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Studies on Human Genetic Characteristics in the Nansei Islands

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Introduction

The Nansei Islands belong to two prefectures, Kagoshima and Okinawa, and consist of many isolated islands. From the viewpoint of human genetics, they can be divided into two groups. One group is composed of islands extending from Southeast Asia to Kagoshima via Taiwan and Okinawa. These islands are of interest for those who study the transmission of genes due mainly to the flow of immigrants. The other group consists of islands which are quite clearly isolated from the main group of the Nansei Islands (Fig. 1).

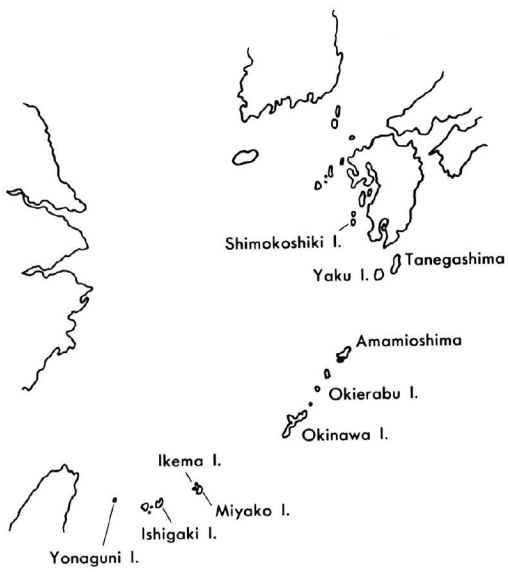

Fig. 1. Map of Nansei Islands

Human genetic studies have been performed on the Nansei Islands, which present the two prominent characteristics mentioned above, for the last 10 years. This paper deals with the results obtained from them.

Materials

A survey was conducted mainly on schoolchildren. A total of 6,056 children were examined, as shown in Table I. They consisted of 555 children of Shimokoshiki Island,

Table I Materials

Area		Male	Female	Total
Shimokoshiki I.	Kashima V.	117	160	277
	Shimokoshiki V.	129	149	278
Tanegashima	Minamitane T.	521	491	1012
Yaku I.	Yaku T.	438	475	913
Amamioshima	Uken V.	343	366	709
Okierabu I.	China T.	257	215	472
	Wadomari T.	261	217	478
Okinawa I.	Nakijin V.	278	243	521
Miyako Is.	Ikema I.	366	435	801
Yaeyama Is.	Ishigaki I.	70	69	139
	Yonaguni I.	225	231	456
Total		3005	3051	6056

which includes Shimokoshiki Village and forms an isolated colony, or a U-colony; 1,012 on Tanegashima; 913 on Yaku Island; 709 on Amamioshima; 950 on Okierabu Island; 521 on Okinawa Island; 801 on Miyako Island; 139 on Ishigaki Island; and 456 on Yonaguni Island.

As is clearly indicated on the map, the Koshiki Island is isloated from the other islands of the Nansei group. Geographically, Tanegashima and Yaku Island form a group; Amamioshima, Tokunoshima, Okierabu Island and Okinawa Island, another group; and the Miyako-Yaeyama Island, a third group. The fields of all the islands, except Koshiki Island which contains a U-colony, are far from being called isolated colonies. Besides, they have no written history of having accepted a large number of immigrants.

Results

At first, ABO blood type, ear-wax type, and ageusia were selected as polymorphological phenotypes.

1. ABO blood type

The values determined are shown in Table II. The frequency distribution of gene A is expressed in the histogram of Fig. 2. It is 0.294 for the whole Kyushu region,[1] 0.290 for Shimokoshiki, 0.280 for Tanegashima, 0.304 for Yaku, 0.279 for Amamioshima, 0.222

