

On the Serological Constitution of the Fin Whales

II. Further Studies on Blood Groups

By
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Introduction

Blood groups of the fin whales, *Balaenoptera physalus*, have been classified into four types (Bp system) as stated in the previous report (Fujino, K. 1953)¹⁾. After further investigation on the antigen which is contained in the erythrocytes of fin whales, two kinds of new agglutinogens, i.e. Ju1 and Ju2, were found by agglutination between immune antiserum and erythrocytes of fin whales. By the existence of these antigens blood cells of fin whales were classified, independently to Bp system, into three kinds, namely Ju1Ju2, Ju1 and Ju2, and consequently they were classified into twelve kinds as the combination of Bp and Ju systems. Furthermore, besides the four kinds of antigens belonging to Bp and Ju systems a new agglutininogen "X" was found in Bp2Ju1 and OJu1 type fin whale blood cells by immune antiserum, but the correlation between X-antigen and the already known blood groups has not been enough examined up to the present.

After examining the blood groups of fin whales caught from the northern part of the North Pacific Ocean in the years 1954 and 1955 in relation to the Bp and the Ju systems, remarkable differences were seen in frequency of the occurrence of these blood groups between the fin whales from ground off Kamchatka and those from ground off Alaska. In the present report, the results obtained in these two years are discussed in reference to those stated in the previous report.

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Material and Method

Preservation of the erythrocytes of whales: The erythrocytes of whales used as immune antigen were preserved for the purpose of adsorption test of antiserum in classification of blood groups. When collecting the blood, following solution, 1/10 volume of blood, was added to the blood as preservative, and then such material was kept in ice-box.

Na-chloride 8.5 g.
 Na-citrate 50.0 g.
 Guanofuracin 5.0 g.
 (5-Nitro-2-furfurylidene-aminoguanidine Hydrochloride)
 Aqua.....1000.0 ml.

When the blood was collected in fresh condition and was preserved by this method, the erythrocytes was kept in good condition available for adsorption test during three weeks or more, which is the required period for production of antibody in normal (seven times') immunization. After several times' cleaning with salt solution, these preserved erythrocytes are used for agglutination and adsorption test. In this case, no effect of guanofuracin was recognized on these reactions. In all other respects with regard to erythrocytes of human being, immune animal, immunizing method, collecting and preserving method of anti-serum, testing methods of agglutination and adsorption tests, the materials and methods were just the same as in the previous work.

Experiment and Result

a) *Classification of Ju system blood groups.* When a rabbit is immunized with O type cells belonging to Bp system, immune antibodies against these cells are produced in the rabbit serum. By the cross reaction of this immune antiserum with several kinds of O cells belonging to Bp system, two kinds of new agglutinogens, i.e. Ju1 and Ju2 which are different from the antigens of Bp system, were found. Two examples of the cross reaction (agglutination) are shown in table 1.

Table 1
 Cross reactions (agglutination) of immune antisera of rabbits immunized with O cells by several kinds of O cells belonging to Bp system

a) In case of anti-428 (OJu1) erythrocytes immune serum

* **	No. 170	No. 171	No. 172	No. 177	No. 178	No. 179
No. 170	-	-	-	-	-	-
No. 171	+	-	+	+	+	-
No. 172	-	-	-	-	-	-
No. 177	-	-	-	-	-	-
No. 178	-	-	-	-	-	-
No. 179	+	-	+	+	+	-
Blood group	Ju1	Ju2	Ju1	Ju1	Ju1Ju2	Ju2

b) In case of anti-867 (OJu2) erythrocytes immune serum

* **	No. 170	No. 171	No. 172	No. 177	No. 178	No. 179
No. 170	-	+	-	-	+	+
No. 171	-	-	-	-	-	-
No. 172	-	+	-	-	+	+
No. 177	-	+	-	-	+	+
No. 178	-	-	-	-	-	-
No. 179	-	-	-	-	-	-
Blood group	Ju1	Ju2	Ju1	Ju1	Ju1Ju2	Ju2

Remark: * cells used for agglutination. ** cells used for adsorption.

