mean numbers of microfilariae are roughly seen in younger or middle age groups. However, heavily infected individuals are found irrespectively of age and sex. The mean number of microfilariae is found greater in carriers who are found in a greater number in a house. In this village a familial aggregation of carriers is roughly proved though not significantly.

In the blood of some 14% of carriers, microfilariae disappeared naturally, during nineteen months from October, 1961 to May, 1963, during which in cold months from October to May the female mosquito became dormant and in hot season from June to September mosquitoes were controlled by residual spraying and larvicide.

2) Abumize Village :

The village is situated near seashore and has a vast number of semi-tide-water pools suitable for the breeding of *Aedes togoi* in the long and wide sea coast.

The village, now of 20 houses, had only some 5 houses about 40 years ago, becoming larger little by little in number of houses by 10 years ago. Of all 84 villagers examined in 1961, 7 or 8.3% were found positive. In younger age groups, however, few positives were detected suggesting little infections might have been taking place after their immigration. The adult carriers seem to be positive immigrants from nearby villages.

3) The filarial infectivity of persons to mosquitoes in a community has an intimate relation to the picture of the occurrence of microfilariae in the community and can be demonstrated by a frequency distribution of persons in percentage for the whole population in a community against the microfilarial levels which are set up for the ranges of the expected infection rates of mosquitoes fed on the carriers having adequate numbers of microfilariae to get the rates. The conception may be applicable to the infectivity of persons in a patient's

house within a community. The average of the levels is useful in comparing the pictures of the occurrence of microfilariae among communities among houses or and will be called the index of filarial infectivity of persons to mosquitoes in a community or in a house. The index is thought to have a close relation to the natural infection rate of mosquitoes in a community or in a house as far as mosquitoes *C. pipiens* group are concerned in the transmission of filariasis.

4) A familial aggregation of carriers was roughly detected in Nagate Village though not significantly where the microfilarial incidence was 14.0%, while the same phenomenon was denied in Aogashima (Hayashi et al., 1959) where the incidence was 12.0%. On the other hand it was proved strongly significant in Amakubo (Nagatomo, 1961) where the incidence was as high as 17.2%. The above suggests that the borderline to make possible the occurrence of the familial aggregation of carriers in a community may be near 15% in the incidence.

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摘　　要

長崎県下の長手，鎧瀬両部落で，1960年来，バンクロフト糸状虫症の疫学，特に伝播蚊との関係について一連の調査研究を行なっているが，本報では主として糸状虫症の浸淫状況について述べる．

1） 長手部落：1961年８月，部落民全員 577名から採血し，81名（14.0%）の仔虫陽性者を認めた．男性の仔虫陽性率は女性よりも有意的に高い．陽性率は５−９才では低く，年令が進むにつれて高くなり，40−49才及び 50−59 才で最高となって，その後又低くなる．症状保有者は全住民の10.3%であり，最も普通な症状はクサフルイで，20−29才から見られ，乳び尿及び陰のう水腫はこれに比べるとかなり少なく，よりおそくから初発する．

糸状虫症浸淫の歴史的変遷を解明するために，仔虫及び症状の存否を組合わせた４つの症状区分について，それらに属する人員構成を吟味して次のような推定を得た．1） 部落民の約40%以上の者が一生の間に感染を受ける．2） 支那事変勃発以前の約50年の間にはかなり盛な感染が起っていたと考えられる．3） 支那事変及び第二次世界大戦の約８年間には感染の強さがかなり弱くなり，4） 終戦後再びかなり強い感染が起ったように思われる．

アカイエカの好適発生源が多数存在する部落東部に，患家が比較的集中的に分布している．

平均仔虫数は，若，中年令層に高い傾向がみられるが，散発的には重感染を受けたと思われる者が年令，性に関係なく見られる．

1961年10月から1963年５月までの約19カ月の間，低温時における吸血活動の停止と，引き続く伝播蚊の駆除のために感染は起らず，又起さなかったが，この間に，約14%の仔虫陽性者が自然陰転した．

2） 鎧瀬部落：本部落はトウゴウヤブカの好適発生水域が驚くほど多数に存在する岩礁海岸にある．殆んどの家は，第二次世界大戦中及び戦後の数年間に，近隣部落からの移住者によって建てられた．1961年，部落全員 84名を採血し，７名（8.3%）の仔虫陽性者を認めた． 若い年令層に仔虫陽性者が極めて少ないので，移住後の部落内での感染は極めて少なかったように思われる． 成人の陽性者は移住前の感染者であろう．こゝに，多発するトウゴウヤブカの伝播性が問題となるが，この事については後報する．

3） ある集団内（又は患家内）に於ける住民の，蚊への感染能力段階に対する頻度分布は，被吸血者の仔虫数から推定される蚊の実験的感染率の５段階の仔虫数水準に属する人員の百分率頻度分布によってよく示し得る．この頻度分布は，その集団（又は患家）の対仔虫密度仔虫保有率の分布と密接な関係があるのであるが，その水準の平均， 即ち平均感染能力を， 集団（又は患家）の感染能力指数と名づける． この指数は，部落（又は患家）におけるアカイエカの自然感染率と密接な関係があると思われ，集団（又は患家）に於ける仔虫保有相とアカイエカ群の自然感染との関係を究明していくのに役立つと考えられる．

4） 仔虫陽性者の家族集積性は，仔虫陽性率が14.0%であった本部落ではその傾向があるが有意的ではなく，林ら（1959）は12.0%の青ヵ島ではこれが認められなかったと云って居り，永友（1961）は17.2%の天久保部落で高度にこれを認めている． これらの事から，家族集積性が認められる仔虫陽性率の限界は15%前後にあると考えられる．

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