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Five Natural Troops of Japanese Monkeys on Shodoshima Island: II. A Comparison of Social Structure

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ABSTRACT. The results of a comparative study of five natural troops of Japanese monkeys living on Shodoshima Island are as follows. (1) When troops were feeding at the feeding places, various cases, such as individuals spaced out dispersively or close by in a gregarious state, were observed. (2) Differences were also observed among the troops at the feeding place; some troops always fed in a dispersive state, on the whole, while others fed in a gregarious state with small distances between individuals. (3) Differences of social structure were observed among the five troops: differences of the number of classes and sub-classes in males and females, of the relation between classes and their age distribution in males, of the proportion of individuals who intruded into the central part of the troop or who made it their core area of activity to the total male population, etc., and it was also assumed that some troops were integrated more strictly, while others were integrated loosely. (4) These differences of social structure among the troops were assumed to be closely related to the gregariousness or dispersiveness of the each troop at feeding time. From these facts several decisive factors of social structure were considered.

INTRODUCTION

Among the various studies we have dealing with various aspects of natural societies of Japanese monkeys, MIZUHARA (1957) and KAWAI (1964) made model studies, directly referring to comparisons of social structure. Through comparative studies of troops, they have not only made clear the differences of social structure among troops but have also given their consideration of the main factor which caused these differences. MIZUHARA (1964) investigated the decisive factor of social structure through continuous and long-term observation of a troop and also through analysis of temporal changes which caused changes of environmental factors, increase of population, and the interchange of main members.

Comparing the Takasakiyama and the Taishakukyo troops, MIZUHARA (1957) remarked that there was a great difference in population between both troops and that this caused the difference of composition in the troops. He presumed that the difference of quality that a certain specific status which exists in one troop whereas it does not exist in the other troop would be attributed to this kind of composition difference, and this difference would cause the difference of social structure in both troops.

On the other hand, KAWAI (1964), through comparative investigation of many troops, gave the following two possibilities as the main factors causing a difference of social structure: (1) one depends on the characteristic social system of each troop,

(2) the other is decided by the character of the leader, and he placed more emphasis on the latter.

However, besides the sociological analyses mentioned above, it may also be possible to analyze the differences of social structure from the point of physiology or genetics and to regard them as differences of genetically nervous types, which is characteristic of breeding groups, as MIZUHARA and KAWAI have already pointed out. The possibility that such repulsive and closed groups as Japanese monkeys are isolated from one another and, as a result, genetic differences might be produced cannot be denied.

It is the purpose of this paper to analyze and compare the social structures of the five natural troops of Japanese monkeys, O, T, S, I, and K troops, which live on Shodoshima Island and to ellucidate their differences and, at the same time, to discuss the main factors which cause these differences. Moreover, the writer will also try to investigate the hypotheses already presented by MIZUHARA and KAWAI concerning the main factors of social structure.

For further details on the troops on Shodoshima Island the reader should refer to Report (I) (YAMADA, 1966).

II. COMPARISON OF COLLECTIVITY IN THE TROOPS

1. DISTANCE BETWEEN INDIVIDUALS WHEN FEEDING

Each troop had its own character at the feeding place. In one troop individuals were close to one another and fed in a gregarious state, whereas in another troop individuals were repulsive and could feed only in a state of dispersion. It was assumed that such a difference might be caused by the difference in the approachable distances among individuals, in other words, by the difference in minimum distances between individuals.

In order to study the collectivity of an entire troop and the average minimum distances among individuals[1], the writer sought the extent occupied by the members of each troop in its most aggregate state. The number of individuals in each troop who fed simultaneously at the limited space where feed had been provisioned was recorded.

Table 1 shows the first comparison of O and T troops, both of which consisted of 52 monkeys[2]. In T troop 48 individuals, or 92.3 % of the total population, could feed simultaneously in the space 3.6 m × 7.2 m prepared in the center of the feeding place, whereas in O troop only 30 individuals (57.7 %) could. From a comparison of the two troops when feeding, T troop proved to be more gregarious.

In addition, the fact that in T troop the 48 who fed at the above-mentioned space

1) The shortest distance at which the individual feeds without any trouble is to be called "the minimum distance between individuals when feeding." This is the minimum distance from high-ranking individuals where low-ranking ones are tolerated during feeding.

2) This is the example, from an experiment lasting more than ten days, when the most individuals, including leaders, entered the space at the same time and kept on feeding for a limited time. Wheat was used as food and was scattered evenly over the area.

Table 1. Population which gathered in the limited space (3.6 m × 7.2 m) when feeding, O and T troops.

Sex	Class	O Troop			T Troop		
		Within	Outside	Total	Within	Outside	Total
Male	Leader	2	0	2	2	0	2
	Sub-leader	1(1)	0	1	1	0	1
	Ordinary Male	0	6	6	4(2)	1	5
	Semi-solitary Male	0	2	2	0	1	1
	Young Male	1	6	7	3	2	5
	Juvenile & Infant	7	2	9	10	0	10
Female	Nucleus Female	7	0	7	2	0	2
	Ordinary Female	5	3	8	13	0	13
	Peripheral Female	0	2	2			
	Young Female				3	0	3
	Juvenile & Infant	7	1	8	10	0	10
	Total	30(1) (57.7%)	22 (42.3%)	52	48(2) (92.3%)	4 (7.7%)	52

( ): individuals sometimes unstable.

included the total membership of the central part of the troop plus a few peripheral males showed that the extent of the central part when feeding was, in reality, smaller than the above-mentioned space. On the contrary, in O troop, the 22 who stayed out of the space included some ordinary females and immature individuals which were member of the central part, and this showed that the real extent of the central part of this troop was larger than the above-mentioned space.