When a rabbit is immunized with the fin whale blood cells which belong to OJu1, the anti-Ju1 and the species specific agglutinins are produced in the serum of the rabbit. If the latter antibody is adsorbed away with OJu2 corpuscles, the anti-Ju1 immune antibody is obtained. The anti-Ju2 immune antibody is also obtained by the same operation. By the agglutination between these immune antibodies and erythrocytes, it was proved that the two kinds of agglutinogens, namely Ju1 and Ju2, exist in the blood corpuscles of fin whales. By these antigens, the blood groups of fin whales were classified independently to Bp system into three kinds, namely Ju1Ju2, Ju1 and Ju2, and in consequence they were classified into following twelve kinds of types by the combination of Bp and Ju systems.

Table 2
Blood groups of fin whales in Bp and Ju systems

Bp system Ju system	Bp1Bp2	Bp1	Bp2	O
Ju1Ju2	Bp1Bp2Ju1Ju2	Bp1Ju1Ju2	Bp2Ju1Ju2	OJu1Ju2
Ju1	Bp1Bp2Ju1	Bp1Ju1	Bp2Ju1	OJu1
Ju2	Bp1Bp2Ju2	Bp1Ju2	Bp2Ju2	OJu2

b) *New agglutinogen X detected by immune antibody.* When a rabbit is immunized with the blood cells which belong to OJu1 group, anti-Ju1 antiserum is produced by the immune animal. After examining the adsorption test of this antiserum with several kinds of OJu1 blood cells, it was proved that a new antigen "X", which belonged to neither Bp nor Ju systems in already known classification, was contained in

the OJu1 type blood cells of fin whales. This antigen X is also detected in Bp2Ju1 type cells besides in OJu1 cells, but the existence of this antigen in other kinds of cells belonging to Bp and Ju systems has not been examined completely yet up to the present.

c) *Preparation of reagents (standard sera)*. As the existences of antigens of Ju system and X are confirmed positively, in case of preparation of the reagent (standard serum) regarding to Bp system blood groups, it is necessary to make clear whether Ju1 or Ju2 antigens are contained in the erythrocytes of immune antigen and to select the cells not containing X antigen as immune antigen.

1) Anti-Bp1 immune antiserum. When a rabbit is immunized with the fin whale blood cells, which belong to Bp1Ju1 group without X antigen, three kinds of immune antibodies, namely anti-Bp1, anti-Ju1 and species specific antibodies, are produced in the serum of the rabbit. If the anti-Ju1 and species specific antibodies are adsorbed away from this antiserum with OJu1 type cells, the anti-Bp1 antibody may be obtained. In case of using Bp1Ju2 and OJu2 cells as the immune and adsorbing antigens respectively, the anti-Bp1 antibody is also to be obtained by the same operation.

2) Anti-Bp2 immune antiserum. In case of preparation of anti-Bp2 immune antiserum, Bp2Ju1 cells without X antigen and OJu1 cells are used as the immune antigen and the adsorbing antigen respectively in the same operation as stated in the previous paragraph 1). When the Bp2Ju2 cells without X antigen and OJu2 cells are used as the immune and adsorbing antigens respectively, the anti-Bp2 antibody is also to be obtained.

3) Anti-Ju1 immune antiserum. As already stated in section a), in case of preparation of anti-Ju1 immune antiserum OJu1 cells without X antigen are used as immune antigen and OJu2 cells are used for adsorption of species specific antibody.

4) Anti-Ju2 immune antiserum. If OJu2 cells without X antigen and OJu1 cells are used as immune and adsorbing antigens respectively, anti-Ju2 antibody is to be obtained in the same operation.

5) Anti-X immune antiserum. After being a rabbit immunized with OJu1 cells with X antigen, anti-X, anti-Ju1 and species specific antibodies are produced in the serum of this rabbit. If the latter two kinds of antibodies are adsorbed away by the OJu1 cells without X antigen, anti-X antibody may be obtained alone. In case of using Bp2Ju1 cells with X antigen and Bp2Ju1 cells without X antigen as the immune and adsorbing antigens respectively, the anti-X antibody is also to be made by the same treatment as abovestated.

d) *Agglutinin titer of immune antibody.* Each one example of agglutinin titer of immune antibody which was obtained by the stated operations is shown in table 3.