Table II ABO Blood Type

Area	O %	A %	B %	AB %	A gene frequency	B gene frequency
Kyushu	29.2	40.4	20.6	9.8	0.294	0.166
Shimokoshiki I.	32.0	41.1	18.4	8.5	0.290	0.145
Tanegashima	31.0	39.1	20.8	9.0	0.280	0.163
Yaku I.	28.5	40.9	19.2	11.5	0.304	0.162
Amamioshima	28.3	37.9	24.3	9.4	0.279	0.190
Okierabu I.	37.9	32.7	22.9	6.4	0.222	0.162
Okinawa I.	29.8	53.4	10.6	6.3	0.365	0.089
Ikema I.	39.3	23.6	30.1	7.0	0.167	0.207
Ishigaki I.	32.4	35.3	24.5	7.9	0.250	0.181
Yonaguni I.	34.4	25.4	31.4	8.8	0.188	0.226
Taiwan Takasago Tribe	29.5	36.7	22.0	11.8	0.541	0.189

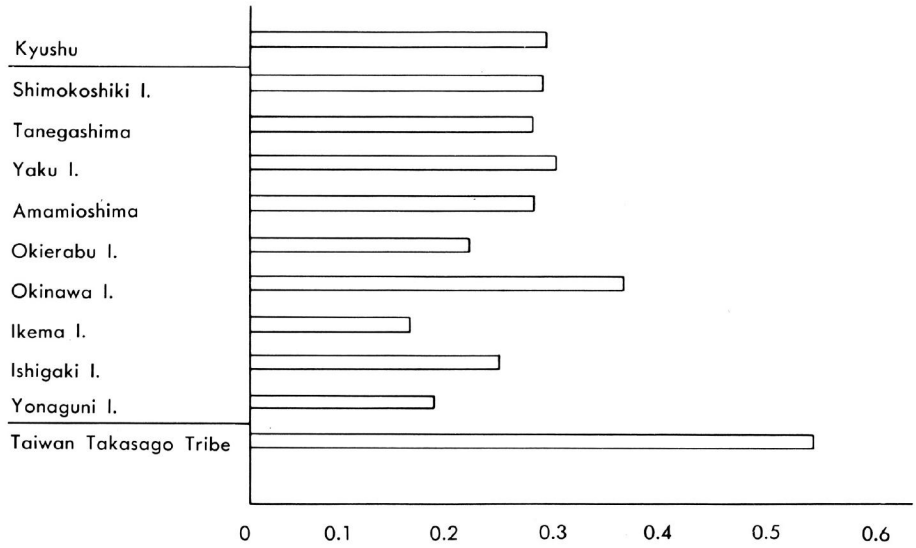

Fig. 2. ABO Blood Type Frequency of gene A

Okierabu, 0.365 for Okinawa, 0.167 for Ikema, 0.250 for Ishigaki, and 0.188 for Yonaguni. In addition, it was reported to be 0.541 for a tribe called Takasago in Taiwan.[2] It exhibits no geographical inclination, although there are geographical differences in it. On

the other hand, there is a geographical inclination which increases from the northern part toward the southern part in the main islands of Japan. Generally speaking, the Nansei Islands present a chasm of frequency distribution between the main part of the Kyushu region and Taiwan. The frequency was low in seven islands and high in two of the Nansei Islands.