In the study of collectivity in the larger S, I, and K troops when feeding the space occupied by the total membership of the central part in each troop was recorded,[3] and the writer obtained the following figures: 156 monkeys who composed the central part of K troop could enter and feed simultaneously in a space 5 m × 8 m, in I troop 90 to 92 in a space 5 m × 8 m, and in S troop 92 to 94 in a space 8 m × 8 m.

In a comparison of the collectivity of the five troops mentioned above, the average area possessed by one individual[4] in each troop when feeding was counted as follows: O troop, 0.9 m^2; S troop, 0.7 m^2; T troop, 0.5 m^2; I troop, 0.4 m^2; K troop, 0.2 m^2.[5] From these figures it can be seen that O troop is the most dispersive, having the largest average minimum distance between individuals, and that the distances in other troops are smaller in the order S, T, I, with K troop being the most gregarious troop and having the smallest average minimum distance between individuals.

2. Distance and Tolerance

I now wish to refer to the meaning of the distance between individuals when feeding.

3) This is the minimum space in which the full membership of the central part could feed, and this minimum space was acquired by means of scattering wheat over various spatial areas.

4) The average area possessed by one individual

$$= \frac{\text{the total area possessed by the tested individuals}}{\text{the number of tested individuals}}$$

5) This account includes infants in their mothers' arms. The area possessed by individuals moving about independently is probably a little larger.

It has been made clear by many reports (ITANI, 1954; TOKUDA, 1955; KAWAMURA, 1956a; MIZUHARA, 1957; KAWAI, 1958; YAMADA, 1963, etc.) that concerning Japanese monkeys when feeding at feeding places, high-ranking individuals are often seen to attack the low-ranking individuals who try to approach them and they are also seen to keep them at a distance and to keep food to themselves. Consequently, low-ranking individuals generally don't dare approach the high-ranking individuals and instead move around at regular distances from them.

Such repulsive and rejective character depends on individuals. Some rejective individuals firmly refuse any approach of low-ranking individuals while others are tolerant enough to allow their approach to a certain degree. MIZUHARA (1957) reported that the leader of the Takasakiyama troop, *Jupiter*, was very rejective and never allowed any individual to approach within 2 meters of him when he was feeding, whereas the leader of the Taishakukyo troop, *Garcia*, often allowed other individuals to feed in his vicinity; MIZUHARA presumed that such a difference in the behavior of the two leaders could be ascribed to the difference in their degree of tolerance.

Often, one and the same individual showed selectivity, that is, he was tolerant of a certain individual whereas he rejected another. TOKUDA (1955, 1958), through the investigation of the Koshima troop, regarded this selective relationship as a problem of ranking difference or as a difference in status. On the other hand, KAWAI (1958), who investigated the same Koshima troop later, insisted that such a phenomenon should rather be regarded as a problem of tolerance and mentioned that individuals who tolerated one another had either a blood-relationship, a fellow-relationship, or a leader-female relationship, respectively. YAMADA (1963) found that as especially high tolerance frequency was to be observed among individuals with a mother-offspring relationship.

According to the above-mentioned views, it can safely be said that the distances between individuals at feeding places are influenced by the characters of the individuals and by the social relations between them; the above-mentioned tests concerning collectivity when feeding proved to have elucidated the charaters of the members composing each troop and the social relations among them, and the figures obtained in the tests seemed to indicate the average tendency of these members. In a dispersive troop, such as O troop, it seemed likely that the members included many individual with rejective character and individuals less tolerant in their social relations, while, on the other hand, in a gregarious troop such as K troop, it can be assumed there were many individuals with a tolerant character and that they were also more tolerant in their social relations.

3. Attacks Based on a Self-Centered Desire and Attacks for Maintaining the Social Balance

It is generally observed at a feeding place that individuals threaten or attack and drive away the low-ranking individuals who happen to be in their close vicinity to obtain food. The writer intends to call such attacks 'rejective behavior' for convenience sake. Such 'rejective behavior' is observed in all individuals regardless of ranking and sex. Most attacks observed in females particularly, with the exception of attacks to protect their children, are regarded as 'rejective behavior.'

On the other hand, such types of attack as the following cannot be regarded as an attack due to rejective desire in its general sense: attack for quieting or controlling trouble among troop members, attack for protecting the troop members against an intruder, and attack for demonstrating superiority. Such attacks are seen among only a limited number of individuals, such as leaders and sub-leaders, who are high-ranking males or, on rare occasions, high-ranking females, and they are different from rejective attack.

Moreover, as reported by ITANI (1954) and MIZUHARA (1957), during the mating season the males of the Takasakiyama troop violently attacked estrous females. This is very characteristic behavior which has never been observed in other troops, but it is clear that in most cases this is a step which is followed by mating and is not caused by simple rejection, or it can be regarded as a kind of demonstration attack with a sense of frustrative behavior in it.

If rejective behavior can be defined as an attack with a self-centered desire due to personal selfishness, attack for control can be called a maintenance attack with a view to maintaining the social order. The writer intends to call this kind of attack 'aggressive behavior' and also to call the individuals frequently displaying such attacks 'aggressive individuals.'