Table 3
Agglutinin titer of immune antibody

Immune rabbit		Immune antigen	Immune antibody	Agglutinin titer					
No. Sex	Serum type & A ⁺ or A ⁻			Antigen					
				Bp1	Bp2	Ju1	Ju2	X	
29	M	o', A ⁺	No. 45, Bp1Ju2	Anti-Bp1, Anti-Ju2 agglu.	160	0	0	320	0
30	M	α', A ⁻	No. 1562, Bp2Ju2	Anti-Bp2, Anti-Ju2 ,,	0	800	0	400	0
31	F	o', A ⁻	No. 428, OJu1	Anti-Ju1 ,,	0	0	160	0	0
30	M	α', A ⁻	No. 1562, Bp2Ju2	Anti-Bp2, Anti-Ju2 ,,	0	800	0	400	0
32	F	α', A ⁻	No. 480, Bp2Ju2X ^{a)}	Anti-Bp2, Anti-Ju2, Anti-X ,,	0	200	0	400	20

Remark a) X antigen in No. 480 cells had not been examined prior to immunization. However, judging from the existence of anti-X antibody in the immune antiserum, the positive proof of X antigen in this cells may be assumed. X⁺ means the blood group possessing X antigen.

It is seen from this table that the anti-X antibody shows a remarkably low titer in comparing with those of the anti-Bp and anti-Ju antibodies.

Table 4
Blood group frequencies of fin whales taken from the northern part of the North Pacific Ocean

(upper figures: actual number of whales
lower figures: percentage of total number)

a) Catch in the year 1954
A-ground

Ju system \ Bp system	Ju1Ju2		Ju1		Ju2		Total
	male	female	male	female	male	female	
Bp1Bp2	2 1.0	1	5 3.8	7	2 0.6	0	17 5.4
Bp1	5 2.5	3	11 7.0	11	5 3.2	5	40 12.7
Bp2	1 0.6	1	27 19.0	33	9 5.4	8	79 25.0
0	6 3.5	5	80 43.7	58	20 9.7	11	180 56.9
Total	14 7.6	10	123 73.5	109	36 18.9	24	316 ^{a)} 100.0

B-ground							
Bp system	Ju system		Ju1		Ju2		Total
	male	female	male	female	male	female	
Bp1Bp2	0	0	0	0	0	0	0
	0.0		0.0		0.0		0.0
Bp1	0	0	0	0	0	0	0
	0.0		0.0		0.0		0.0
Bp2	1	0	20	17	1	1	40
	0.3		9.4		0.5		10.2
0	1	0	160	189	2	1	353
	0.3		88.8		0.7		89.8
Total	2	0	180	206	3	2	393 ^{b)}
	0.6		98.2		1.2		100.0

Remark: In the year 1954 no available data were taken from C-ground.

a) 56.0% of total catch of this ground. b) 67.2% of total catch of this ground.

b) Catch in the year 1955.

A-ground							
Bp system	Ju system		Ju1		Ju2		Total
	male	female	male	female	male	female	
Bp1Bp2	0	0	1	1	0	0	2
	0.0		1.8		0.0		1.8
Bp1	0	0	2	1	2	0	5
	0.0		2.6		1.8		4.4
Bp2	1	0	8	1	2	0	12
	0.9		7.9		1.8		10.6
0	2	0	37	46	4	5	94
	1.8		73.5		7.9		83.2
Total	3	0	48	49	8	5	113 ^{c)}
	2.7		85.8		11.5		100.0

B-ground							
Bp system	Ju system		Ju1		Ju2		Total
	male	female	male	female	male	female	
Bp1Bp2	0	0	0	0	0	0	0
	0.0		0.0		0.0		0.0
Bp1	0	0	0	0	0	0	0
	0.0		0.0		0.0		0.0
Bp2	1	1	131	135	4	1	273
	0.2		25.7		0.5		26.4
0	2	3	400	349	3	4	761
	0.5		72.4		0.7		73.6
Total	3	4	531	484	7	5	1034 ^{d)}
	0.7		98.1		1.2		100.0

C-ground

Bp system \ Ju system	Ju1Ju2		Ju1		Ju2		Total
	male	female	male	female	male	female	
Bp1Bp2	0	0	0	0	0	0	0
	0.0		0.0		0.0		0.0
Bp1	0	0	0	0	0	0	0
	0.0		0.0		0.0		0.0
Bp2	0	0	9	6	1	0	16
	0.0		46.9		3.1		50.0
0	1	0	8	6	0	1	16
	3.1		43.8		3.1		50.0
Total	1	0	17	12	1	1	32 ^{e)}
	3.1		90.7		6.2		100.0

Remark: c) 76.4% of total catch of this ground.

a) 87.9% ,, ,, ,,

e) 91.4% ,, ,, ,,

e) *Frequencies of Bp and Ju systems' blood groups.* By using the stated reagents frequencies of occurrence of the blood groups regarding to Bp and Ju systems were investigated on the fin whales taken from the northern part of the North Pacific Ocean in the years 1954 and 1955. These results are shown in table 4 separately by Whaling grounds A, B and C of the northern part of the North Pacific Ocean noted in figure 1.