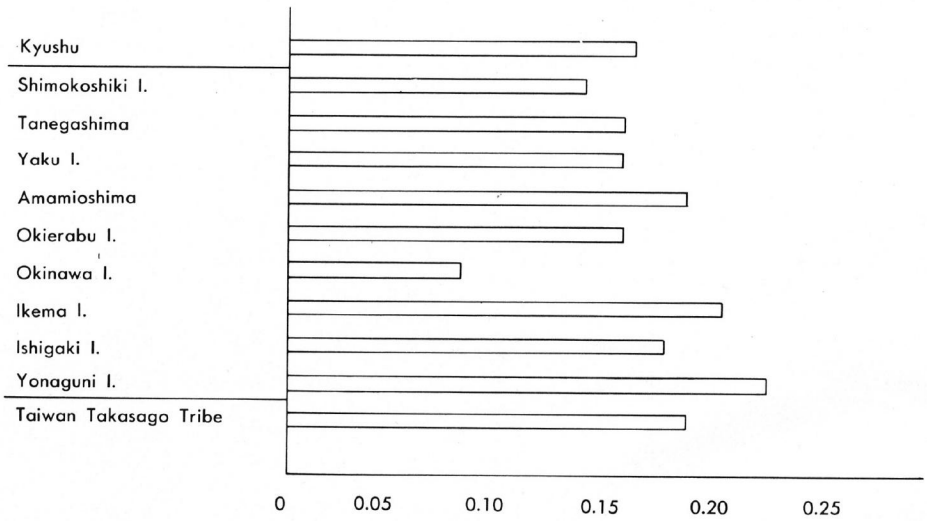

Fig. 3. ABO Blood Type Frequency of gene B

The frequency distribution of gene B is expressed in the histogram of Fig. 3. It is 0.166 for the whole Kyushu region, 0.145 for Shimokoshiki, 0.163 for Tanegashima, 0.162 for Yaku, 0.190 for Amamioshima, 0.162 for Okierabu, 0.089 for Okinawa, 0.207 for Ikema, 0.181 for Ishigaki and 0.226 for Yonaguni. A close resemblance of frequency was noticed between Tanegashima and Yaku, and among the Ikema, Ishigaki, and Yonaguni islands. In general, however, there is great variation in this frequency.

Data on the variation of genetic phenotypes examined from the ABO blood type in Japan were published by Furuhata et al.[1] They present the statistics of a large number of inhabitants, numbering in the tens of thousands, for each region of the country. Accordingly, it is impossible to compare the data obtained from less than 1,000 inhabitants on an island in the present survey with those mentioned above.

2. Ear-wax type

The frequency distribution of the gene for the wet ear-wax type is indicated in Table III. It is 0.090, on the average, for Japan,[3] 0.140 for China,[3] 0.038 for the Republic of Korea,[3] and 0.465 for the Takasago tribe in Taiwan.[3] It is 0.178 for Shimokoshiki, 0.182 for Tanegashima, 0.148 for Yaku, 0.229 for Amamioshima, 0.298 for Okierabu, 0.346 for

Table III Ear-wax Type (Wet Type)

A r e a	frequency (%)	gene frequency
China	26.0	0.140
Republic of Korea	7.5	0.038
Japan (mean)	17.2	0.090
Shimokoshiki I.	32.4	0.178
Tanegashima	33.1	0.182
Yaku I.	27.3	0.148
Amamioshima	40.6	0.229
Okierabu I.	50.7	0.298
Okinawa I.	57.2	0.346
Ikema I.	55.0	0.329
Ishigaki I.	63.1	0.393
Yonaguni I.	57.2	0.346
Taiwan Takasago Trive	71.4	0.465
German	96.9	0.823