Concerning the above-mentioned attack behavior calssified into two different types, namely 'rejective behavior' and 'aggressive behavior,' we should first discuss whether they are correlated: for example, the individual showing frequent attacks might be active in both behaviors, and the individual showing few attacks may be inactive in both behaviors.

MIZUHARA (1957) reported that *Jupiter* (L1)[6] of the Takasakiyama troop was so aggressive and rejective that he often made control attacks and also didn't allow other individuals to approach within about 2 m of him. On the other hand, *Titan*(L2), compared with *Jupiter*, was a less aggressive and more tolerant individual. Concerning members of the troops on Shodoshima Island, *Atlas*(L1) and *Take*(L3) of K troop, *Gin*(L2) of O troop, *Jiro*(L2) of S troop, and *Musashi*(L2) of I troop were comparatively rejective and aggressive individuals. On the other hand, *Fudo*(L2) of K troop, *Kin*(L1) of O troop, and *Ichiro*(L1) and *Saburo*(L3) of S troop were rather inactive individuals, showing less rejective and less aggressive behavior.

In some cases, however, the two behaviors did not correlate. *Waka*(L2) of T troop, and *Globe*(L4) and *Ruck*(L5) of K troop were aggressive individuals often making control attacks, but at the same time they were tolerant individuals. On the other hand, as in the example observed in *Don*(L6) of K troop, some individuals frequently showed rejective behavior but little aggressive behavior. Furthermore, the ordinary males and females, even if they were very rejective, had a general tendency not to show aggressive behavior.

6) L1 means the first leader. L2 stands for the second leader, etc.

III. COMPARISON OF SOCIAL STRUCTURE IN THE TROOPS

1. CLASSES OF MALES

ITANI (1954) noticed in the male members of the Takasakiyama troop the existence of stratification derived from a group of the same age and accompanied by a certain kind of differentiation of social functions. He called it 'status' and classified it into seven parts. Though ITANI used the same term, 'status,' as CARPENTER (1942) had previously, its meaning was remarkably different. Therefore, to avoid a confusion of terms, many recent investigators have used the term 'class' for the social differentiation that ITANI found, though some, like MIZUHARA (1965), have been following the terminology ITANI used. I will use the new term, 'class.'

In Report (I), I classified the males, except for infants and juveniles, into five classes: leaders, sub-leaders, ordinary males, semi-solitary males, and young males[7]. Moreover, according to the place they mainly moved around in and to their ranking relations, I also divided the ordinary males into three sub-classes, i.e., central, upper, and lower. In the same way, I divided the young males into two sub-classes, central and peripheral. In addition, a male party, which was a specific small group composed only of males, moved following K troop and could be regarded as a special type of semi-solitary males.

However all of the above-mentioned classes or sub-classes were not observed as being common to all five troops, and as Table 2 shows, some troops had central and upper sub-classes among ordinary males while some had none at all[8]. The number of

Table 2. Classes and sub-classes of males in each troop and the individuals belonging to them (infants and juveniles are omitted).

		Troop				
		O	T	S	I	K
Central male	Leader	2	2	3	5	6
	Sub-leader	1	1	2	3	3
	Central ordinary male				2	3
	Central young male	1	1	1	4	7
Peripheral male	Upper ordinary male		2	9	17	1
	Lower ordinary male	6	3	8–9	ab.10	1
	Semi-solitary male	2	1	6	5	9*
	Peripheral young male	6	4	9–10	4–5	3
Total		18	14	ab.40	ab.50	33
Troop size		52	52	130–140	125–130	170

* Male party

7) It would seem likely that young males are a kind of age group and in a priori stage of class formation. But as in some troops they are sometimes classified into categories according to a difference in behavioral patterns, I regarded it as a class for the sake of comparison. It may be more proper to regard semi-solitary males as a type of ordinary male rather than to consider them as an independent class. But as a great difference in behavioral patterns was observed between them and the other ordinary males, I tentatively dealt with them as another class.

8) Ordinary males of O troop were not differentiated into sub-classes, but their behavioral pattern was equivalent to that of the lower ordinary males in other troops.

male classes and sub-classes is six in O troop, seven in T and S troops, and eight in I and K troops; therefore, according to the patterns of social differentiation in males, these five troops can be classified into three types, i.e., O-type (O troop), S-type (S and T troops), and K-type (K and I troops).

It is possible to classify the five troops into three types because the patterns of the ordinary males' differentiation into sub-classes were different in each troop. In the O-type troop, all of the ordinary males usually moved around in the peripheral part of the troop, and no differentiation into sub-classes was observed. As for S-type troops, except for the ordinary males who moved in the same behavioral pattern as that of the O-type troops, ordinary males with new behavioral patterns, such as frequently entering the central part of the troop and feeding there, emerged. A differentiation of ordinary males into a sub-class was recognized in this point, and I called the former 'lower ordinary males,' the latter 'upper ordinary males.' As far as K-type troops are concerned, besides the above-mentioned two sub-classes, the central ordinary males with the other behavioral patterns, who used to move around in the central part of the troop, appeared.

What should be particularly noticed is that a correlation is apparently observed between the patterns of males' differentiation into sub-classes and the collectivity of each troop when feeding or the distances between individuals. In the most dispersive, or O-type troop, all of the ordinary males always moved in the peripheral part; on the other hand, in the slightly gregarious S-type troops some ordinary males often intruded into the central part, and, moreover, in the most gregarious K-type troops, some ordinary males even used the central part as their core living area.