From this table, the following differences may be seen between fin whales from A ground and those from B ground taken in both years 1954 and 1955.

I. As to Bp systems, in the case of A ground Bp1 factor (Bp1 and Bp1Bp2 groups) occurs 18.0% of 316 whales in the year 1954 and 6.2% of 113 whales in the year 1955, on the contrary to this fact, however, no Bp1 factor is seen in the B ground.

II. As regards Ju systems, Ju1 blood group occurs more predominantly than Ju2 group both in the A and B grounds. The ratios of occurrence of Ju2 factor (Ju2 and Ju1Ju2 groups), which show 26.5% and 14.2% in the years 1954 and 1955 respectively as to the A ground, are deemed to be by far higher than those of the B ground, namely 1.8% and 1.9% in the years 1954 and 1955 respectively.

In the C ground, only 32 whales were examined on blood groups, so the data of this ground are not sufficient to compare the occurrence of blood groups with others in relation to differentiation of races.

Occurrence ratio of X antigen is examined on the blood cells be-

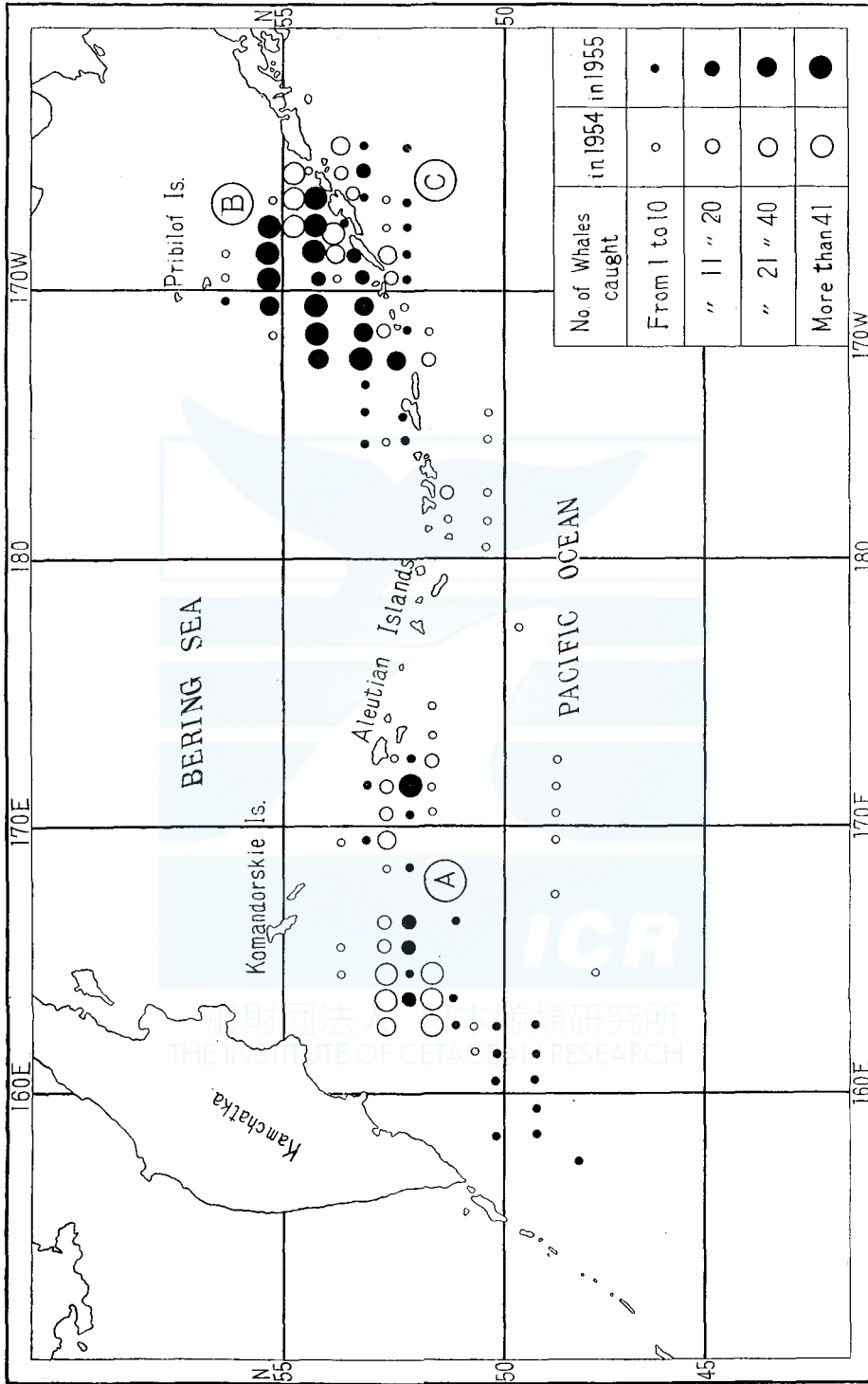


Fig. 1 North Pacific Whaling Grounds in the Japanese Whaling Expedition in the Years 1954 and 1955.

longing to Bp2Ju1 and OJu1 groups only. The results are shown in table 5. As to the other blood cells except Bp2Ju1 and OJu1 groups, no available detection of X antigen is carried out, but the X antigen must occur in their blood cells also.

Table 5
Frequency of occurrence of X antigen

X antigen Bp and Ju system	X ⁺		X ⁻		Total
	male	female	male	female	
Bp2Ju1	2	1	0	2	5
	8.6		5.7		14.3
OJu1	5	6	14	5	30
	31.4		54.3		85.7
Total	7	7	14	7	35
	40.0		60.0		100.0

Remark, upper fig.: actual number of whales examined.

lower fig.: percentage of total number examined.

Discussion

a) *Purification of standard reagents.* In the present report, the author states that the blood groups of fin whales can be classified by the Ju system independently to Bp system which was noted in the previous report (Fujino, 1953). Accordingly, in case of judgement of blood groups belonging to Bp and Ju systems, four kinds of standard reagents, namely anti-Bp1, anti-Bp2, anti-Ju1 and anti-Ju2 reagents, should be used for testing after treatments of purification which are stated in section 3-c). That is to say; in the latter case of anti-Ju1 and anti-Ju2 sera it is necessary that the species specific antibody is merely adsorbed away from the immune antibody prior to use, but in the former case of anti-Bp1 and anti-Bp2 sera, anti-Ju1 and anti-Ju2 antibodies should be still more adsorbed away from the immune anti-serum besides species specific antibody.