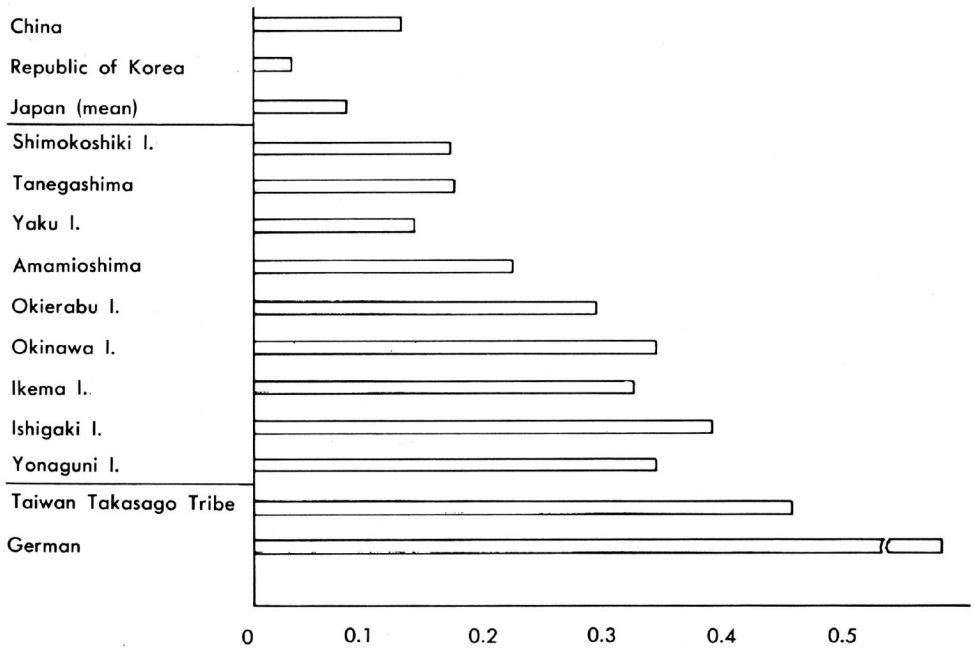

Fig.4. Ear-wax Type
Frequency of gene for wet ear-wax type

Okinawa, 0.329 for Ikema, 0.393 for Ishigaki, and 0.346 for Yonaguni. In addition, it was reported to be 0.823 among the Germans.[4] The frequency distribution of the wet ear-wax type shows a gentle geographical inclination from the north toward the south, or from the average value of the Japanese toward the value of the Takasago tribe in Taiwan. It increases a little among Tanegashima, Amamioshima, Okierabu, Okinawa, and Ishigaki in the order listed.

3. Ageusia

There are many methods to test ageusia. In the present survey a 1 : 4 dilution was prepared from 0.18% saturated aqueous solution of PTC. Those who were not sensible to the bitter taste of this dilution were regarded as affected with ageusia.[5] Fresh water was served as the control. Each examinee was asked to taste the dilution and fresh water alternately. The frequency distribution of ageusia and the absence of that gene are shown in Table IV. The frequency distribution for the ageusia gene is expressed as a histogram in Fig. 5. It is 0.406 for Miyazaki Prefecture,[5] 0.526 for Shimokoshiki, 0.355 for Tanegashima, 0.381 for Yaku, 0.515 for Amamioshima, 0.456 for Okierabu, 0.369 for Okinawa, 0.390 for Ishigaki, 0.558 for Yonaguni and 0.330 for the Takasago tribe. It is quite variable. It is higher in Shimokoshiki, lower in Tanegashima and Yaku, higher in Amamioshima and Okierabu, lower in Okinawa and Ishigaki, higher in Yonaguni, and lower among the Takasago than in Miyazaki Prefecture. These results seem to indicate that Tanega-

Table IV PTC Ageusia

Area	frequency of ageusia (%)	gene frequency (%)
China	10.6	0.326
Hanamaki	6.8	0.261
Mishima	14.1	0.375
Kochi	14.3	0.378
Miyazaki	16.5	0.406
Shimokoshiki I.	27.7	0.526
Tanegashima	12.6	0.355
Yaku I.	14.5	0.381
Amamioshima	26.5	0.515
Okierabu I.	20.8	0.456
Okinawa I.	13.6	0.369
Ishigaki I.	15.2	0.390
Yonaguni I.	31.1	0.558
Taiwan Takasago Tribe	10.9	0.330