The intensity of rejection shown by individuals when feeding not only decides the collectivity of the troop but also has the possibility of relating, for the individual of the peripheral part, to the ease or difficulty of his intruding into or settling in the central part, and it (the intensity of rejection) is also quite likely to relate to the pattern of male social differentiation and to the general social structure of the troop.

2. Classes of Males and Their Population

Figure 1 shows the ratio, by percentage, of the population of each class or sub-class to the total number of males, except infant and juvenile males, in each troop.

A comparison of O and T troops, both of which consist of 52 individuals, elucidated that the percentage of leaders and that of central males including the leaders was larger in the more gregarious T troop, and the males, including the upper ordinary males, who could move about in the central part in any way comprised 42.8 % of the total males in T troop, whereas they amounted to only 22.1 % in O troop.

In the large-type S, I, and K troops, a tendency toward almost the same correlation as that observed in O and T troops were recognized between the collectivity of the troop and the ratio of the population belonging to each class or sub-class, but in K troop the correlation was rather irregular because of the large population of males belonging to the male party.

From the above-mentioned facts, so far as the troops with the same population are compared, it can safely be said that the percentage of males moving about in the central part or of males of high-ranking classes, such as the leaders, increases in

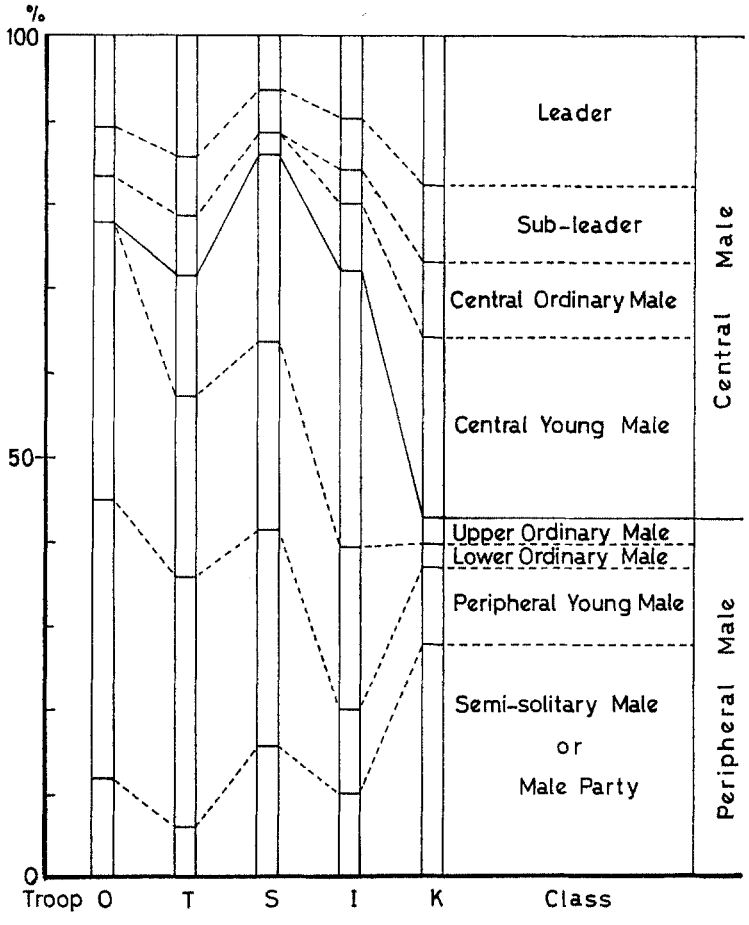

Fig. 1. The ratio of male individuals belonging to each class and sub-class. Total males, except infants and juveniles, were figured as 100.

proportion to the gregariousness the troop displays. This seems to show that in gregarious troops the peripheral males can easily intrude into the central part and that low-ranking males can easily be promoted to a higher-ranking class.

Next, comparing the troops which had big differences in population, we found that K troop, the most gregarious, had the biggest percentage of high-ranking classes, such as leader or of central males, as had been expected, but in I and T troops, the percentage of the central males were the same, although that of the leaders was bigger in the dispersive T troop. In regard to O and S troops, both the percentages of leaders and of central males were bigger in the more dispersive O troop.

The above-mentioned facts show that the number of males in the central part, such as leaders and central males, both of whom perform main roles in the troop, does not increase in the same ratio as the increase of troop members, and it may be suggested that the number of the males belonging to each class or sub-class is decided by the character of members, as observed in the collectivity of the troop, or by the number of the total population of the troop.

3. Classes of Males and Their Ages

Figure 2 shows the composition, by age, in the classes and sub-classes of each troop. I will compare, first of all the relationships of age among the four classes or sub-classes of each troop: leaders, sub-leaders, upper ordinary males, and lower ordinary males.

In O troop, there were no upper ordinary males; in the other classes there was no overlap in age groups, the high-ranking classes being composed of the more aged males. In the other four troops, however, there were overlaps in some or all classes.

In S troop, only the leaders comprised the advanced age group alone, and no overlap in age was observed between them and other classes[9]. Excepting the leaders, all classes were composed of many age groups covering young and old individuals. Moreover, there was no tendency for the high-ranking classes to be composed of older ages.

