

THE CLIMATE THEORY IN LEPROSY

BY EINOSUKE SHIONUMA^{*}

KENJI NAGAI

AND TEI MAEDA

Keiaien, National Leprosarium

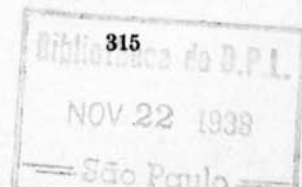
Kagoshima, Japan¹

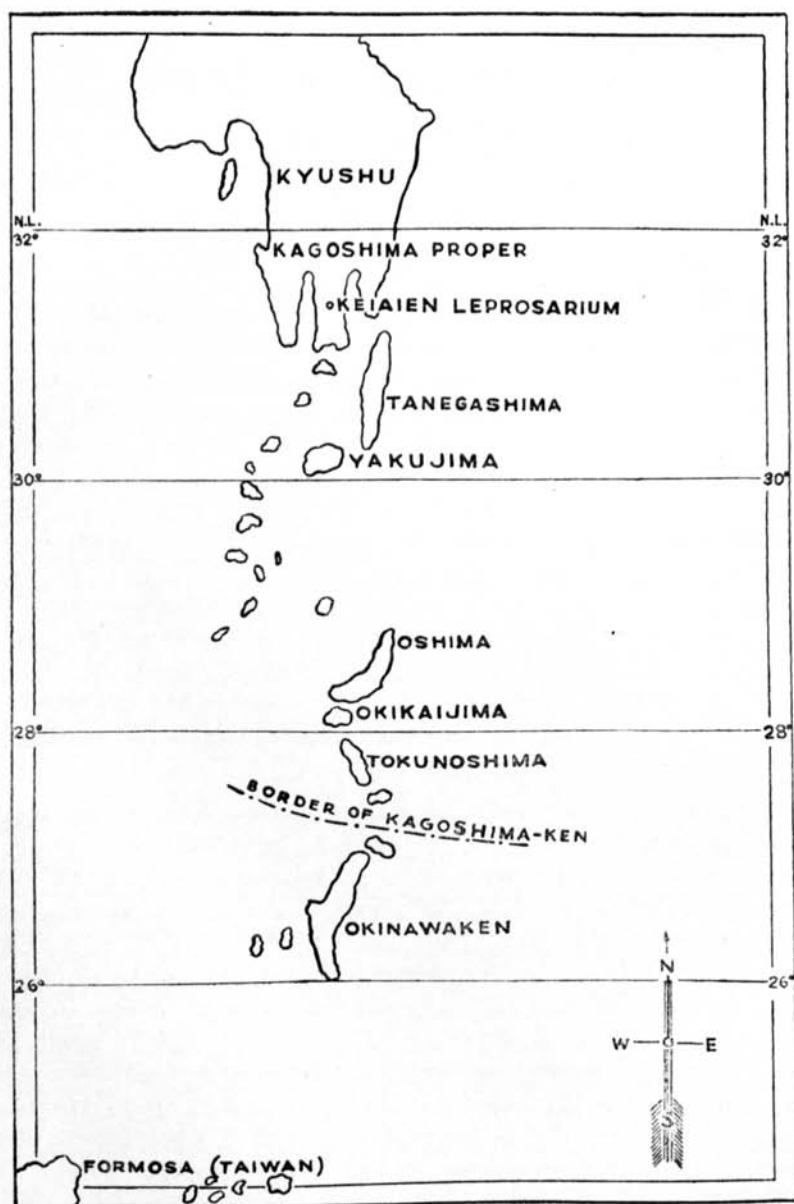
Foreign physicians visiting Japan seem to think that there is an unusually large amount of leprotic alopecia among our patients. Fumio Hayashi had the opportunity, in 1933, to see whether this condition exists among other peoples. He found that, though it occurs in other leprosy countries, in none of them was it as prevalent and severe as in Japan, where in certain leprosaria more than one-half of the inmates are more or less bald. He observed (2) that not only leprotic scalp involvement but other changes caused by the disease, as those of the eye or the nerve, are more severe in Japan than in other countries. These differences he explained on the basis of the climate theory: that the colder the climate the more severe the leprosy symptoms. In agreement with this view is the fact that, in Japan, leprosy symptoms become more marked in winter than they are in summer.