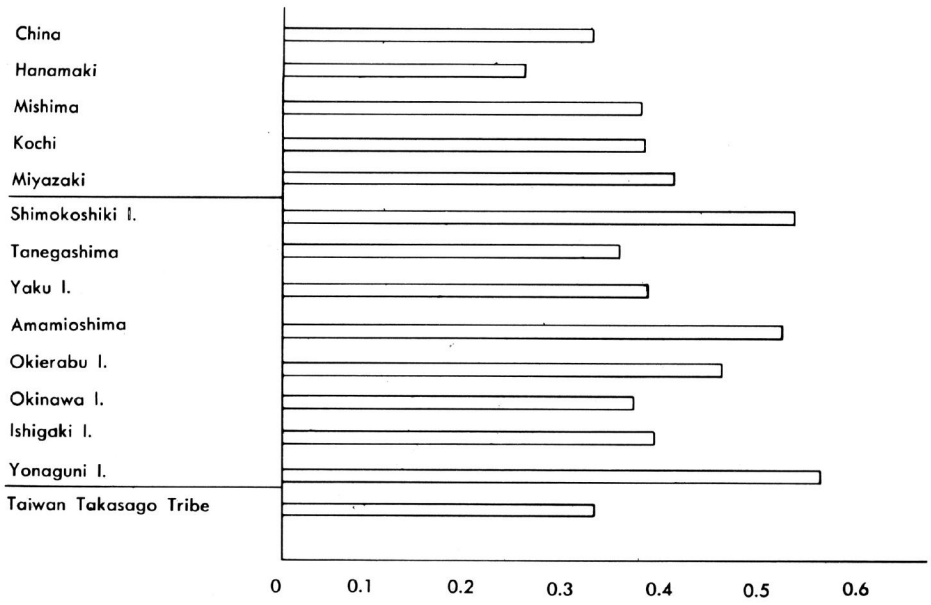

Fig. 5. Frequency of gene for PTC ageusia

shima and Yaku form a group, and Amamioshima, Okierabu and Okinawa form another group. Generally speaking, the Nansei Islands are located between Miyazaki Prefecture and the Takasago tribe, so far as this frequency if concerned. There is no large difference in the frequency between the Nansei Islands and this prefecture or this tribe.

4. Fingerprint

Fingerprints were selected as a qualitative phenotype. Table V shows the frequency distribution of arch, loop, and whorl fingerprints. It has been reported that the total ridge count of the fingerprint is affected least with the influence of the environment of all the qualitative phenotypes.

On the other hand, it has often been reported that there is a high correlation (0.8) between the total ridge count and pattern intensity. Therefore, the latter was used to study the tendency of fingerprints. The values determined are shown in Table V. They are expressed as a histogram in Fig. 6. They are 149.1 for China,[6] 145.1 for the Republic of Korea,[6] 145.7 for the main islands of Japan,[6] 127.7 for Shimokoshiki, 138.5 for Tanegashima, 139.3 for Yaku, 131.7 for Amamioshima, 130.3 for Okierabu, 129.8 for Okinawa, 137.4 for Ikema, 129.7 for Ishigaki, 136.7 for Yonaguni, and 146.1 for the Takasago tribe. Generally speaking, every island of the Nansei group was a little lower in value than the main

Table V Fingerprint

Area	whorl (%)	loop (%)	arch (%)	pattern intensity (x 10)	fingerprint index
China	50.7	47.7	1.4	149.1	106.3
Republic of Korea	47.3	50.5	2.2	145.1	93.7
Japan (mean)	47.7	50.3	2.1	145.7	94.8
Shimokoshiki I.	31.1	65.5	3.4	127.7	47.5
Tanegashima	41.3	55.9	2.8	138.5	73.8
Yaku I.	42.8	53.7	3.4	139.3	79.8
Amamioshima	33.9	63.9	2.3	131.7	53.0
Okierabu I.	35.5	59.3	5.2	130.3	59.8
Okinawa I.	34.7	60.4	4.9	129.8	57.4
Ikema I.	39.6	58.2	2.2	137.4	68.0
Ishigaki I.	34.2	61.3	4.5	129.7	56.7
Yonaguni I.	41.6	53.5	4.9	136.7	77.6
Taiwan Takasago Tribe	50.0	46.1	3.1	146.1	108.5