In T troop, the leaders consisted of many age groups and had overlaps in age with other classes. As far as the ages of the leaders were concerned, T troop was different

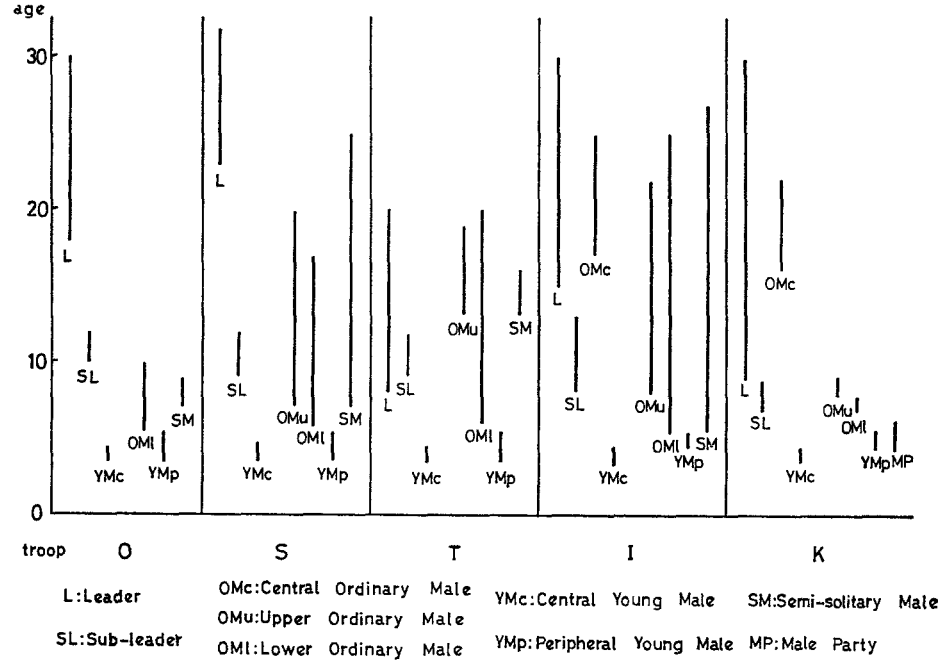

Fig. 2. Classes and sub-classes of males in each troop and its age composition. (This is based on presumed ages.)

9) After the three elder leaders of S troop successively died, comparatively young individuals who had previously been sub-leaders became leaders, and some ordinary males were promoted to sub-leaders. Consequently, the relation of ages among classes became similar to that of T troop.

from S troop, but the relation in ages among other classes had almost the same tendency as that of S troop.

The fact that the leaders in I and K troops had no overlap in age with the sub-leaders was apparently similar to the tendency in O and S troops. But the fact that these leaders were composed of many age groups, ranging from young to old individuals, is rather similar to the tendency in T troop, and these troops (I and K) were different from O and S troops in showing no discontinuity of age between the leaders and the sub-leaders.

K troop showed no overlap in age among classes except for that between the leaders and the upper ordinary males, and thus it had a tendency similar to that of O troop, but this troop was different from O troop in its continuity in age among each class.

As far as I and K troops were concerned, the central ordinary males were comparatively aged individuals only. The semi-solitary males and the male parties were irregular in ages, with the result that in some troops they were composed of young individuals alone, whereas in others they consisted of many age groups ranging from old to young individuals.

In all troops, all of the central young males were 4 years old. O, T, and S troops had one central young male each, while I and K troops had more than two. Concerning the peripheral young males, in I and K troops they were composed of 5-year-old individuals only; on the other hand, in O, T, and S troops, they were composed of 4- and 5-year-old individuals.

In addition, all of the central young males, one of which O, T, and S troops had respectively, were supposed to be the sons of each troop's first-ranking females. They were under their mothers' protection and stood in a particular position[10]. If the individuals ranking No.1 among the females of these troops had no sons of this age, the central young males might have not existed in them.

From the above-mentioned facts, with a few exceptions, it is probable to say that a dispersive troop has younger peripheral males and that a high-ranking class such as leaders is limited to aged individuals. This seems to mean that in a troop which is composed of many individuals with rejective character, the males are moved to the periphery earlier and are delayed in moving into the high-ranking class.

4. CENTRIFUGAL TENDENCY OF MALES

Generally speaking, males, when they are around 4 years old, leave the central part of the troop where their mothers are and settle in the peripheral part. ITANI (1954) assumed this phenomenon as follows: young males voluntarily visit the aged individuals in the pheripheral part looking for playmates, and it is not proper to think that they leave the central part because they are intentionally driven out by the high-ranking individuals of the central part. But as has already been stated, the fact that in

10) Actual observation gave us some examples to the effect that when a central young male made trouble with another individual his mother helped him, or some individuals kept away from him when he approached for fear of attack by the protector. Therefore, he maintained superiority dependent on his mother when near her, was superior to all individuals except his mother and leaders, and moved around comparatively freely.

each troop each individual moved to the periphery at different ages seems to suggest that it might be attributed not only to the free behavior of the individual but to some other factors in the social environment.

As Table 3 shows, the 5-year-old males moved to the periphery in each troop. As far as the 4-year-old males were concerned, in I and K troops they all remained in the central part, while in O, S, and T troops they all, except one exceptional individual in each troop, moved to periphery.