In 1935 the newly established leprosarium, Keiaien, in Kagoshima prefecture, admitted in almost equal numbers patients from three districts: 129 from Okinawa Island, about N.L. 26°; 116 from the Oshimas, at N.L. 28°; and 112 from Kagoshima and the neighboring prefectures on Kyushu, N.L. 31°-32° (Text-fig. 1). In the tables the last-mentioned are all included under "Kagoshima." Administratively, Oshima county belongs to Kagoshima-ken but it and Okinawa are dealt with separately except when all groups are considered together, in which case the name of the leprosarium—Keiaien—is used. Data on temperatures at these places, and also at the Aiseien leprosarium, on Nagashima Island, Okayama-ken, are given in Table 1.

A year ago, visiting Okinawa and Oshima, Hayashi came to the opinion that the climate theory would apply in these islands, and an investigation in Keiaien of this important and

¹ Director, Fumio Hayashi





TEXT-FIG. 1.—Sketch map showing Kagoshima, in the southern part of Kyushu Island, where the Keiaien leprosarium is located, and Oshima and Okinawa Islands to the south.

interesting question was undertaken. Medical officers of this institution have investigated and published on alopecia leprosa, eye symptoms and nerve symptoms (Nagai 5, Shionuma 6, Maeda 3). The data obtained are given briefly here.

LEPROTIC ALOPECIA

When Nagai was in charge in Aiseien he studied alopecia there, and that has helped in the present investigation. In Table 2 are given the figures for that condition in both Aiseien and Keiaien, the latter also being subdivided according to the sources of the patients, namely, Okinawa, Oshima and Kagoshima proper. These figures are interesting for comparison with the statistics of various foreign leprosaria published by Hayashi.

In N-type leprosy alopecia is only exceptionally seen, and then only in cases of "macula tuberculoid" when the lesions are located on the head. That condition is quite different from the alopecia of C-type leprosy, the so-called alopecia leprosa. In Table 3 are shown the numbers of C cases among those dealt with, and the frequency of alopecia among them.

From both of these tables it is evident that the warmer the climate the lower the frequency of alopecia.

Though in these figures the percentages for Kagoshima are larger than for Aiseien, Table 4 shows that the grade of alopecia in the former place is much slighter than in the latter.² In all of the Okinawa cases it is of first grade. This is in line with the fact that in the Philippines leprotic alopecia does not occur, although a few Chinese in Malaya show it. On the other hand, the author has recently seen (1) a photograph of a group of Chinese lepers in Kaolan, Lanchow, North China (N.L. 35°), who all showed marked (grade 3 or 4) alopecia.

LEPROTIC EYE LESIONS

Blindness in lepers was investigated by Hayashi during his world tour, and the figures which he published are reproduced in Table 5, for comparison with those of the leprosaria in Japan.

Shionuma examined for eye lesions 472 inmates, including 143 from Okinawa, 145 from Oshima and 184 from Kagoshima; 198 of them were of the N type and 274 of the C type. In

² The grades and forms of leprotic alopecia have been described by Mitsuda and Nagai (4).

Table 6 are given the statistics on eye changes in the C-type cases coming from these three districts. Most of the lesions were more severe in the Kagoshima cases than in the two other groups.

Though it is not easy to classify these changes by grade for comparison, keratitis leprosa may be classified into three grades according to the extent of pannus and parenchymatous infiltration, as follows: Grade 1 shows opacity in the upper circumference of the cornea, like arcus senilis. Grade 2, pannus or keratitis punctata expands in the upper half of the corneal meridian. Grade 3, the whole surface of the cornea is covered with pannus or with heavy parenchymatous infiltration. Trachoma pannus and other complications are all excluded.