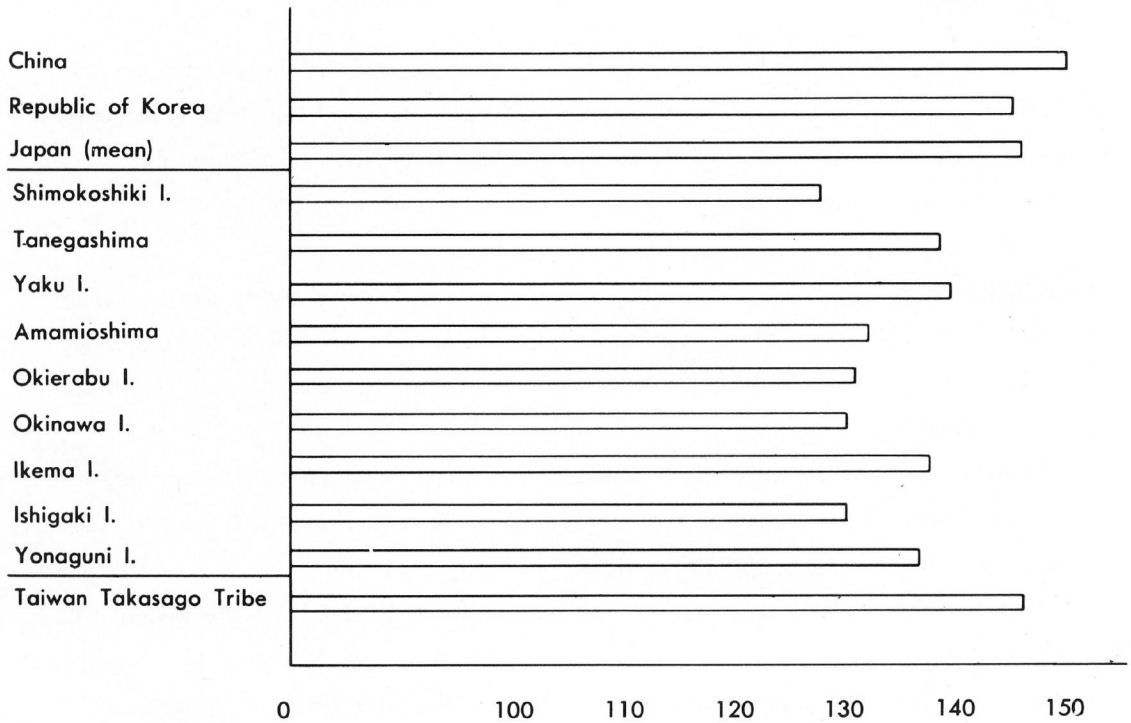

Fig. 6. Pattern intensity of fingerprint (x 10)

islands of Japan (145.7) and the Takasago of Taiwan (146.1). A more detailed observation revealed a tendency that Tanegashima and Yaku formed a group; Amamioshima, Okierabu, and Okinawa, another group; and Ikema, Ishigaki and Yonaguni, a third group.

5. Double eyelid

It has been reported that the double eyelid is prevalent among Caucasians and Negroes and infrequent among Mongolians. In the present investigation, double eyelids were detected by ocular inspection. Its frequency distribution is indicated in Table VI. It is

Table VI Eyelid Type

Area	double eyelid (%)	single eyelid (%)
Japan (mean)	33.8	66.2
Shimokoshiki I.	68.8	31.2
Tanegashima	59.1	40.9
Yaku I.	65.1	34.9
Amamioshima	73.6	26.4
Okierabu I.	80.2	19.8
Okinawa I.	82.1	17.9
Ikema I.	96.6	3.4
Ishigaki I.	81.6	18.4
Yonaguni I.	82.9	17.1
Taiwan Takasago Tribe	100.0	0.0