The above-mentioned exceptional 4-year-old males in O, S, and T troops and all of the same aged males in I and K troops were not necessarily retarded in mental growth. They were sometimes observed to visit the peripheral part and to move together with their playmates. They were different from their fellow males, who had already moved to the periphery, in the following points: they moved broadly, taking advantage of the central and peripheral parts, and especially when feeding they could eat with the high-ranking males and females in the central part apart from the fellows of the peripheral part.

Generally speaking, as they grow up the males come to part from their mothers and spend much more time with their same age fellows. This may be considered attributable to the change of social desire which accompanies their growth, but at the same time it seems to be caused by the change in their social position. The biggest change at this time is that a ranking relation develops among them and, at the same time, they are ranked in the ranking structure of the full troop. As a result, it seems likely that the restrictions on their behavior, which are based on the ranking relationship, will increase all the more. At this stage of growth their behavior grows more active; doesn't that force them to proceed to the peripheral part, which is a less restricted and freer area for them, leaving the central part with its many restrictions?

When the above-mentioned view is applied to the difference in the individuals of the same troop, it can be explained as follows. The exceptional central young males in O, S, and T troops were the sons of the first-ranking females of each troop, and they were observed to be under their mother's intense protection. It is more than probable that they gained an advantage over other individuals through their mothers' protection, and consequently that social restrictions on them decreased and their behavioral liberty was comparatively guaranteed.

On the other hand, in the case of the 4-year-old males of I and K troops, these troops were gregarious and composed of individuals with a tolerant character, and it is assumed that they imposed comparatively few restrictions on the behavior of other

Table 3. Main life area of the young males in each troop and its population.

	Central part		Peripheral part		
Troop	4 yrs.	5yrs.	4yrs.	5yrs.	Total
O	1	0	4	2	7
S	1	0	4–5	4	10–11
T	1	0	2	2	5
I	4	0	0	4–5	8–9
K	7	0	0	7(4)	14(4)

( ): individuals belonging to the male party.

individuals. Wouldn't that enable the 4-year-old males to move about in the central part and delay moving to the periphery?

5. CENTRIPETAL TENDENCY OF MALES

The contrary of the centrifugal tendency, centripetal behavior is observed in the peripheral males, who attempt to enter the central part of the troop and watch for a chance. ITANI (1954) called this the 'centripetal tendency of males.'

The peripheral males may attempt to enter the central part for the purpose of gaining food at the feeding place or females during the mating season, but if there is an 'identification mechanism' in each individual for high-rank or leadership, as IMANISHI (1957) maintained, this centripetal tendency is probably its 'indication' and is therefore possibly different from merely gaining food or females.

In comparison with the behavioral pattern of the ordinary males in each troop, few ordinary males of O troop entered the central part, while some in S and T troops did; moreover, in I and K troops some even became central males who moved around in the central part as their main living area. Is it the difference in the intensity of the centripetal tendency that brought about the difference in behavioral patterns of the ordinary males among each troop and among each individual in the troop?

As stated in Report (I), the ordinary males in O troop were actually observed to attempt entry into the central part. But whenever they attempted it, they had troubles with the females, and they could not move around in the central part because they were attacked and driven away by the high-ranking males. In the same way, the lower ordinary males of other troops were attacked and driven away by the upper ordinary males moving around the central part every time they attempted to enter. The reason the upper ordinary males and central ordinary males were frequently able to enter the central part or to make it their main life area was that they were seldom attacked and driven away by the high-ranking males.

From the above-mentioned facts, it can be assumed that whether peripheral males such as ordinary males enter the central part or not depends not on the intensity of their centripetal tendency but rather on the attitude toward intruders of the members who receive them in the central part. It is probable to say that, in a gregarious troop composed of individuals with a tolerant character, entering into the central part is easier.

6. BEHAVIORAL PATTERN OF ADULT MALES

Figure 3 shows schematically the relationship between the females and each class or sub-class of adult males, except semi-solitary males, in each troop, the positiveness of attacks for maintaining the society as observed in control attack, and their main life area. The writer wishes, for reference and comparison, to cite examples of the Takasakiyama troop reported by ITANI (1954) and MIZUHARA (1957).

In O troop, all adult males except the sub-leaders were classified into two categories, i.e., those (leaders) who have complete superiority over all the females, make positive attacks to maintain the society, and are always stable in the central part of the troop, and those (equivalent to the lower ordinary males) who have no superiority over the