The percentages of cases at Keiaien that were found to have keratitis leprosa were (as is shown in Table 6): from Kagoshima 71.0, from Oshima, 52.3, from Okinawa 46.9. These lesions are classified by grade in Table 7. It is evident that the farther south the district is located, the higher the proportion of grade 1 lesions and the fewer those of the third grade. These figures correspond with those for C-type cases in Table 8, which shows the degrees of advancement of the disease in the cases from the three districts concerned.

NERVE SYMPTOMS

This same relationship to climate is seen also in nerve symptoms. As reported by Hayashi, radialis and accessorius paralysis are not seen as often in the tropics as in Japan, nor does high grade facialis paralysis occur as frequently.

Nerve thickening as found in 457 patients—187 from Kagoshima, 146 from Oshima and 124 from Okinawa—is shown in the first part of Table 9. Statistics of Yoshinobu Hayashi at the Zensei leprosarium, Tokyo, are included for comparison. As the thickening of nerves is only a transitory phenomena, it is not so important for this study as paralysis. Even so, the frequency of nerve thickening is higher in Kagoshima proper than in the more southernly regions. Gross data such as these are unsatisfactory because nerve thickening is more common in C-type cases than in N; the proportion of C:N must be considered, which is 132:55 in Kagoshima inmates, 77:69 in Oshima and 55:69 in Okinawa. Figures for the N-type groups are given in the second part of Table 9. Here again the figures are highest in Kagoshima, except in one instance.

Deformity of fingers and toes in Keiaien is less common than at Zensei, the percentages being 64.8 and 81.1, respectively. The detailed figures are not given here as the matter is complicated by factors such as the fact that the Okinawa cases include many vagabonds who had been living under miserable conditions and had many high grade deformities. More important are the data on motor paralysis, given in Table 10, which show how paralyzes of the facial, radial and accessorius nerves predominate in northern cold climates. Analysis of data on the duration of the disease at the time facial paralysis began shows that it comes on earlier in the colder regions than in the warmer ones.

DISCUSSION

In the course of this analysis the question arose whether or not the more extensive changes found in the patients from Kagoshima might be due to greater duration of the disease than in the case of those from the other two districts. Investigation of this point revealed the fact that the average duration, since its first appearance, was: Kagoshima cases 9.3 years, Oshima cases 9.8 years, Okinawa cases 10.3 years. Since the appearance of C efflorescence (which in considering C-type cases is more important than the duration of the disease): Kagoshima cases 5.8 years, Oshima cases 5.6 years, Okinawa cases 6.1 years. Thus, contrary to what might be expected from the condition of the patients, those from Okinawa were of longer standing than the others, but nevertheless the changes in them were less severe than in the cases of shorter duration from the north.

One other element that may affect the severity of symptoms is perhaps the epidemiological status in a region, a matter than cannot be discussed here.

In the summer of 1937 the authors had an opportunity to examine 18,236 inhabitants of Kikaijima, one of the Oshima archipelago, from where almost no lepers had been sent to the leprosarium and where leprosy has been very prevalent since olden times. Among the people examined 112 lepers were found (6 per thousand). Among them were no blind ones and none with alopecia; nerve changes also were not advanced. As this examination included all of the inhabitants, the relative mildness of the disease in the southern islands is thus established.

CONCLUSIONS

(1) Alopecia leprosa (Nagai), eye lesions (Shionuma), and nerve symptoms (Maeda) are more severe and more prevalent in places with a cold climate than in warmer ones.

(2) The "climate theory"—the warmer the climate the less severe the leprosy symptoms—is supported by the results of this investigation.