In case of judgement of blood groups which was stated in the previous report, as the Ju system blood groups are not known yet, such purification of standard reagents was not considered. Consequently the following tests should be carried out on these standard reagents and on the adsorbing cells which was used in these investigations as related to accuracy of judgement of blood types. That is to say:

I. Which kinds of antigens of Ju system, namely Ju1 or Ju2, had been contained in the blood cells being used as the immune antigen in case of preparation of anti-Bp1 and anti-Bp2 reagents? In other

words, which kinds of antibodies in relation to Ju system blood groups, namely anti-Ju1 or anti-Ju2 antibodies, has been contained in anti-Bp1 and anti-Bp2 reagents?

II. In the case of adsorption of species specific antibody from the antisera which contain anti-Bp1 and anti-Bp2 antibodies, following question is to be risen. That is, whether the erythrocytes being used was suitable or not as related to adsorption of anti-Ju antibody, in other words, whether anti-Ju antibody was adsorbed away completely or not.

As regards I, some examinations were carried out on the sera which were prepared in the year 1952 and was preserved since then. Consequently, in the anti-Bp1 and anti-Bp2 immune antisera, the existence of anti-Ju2 antibody was not recognized, but anti-Ju1 antibody was detected positively alone. Then the antibodies being contained in the two kinds of these immune antisera are as follows:

- (1) Anti-Bp1 blood cells immune No. 11 rabbit serum
=anti-Bp1+anti-Ju1+species specific antibodies.
- (2) Anti-Bp2 blood cells immune No. 12 rabbit serum
=anti-Bp2+anti-Ju1+species specific antibodies.

Following remarkable declines of agglutinin titers of these antibodies took place during the interval of three years' preservation.

After preservation agglutinin titers are 20 times in anti-Bp1 and 40 times in anti-Ju1 antibodies of heading (1), and are 80 times in anti-Bp2 and 40 times in anti-Ju1 antibodies of heading (2), while in the time of preparation the agglutinin titers of anti-Bp1 and anti-Bp2 antibodies were 320 and 1280 times respectively (Fujino, 1953), that is fairly high titers in comparing with those after preservation.