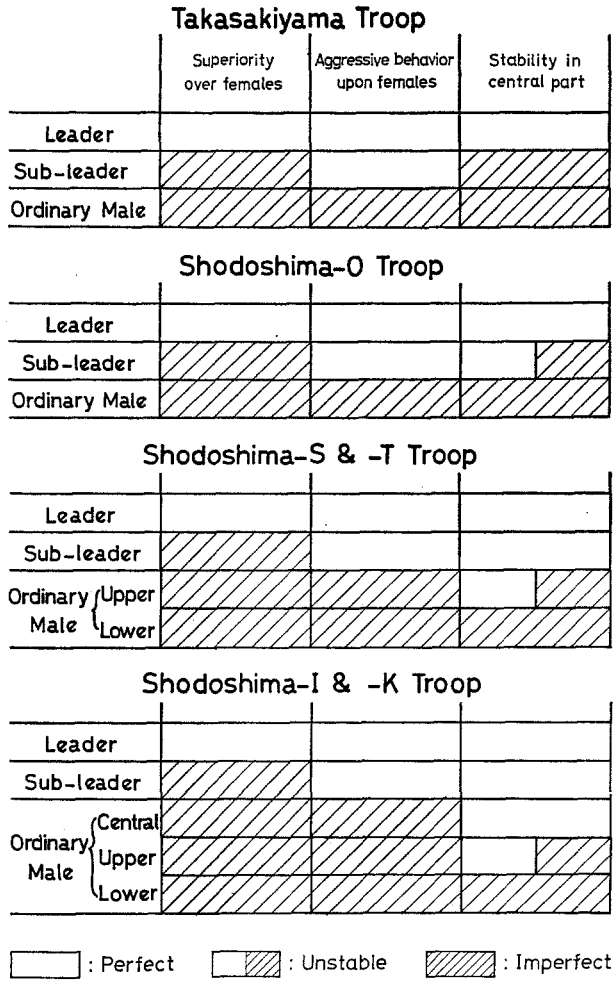

Fig. 3. Comparison of behavioral pattern of leaders, sub-leaders, and ordinary males in each troop.

females[11], do not make positive attacks for maintaining the society[12], and always move around in the peripheral part. The sub-leader of this troop was as incomplete in superiority over the females as the ordinary males were, while his attacks for social maintenance were as positive as those of the leader. He moved around chiefly in the central part, but he was often driven to the peripheral part by high-ranking individuals

11) Generally speaking, sub-leaders and some ordinary males actually ranked higher than the females; but in the central part the females, who were sometimes dependent on the leaders, could rank higher than they.

12) These individuals sometimes attacked for control, helping the leaders and sub-leaders, but those attacks were dependent on the high-ranking males, and it does not mean that they really possessed the power to make attacks for maintaining the society.

and females[13]. The behavioral pattern of the sub-leader was intermediated between those of the leader and the ordinary males.

In S and T troops, the behavioral patterns of the leaders and the lower ordinary males were almost the same as those of O troop, whereas the sub-leader, who always moved around in the central part, was different from his counterpart in O troop. Although the sub-leaders of these troops lacked complete superiority over the females, they always moved around in the central part and their behavioral pattern was more similar to that of a leader than to that of the sub-leader of O troop. On the other hand, the behavioral pattern of the upper ordinary males, who frequently visited the central part, was similar to that of the sub-leader in O troop, but in regard to attacks for maintaining society they were the same as the lower ordinary males.

The behavioral patterns of the leaders, sub-leaders, and upper and lower ordinary males in I and K troops were analogous to those of S and T troops, but the central ordinary males, who were observed only in these troops, were the same as the leaders from the standpoint of their main life area; as regards the other two points, however, they were the same as the other ordinary males.

In the Takasakiyama troop, on which ITANI and MIZUHARA reported, all the adult males, except the semi-solitary males, are divided into three classes, namely, leaders, sub-leaders, and ordinary males[14], and all the ordinary males are regarded as lower ordinary males who do not intrude into the central part. These facts prove that the pattern of social differentiation of the Takasakiyama troop is almost the same as that of O troop. But as far as the sub-leaders were concerned, though they had almost the same functions as those of the Shodoshima Island troops, their life area was limited to the peripheral part just as the lower ordinary males' was, and they never intruded into the central part. Therefore, this troop may possibly be said to have a social structure with a tendency stronger than that of O troop, in which the sub-leaders were often driven into the peripheral part.

Through comparing the necessary condition for adult males to settle in or to enter the central part, the following conclusion presents itself.

In the Takasakiyama troop, only those that held perfect superiority over females and made attacks for maintaining the society were allowed to settle in the central part, and if one of these elements was lacking they were not even allowed to enter there. Therefore, in this troop the leader was the only adult male that moved around in the central part.

On the other hand, as we have observed in K and I troops, there are some troops in which the central ordinary males, who lack superiority over females and make few

13) A sub-leader of O troop, in trouble with females, was often driven into the peripheral part by a control attack from the leaders. In this case, his life area was almost the same as that of the ordinary males.

14) ITANI (1954) called the class ('status' according to ITANI) in the Takasakiyama troop equal to the ordinary males in each troop of Shodoshima Island 'young males.' But, as 'not young' individuals were included among the 'young males,' the term suggesting an age group is not appropriate. All of the ordinary males ('young males' according to ITANI) of the Takasakiyama troop were equal to the lower ordinary males, just as in O troop, judging them from the method applied to each troop on Shodoshima Island.

attacks to maintain the society, are allowed to move around in the central part[15], and as intermediates between these two types, there are some troops (O troop, for example) where individuals who lack one requisite are allowed, though unstably, to move around in the central part, whereas if they lack both elements they are unable to intrude there, while there are also some other troops (S and T troops, for example) where one requisite is enough to guarantee the individual's remaining stable in the central part, and even without any of the requisites, they can intrude these[16].

The writer does not have exact data on collectivity when feeding for the Takasakiyama troop, but from general observation this troop was considered to be more dispersive than O troop. It should also be noted that there is a deep correlation between the condition under which adult males may settle or intrude into the central part and the collectivity of the troop when feeding.

7. Social Differentiation of Females

All troops had nucleus females and ordinary females, but peripheral females were not observed in T and K troops. Moreover, concerning the peripheral females of the three troops, a difference in behavioral patterns between those of O troop and those of the other two troops was recognized.