REFERENCES

- (1) [ANON.] Chinese men in the Kaolan Home (photograph). Without the Camp. (1936) No. 160, October.
- (2) HAYASHI, F. Report of a leprosy study tour. *Internat. Jour. Lep.* 3 (1935) 165-180.
- (3) MAEDA, T. Climate theory and nerve symptoms. 10th Japan Leprosy Conference. 1937.
- (4) MITSUDA, K. AND NAGAI, K. On alopecia leprosa. *Internat. Jour. Lep.* 5 (1937) 247-252.
- (5) NAGAI, K. Climate theory and alopecia leprosa. 9th Japan Leprosy Conference. 1936.
- (6) SHIONUMA, E. Climate theory and eye symptoms. 9th Japan Leprosy Conference. 1936.

TABLE 1. *Latitudes and temperature data of the regions from which patients studied were drawn.*

Region	Latitude (North)	Temperatures (1935)			
		Average	Maximum	Minimum	Difference
Kagoshima ^a	31°-32°	16.9°	34.6°	-4.3°	38.9°
Oshima Islands (Naze).	28°	21.0°	34.8°	-6.6°	28.2°
Okinawa Island (Nawa)	26°	22.0°	31.5°	-10.0°	21.5°
Aiseien Asylum.....	34.7°	14.7°	35.9°	-6.1°	42.0°

^a Keiaien, 31.3°TABLE 2. *Cases of alopecia at Aiseien and Keiaien, with subdivisions of the latter.*

Region	Number of patients	Alopecia	
		Cases	Percent
Aiseien asylum.....	1,050	560	53.3
Keiaien asylum ^a	418	114	27.3
Kagoshima.....	150	84	56.0
Oshima.....	141	17	12.0
Okinawa.....	127	13	10.2

^a Total for Kagoshima as a whole; subdivisions follow.TABLE 3. *Frequency of alopecia in C-type cases.*

Region	Number of cases	Alopecia	
		Cases	Percent
Aiseien.....	845	558	66.0
Keiaien.....	244	112	45.9
Kagoshima.....	107	83	77.6
Oshima.....	78	17	21.8
Okinawa.....	59	12	20.3

TABLE 4. *Grades of alopecia in C-type cases.*

Region	1 grade		2 grade		3 grade		4 grade	
	No.	%	No.	%	No.	%	No.	%
Aiseien.....	278	54.6	152	25.7	112	17.3	16	2.4
Keiaien.....	67	59.8	36	32.1	9	8.0	0	0.0
Kagoshima..	44	53.0	31	37.3	8	9.6	0	0.0
Oshima.....	11	64.7	5	9.4	1	5.9	0	0.0
Okinawa....	12	100.0	0	0.0	0	0.0	0	0.0

TABLE 5. *Blindness in various leprosaria, in Japan and abroad.*

Institution	Date founded	Number of inmates	Blind inmates	
			Number	Percent
Culion (Philippines).....	1906	6,021	67	1.4
Sungei Buloh (Malaya).....	1930	1,200	12	1.0
Purulia (India).....	1888	700	20	3.0
Chandkuri (India).....	1897	700	15	2.5
Hendala (Ceylon).....	1740	600	10	1.7
Pretoria (S. Africa).....	1897	960	20	2.0
St. Isabel (Brazil).....	1932	830	4	0.5
St. Angelo (Brazil).....	1930	937	70	13.5
Carville (U.S.A.).....	1894	351	30	8.5
Kalaupapa (Hawaii).....	1866	470	30	6.4
Zensei (Japan).....	1909	1,109	207	18.7
Aomori (Japan).....	1909	378	50	13.2
Osaka (Japan).....	1909	602	88	14.6
Oshima (Japan).....	1909	515	90	18.0
Kumamoto (Japan).....	1909	761	92	12.0
Aiseien (Japan).....	1930	751	68	9.1
Keiaien (Japan).....	1935	413	6	1.5

TABLE 6. Eye lesions in patients at Keiaien, by region groups.