Agglutinin titer of anti-Ju1 antibody in the time of preparation had not been examined, but such declines of those may be assumed to take place.

As to II, matters are noted as follows. In case that the species specific antibodies were adsorbed away from the abovestated (1) and (2) antisera, the erythrocytes used for adsorption have been selected according to not only agglutination test but also to cross reaction test with anti-Bp1 and anti-Bp2 reagents. Consequently, it may be safely said that judgement of Bp system blood groups, which was stated in the previous report (1953), have not been affected by the occurrence of the antigens belonging to Ju system.

As yet, X antigen is confirmed to occur merely in OJu1 and Bp2Ju1 type blood cells, but it may be presumable that this X antigen occurs in other kinds of cells also. Accordingly, as stated in section 3-c), in case of preparation of reagents blood cells without X antigen should be

used as immune antigen. As X antigen had not been known in the years 1952 and 1954, no attention in purification of antibody, as related to anti-X antibody, has been rendered on the reagents used in these years. Therefore, the existence of anti-X antibody should be examined on these antisera. First, the reagents which was prepared in 1952 did not react positively with X antigen even in the case of using the not diluted sera. However, as it has not been clear whether the declines of titer of anti-X antibody took place as in the other antibodies or not, no information can be received on existence of anti-X antibody in the time of preparation in 1952. Secondly, as regards the reagents being prepared in the year 1954, anti-X agglutinin was detected in anti-Bp2Ju2 immune antiserum (table 3. Anti-X serum). But its titer is very low and reaches up to no more than 20 times. On the other hand, the agglutinin titers of anti-Bp2 and anti-Ju2 antibodies which are contained in this anti-Bp2Ju2 serum reach up to 200 and 400 times respectively, and then this antiserum was always diluted by 50 or 100 times in any case of use. Accordingly, the anti-X antibody of abovestated reagent has never reacted positively with X antigen.

Consequently, it is unlikely supposed that in case of using the anti-Bp2Ju2 reagent judgement of blood type is confused by X-antigen and the frequencies of occurrence of blood groups result in uncertainty.

From the abovestated facts, followings may be supposed. As the sufficient attention was not rendered on purification of antibody in case of preparation of antiserum in the year 1952, it is supposed to be insignificant that the results of occurrence of blood groups in 1952 are compared with those in the years 1954 and 1955 when the purification of antibody was considered in relation to anti-Ju and anti-X antibodies.

According to the facts which was stated in this section, it seems to the author that the following problem is important in future investigation. That is: when the frequencies of occurrence of blood groups are investigated, simultaneously purification of antibody should always be taken into consideration. For the purpose of this problem, it is necessary to detect the unknown antigens and to study on the correlation between titer and dilution rate of antibody and on the declines of titer being derived from preservation regarding to the already known antibody.

b) *Differentiation of breeding populations.* The conception, that the frequency of occurrence of blood groups is significant as indicator of races of animals, bases theoretically on the fact that blood group is a kind of hereditary character²⁾³⁾⁴⁾⁵⁾. It has been already confirmed that blood group is a hereditary character in some mammals⁶⁾ as well as in human being, and in what way are inherited these blood groups into their

calves. It may be analogized from this that the Bp and Ju systems of blood groups of fin whales are also hereditary characters.

As regards the fin whales being taken from the grounds, i.e. A, B and C, of the northern part of North Pacific, no clue by which these fin whales can be separated into different breeding populations has been obtained.⁷⁸⁾ As stated in section 3-e), however, marked differences were seen in the frequencies of occurrence of blood groups related to Bp and Ju systems between the fin whales from A ground and those from B ground in the years 1954 and 1955. According to this fact, it may be assumed that the fin whales from the grounds A and B belong to the separate breeding populations respectively, but in order to reach a definite conclusion the theoretical proof, that is, the statistical treatment basing upon the formality of inheritance, must be obtained. However, as the fin whale has huge body, it is not able to make clear the percentages in inheritance by the breeding of whales. Therefore, a part of the formality of inheritance may be merely confirmed according to the correlation between cows and calves. Embryological study of blood groups and statistical treatment on which the abovestated conceptions have their grounds will be discussed in future occasion.