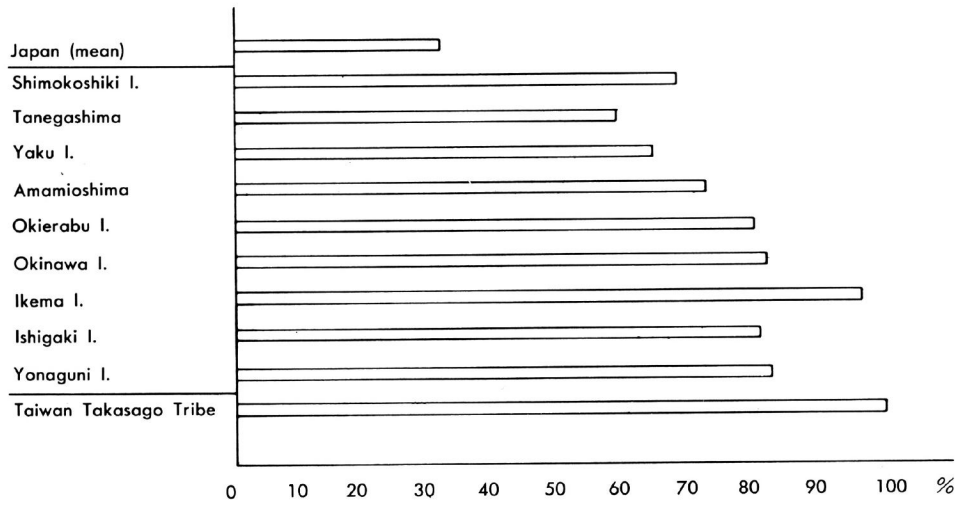

Fig. 7. Frequency of double eyelid

expressed as a histogram in Fig. 7. It is 33.8% for Japan as a whole,[7] 68.8% for Shimokoshiki, 59.1% for Tanegashima, 65.1% for Yaku, 73.5% for Amamioshima, 80.2% for Okierabu, 82.1% for Okinawa, 96.6% for Ikema, 81.6% for Ishigaki, 82.9% for Yonaguni and 100% for the Takasago tribe. Generally speaking, there is a relatively gentle geographical inclination from the noth toward the south, or between the Japanese in the main islands and the Takasago tribe in Taiwan. A detailed examination revealed that Tanegashima and Yaku formed a group; Amamioshima, Okierabu and Okinawa formed another group; and Ikema, Ishigaki and Yonaguni formed a third group.

Summary and Conclusions

The results of the present survey are summarized as follows.

1. ABO blood type, ear-wax type, and ageusia were selected as polymorphological phenotypes. The frequency distribution of genes A and B of ABO blood type was too variable to show a definite tendency. The wet ear-wax type presented a gentle geographical inclination in the frequency distribution between the Kyushu region and Taiwan. With regard to this distribution, Tanegashima and Yaku seemed to form a group; Amamioshima, Okierabu and Okinawa, another group; and Ikema, Ishigaki and Yonaguni, a third group. There was a close resemblance among the inhabitants of Miyazaki Prefecture, those of the Nansei Islands, and the Takasago tribe. With regard to the frequency distribution of ageusia, Tanegashima and Yaku seemed to from one group, and Amamioshima, Okierabu and Okinawa, another group.

2. The pattern intensity of fingerprint was examined among the qualitative phenotypes. Generally speaking, it was a little lower in the inhabitants of the Nansei Islands than in those of the main islands of Japan and the Takasago tribe, and higher in those of the Nansei Islands than in the Caucasians. A detailed observation revealed a tendency that Tanegashima and Yaku formed a group, Amamioshima, Okierabu and Okinawa, another group, and Ikema, Ishigaki and Yonaguni, a third group, so far as the pattern intensity of fingerprint is concerned.

3. There was a relatively gentle geographical inclination of the frequency distribution of double eyelid from the north toward the south, or between the inhabitants of the main islands of Japan and the Takasago tribe in Taiwan. The same tendency as mentioned above was seen in this frequency distribution: Tanegashima and Yaku formed a group, Amamioshima, Okierabu and Okinawa, a second group, and Ikema, Ishigaki and Yonaguni, a third group, with regard to this distribution.

In conclusion, the Nansei Islands are roughly divided into three groups: Tanegashima and Yaku forming one, Amamioshima, Okierabu and Okinawa, a second, and Ikema, Ishigaki

and Yonaguni, a third, so far as the five genetic phenotypes mentioned above are concerned. It was possible to observe a geographical variation between the Kyushu region and Taiwan and a gentle geographical inclination from that region toward this with regard to these phenotypes.

It is difficult to determine whether these variations and inclinations were induced by the flow of immigrants or by the modification of intensity of selection working on the type of gene in accordance with changes in climatic conditions. Probably, it may be reasonable to take both reasons into consideration for the interpretation of those variations and inclinations.

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