Condition	Region-group					
	Kagoshima		Oshima		Okinawa	
	No.	%	No.	%	No.	%
<i>C-type cases</i>	124	—	86	—	64	—
Loss of eyebrow.....	117	94.4	66	76.7	51	79.7
Madarosis.....	117	94.4	66	76.7	49	76.6
Lagophthalmus.....	33	26.0	10	11.6	10	15.6
Ectropium.....	18	14.5	3	3.5	5	7.8
Conjunctival leproma.....	1	0.8	0	0.0	0	0.0
Keratitis e lagophthalmo.....	4	3.2	3	3.5	3	4.7
Keratitis leprosa.....	88	71.0	45	52.3	30	46.9
Episcleritis leprosa.....	12	9.7	6	7.0	2	3.1
Iritis leprosa.....	57	46.0	35	41.0	24	37.5
Secondary cataract.....	8	6.5	2	2.3	1	1.6
Atrophia et phthisis bulbi.....	8	6.5	3	3.5	1	1.6
Unilateral blindness.....	10	8.1	2	2.3	3	4.7
Blindness.....	3	2.4	0	0.0	0	0.0
Intact.....	12	9.7	22	25.6	24	37.5
<i>N-type cases</i>	60	—	59	—	79	—
Lagophthalmus.....	22	36.7	9	15.3	18	22.8
Ectropium.....	12	20.0	3	5.1	3	3.8
Keratitis e lagophthalmo.....	8	13.3	3	5.1	4	5.1
Iritis leprosa.....	9	15.0	7	11.9	5	6.3
Secondary cataract.....	1	1.7	0	0.0	0	0.0
Atrophia et phthisis bulbi.....	2	3.3	0	0.0	0	0.0
Unilateral blindness.....	1	1.7	0	0.0	0	0.0
Blindness.....	1	1.7	0	0.0	0	0.0

TABLE 7. Grades of keratitis leprosa in *C-type* cases at Keiaien, by region groups (percentages).

Degree of change	Region-group		
	Kagoshima	Oshima	Okinawa
Grade 1.....	26.1	48.9	56.7
Grade 2.....	37.5	35.6	26.7
Grade 3.....	36.4	15.6	16.7

TABLE 8. Subclassification of cases at Keiaien, by region groups (percentages).

Type and degree	Region-group		
	Kagoshima	Oshima	Okinawa
C1	21.8	37.2	34.4
C2	56.5	51.2	56.3
C3	21.8	11.2	9.4
N1	21.4	31.4	42.9
N2	59.5	51.4	40.5
N3	19.0	17.1	16.7

TABLE 9. Nerve thickening in patients at Keiaien and Zensei (percentages).

Nerve	Kagoshima	Oshima	Okinawa	Keiaien ^a	Zensei ^a
<i>Total cases</i>					
Auricularis	49.7	37.7	40.3	43.3	51.1
Ulnaris	73.8	69.2	58.9	70.5	87.1
Medianus	69.0	65.0	53.2	63.7	80.0
Radialis	52.9	39.7	35.5	44.2	45.0
Peroneus	18.7	14.4	19.4	17.5	23.0
Tibialis post	45.0	45.1	31.0	41.2	73.0
<i>N-type cases</i>					
Auricularis	66.7	33.3	30.6	—	—
Medianus	45.5	25.6	36.1	—	—
Radialis	33.3	10.3	13.9	—	—
Peroneus	24.2	25.6	30.6	—	—
Tibialis post	27.3	25.6	11.4	—	—

^a Total figures.

TABLE 10. Motor paralysis of patients in Keiaien and Zensei (percentages).

Nerve	Kagoshima	Oshima	Okinawa	Keiaien ^a	Zensei ^a
Facialis	44.9	21.9	26.7	32.6	49.2
Radialis	3.7	1.4	0	2.0	6.2
Accessorius	2.1	0.7	0	1.1	2.0
Peroneus	18.7	14.4	19.4	17.5	23.0

^a Total figures.