Conclusion

(1) The existence of the two kinds of antigens, namely Ju1 and Ju2, which differ from those of Bp system (Fujino, K., 1953), was confirmed positively by using the immune sera which were produced by the rabbits being immunized with the fin whale erythrocytes. Consequently, the blood groups of fin whales were classified independently to Bp system into three kinds, i.e. Ju1Ju2, Ju1 and Ju2, and the existence of twelve kinds of blood groups were proved as follows.

Bp system \ Ju system	Bp1Bp2	Bp1	Bp2	O
Ju1Ju2	Bp1Bp2Ju1Ju2	Bp1Ju1Ju2	Bp2Ju1Ju2	OJu1Ju2
Ju1	Bp1Bp2Ju1	Bp1Ju1	Bp2Ju1	OJu1
Ju2	Bp1Bp2Ju2	Bp1Ju2	Bp2Ju2	OJu2

(2) Frequencies of occurrence of Bp and Ju system blood groups were investigated on the fin whales taken from the ground A, B and C of the northern part of the North Pacific Ocean in the years 1954 and 1955. In what follows these results are noted separately by the grounds of A (off Kamchatka), B (northern side of eastern Aleutian Islands) and C (southern side of eastern Aleutian Islands).

- I. Bp system blood groups (figures in per cent).
- A-ground (316 whales examined in 1954)
 - Bp1Bp2 : 5.4, Bp1 : 12.7, Bp2 : 25.0, O : 56.9
 - „ (113 whales examined in 1955)
 - Bp1Bp2 : 1.8, Bp1 : 4.4, Bp2 : 10.6, O : 83.2
 - B-ground (393 whales examined in 1954)
 - Bp1Bp2 : 0.0, Bp1 : 0.0, Bp2 : 10.2, O : 89.8
 - „ (1034 whales examined in 1955)
 - Bp1Bp2 : 0.0, Bp1 : 0.0, Bp2 : 26.4, O : 73.6
 - C-ground (no whales examined in 1954)
 - „ (32 whales examined in 1955)
 - Bp1Bp2 : 0.0, Bp1 : 0.0, Bp2 : 50.0, O : 50.0
- II. Ju system blood groups (figures in per cent)
- A-ground (316 whales examined in 1954)
 - Ju1Ju2 : 7.6, Ju1 : 73.5, Ju2 : 18.9
 - „ (113 whales examined in 1955)
 - Ju1Ju2 : 2.7, Ju1 : 85.8, Ju2 : 11.5
 - B-ground (393 whales examined in 1954)
 - Ju1Ju2 : 0.6, Ju1 : 98.2, Ju2 : 1.2
 - „ (1034 whales examined in 1955)
 - Ju1Ju2 : 0.7, Ju1 : 98.1, Ju2 : 1.2
 - C-ground (no whales examined in 1954)
 - „ (32 whales examined in 1955)
 - Ju1Ju2 : 3.1, Ju1 : 90.7, Ju2 : 6.2

In these results, the marked differences are seen in the frequencies of blood groups both in Bp and Ju systems between fin whales from A-ground and those from B-ground. Details are as follows.

As regards Bp system, in the A ground Bp1 factor (Bp1 and Bp1Bp2 groups) occurs 18.0 per cent of 316 whales in 1954 and 6.2 per cent of 113 whales in 1955, but contrary to this fact no Bp1 factor is seen in the B ground in both years.

As to Ju system, Ju1 blood type occurs more predominantly than Ju1 type both in the A and B grounds. The frequencies of occurrence of Ju2 factor (Ju2 and Ju1Ju2 groups), which shows 26.5 per cent and 14.2 per cent in the years 1954 and 1955 respectively as to the A ground, are deemed to be by far higher than those, namely 1.8 per cent in 1954 and 1.9 per cent in 1955, of the B ground.

As yet no clue by which these fin whales being taken from the A and B grounds are separated into different breeding populations has been obtained. According to these differences in the frequencies of Bp and Ju blood groups, however, it may be assumed that the fin whales from the A and B grounds belong to the separate breeding populations re-

spectively. But in order to reach a definite conclusion, the statistical treatment must be rendered in future occasions.

(3) The existence of the new antigen X which differs from the antigens belonging to Bp and Ju system is confirmed positively by using the antibody which is produced by the rabbit being immunized with the blood cells of fin whales. Up to the present this antigen X occurred merely in the OJu1 and Bp2Ju1 type blood cells, but the correlations with Bp and Ju systems have not been made clear.

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