S and I troops had one peripheral female each, and these females, in many cases, moved around actively with the ordinary males in the peripheral part of the troop, but on going back to the central part occasionally they moved about together with the ordinary females. Therefore, it was appropriate to regard them as active individuals, among the ordinary females, with a particular character which enabled them to move around taking advantage of the broad area covering the central and peripheral parts.

On the other hand, the two peripheral females in O troop always remained in the peripheral part or in the outermost section of the central part. They were isolated, inactive, ranked low, and could not intrude into the central part because of other females' attacks. In other words, they were evasive individuals who moved around trying to avoid the oppression of the other females, and they exhibited a completely

Table 4. Classes of adult males in each troop and the number of individuals comprising them.

	Troop				
	O	T	S	I	K
Nucleus female	7	2	2	2	3
Ordinary female	8	13	36–37	34–35	38
Peripheral female	2		1	1	
Total	17	15	39–40	37–38	41

15) Another requisite that allowed the central ordinary males to move around in the central part was that these individuals were inactive and seldom caused the high-ranking males and females to attack them.

16) It was the same as in O troop that some ordinary males were unable to intrude into the central part in S, T, I, and K troops, and the reason they could not do so was found mainly in the attacks on them by the upper ordinary males.

different type of behavioral pattern from that of the peripheral females of the other two troops.

Taking the peripheral females of S and I troops as the specific type of ordinary female, these five troops are divided, from the view of patterns of females' social differentiation, into two types, namely, the troop with three classes: nucleus females, ordinary females and peripheral females (O troop), and the troop with two classes only: nucleus females and ordinary females (T, S, I, and K troops).

Moreover, there was another difference between O troop and the other four troops. The nucleus females of the four troops consisted of a few individuals supposed to be in the relationship of mother-daughter or that of sisters, while in O troop the nucleus females, seven in all, divided themselves into two groups, one of which consisted of four and the other three, and both of the groups were repulsive toward each other. In addition, the ordinary females of this troop were also divided into two repulsive groups, a which feature was ascribed to their allying themselves with the group of the nucleus females respectively. This pattern of social differentiation observed in O troop is what the writer called 'clique-differentiation' in Report (I). In the four troops other than O troop, however, such a pattern of social differentiation was not recognized.

8. SOCIAL INTEGRATION

In comparing the five troops, it was found the classes and sub-classes common to all troops were, as those of the central part and excepting infant and juvenile individuals, leaders, sub-leaders, central young males, nucleus females, ordinary females, and young females[17]; as members of the peripheral part and with the exception of the male party as specific types of semi-solitary males, there were lower ordinary males, peripheral young males, and semi-solitary males. The central ordinary males, the upper ordinary males, and the peripheral females which are not mentioned above were observed in some troops but not in others.

Concerning the members of the central part, which were observed commonly in all troops, there arose a question as to whether the sub-leader of O troop could be called, in a strict sense, a member of the central part, for he lacked stability in the central part. In the same way, the central young males of O, S, and T troops were specific individuals, as has been mentioned already, and it is questionable whether they were always allowed to stay in these troops. Judging from the above-mentioned facts, the male members, with the exception of the infants and juveniles, found to be common to all troops, of the central part may be leaders alone.[18]

In O troop, which was the most dispersive when feeding, the following points were characteristic: some females were driven into the peripheral part, the sub-leaders were unstable in the central part, and no peripheral males intruded into the central part; also, the sub-leader, who in other troops was a stable member of the central part, and the central young male, who was regarded as an exceptional individual, were the only

17) The life area of the young females was the same as that of their mothers.

18) As observed in the Takasakiyama troop, there were some examples of the sub-leaders being peripheral males who always moved around in the peripheral part; the central males of this troop were only leaders, if infant and juvenile individuals are excepted.

Table 5. Comparison of social differentiation in each troop.

Class		Troop O	S	T	I	K	
Male	Leader	+	+	+	+	+	Central male
	Sub-leader	+*	+	+	+	+	
	Central young male	(+)	(+)	(+)	+	+	
	Oridnary male Central	−	−	−	+	+	
	Oridnary male Upper	−	+	+	+	+	Peripheral male
	Oridnary male Lower	+	+	+	+	+	
	Peripheral young male	+	+	+	+	+	
	Semi-solitary male	+	+	+	+	+	
Female	Nucleus female	+	+	+	+	+	Central female
	Ordinary female	+	+	+	+	+	
	Young female	−	+	+	+	+	
	Peripheral female	+	(+)	−	(+)	−	Peripheral female

Juveniles and Infants were excepted. +: Existent. −: Not existent. * The individual which sometimes unstable in the central part. ( ) : The individual of exception.

two individuals that could cross over the boundary between the central and peripheral parts. In that meaning, it is possible to say that a clear boundary has been distinctly established between both parts of this troop.

In S and T troops, which were more gregarious than O troop, the sub-leaders kept stability in the central part, and some upper ordinary males, who emerged from the ordinary males, made the boundary of both parts a little obscure by frequently intruding into the central part. In regard to the females, all except one exceptional individual of S troop moved around in the central part.

Concerning the most gregarious I and K troops, they were little different from S and T troops in their behavioral patterns of leaders, sub-leaders and females, but the central ordinary males, who moved around mainly in the central part, emerged from the ordinary males who had originally been members of the peripheral part. Moreover, the central young males, other than the exceptional individuals, who moved around taking advantage of both the central and peripheral parts, emerged from the young males who, in the other troops, used to move around in the peripheral part. As a result, the boundary between the central and peripheral parts in these troops was all the more obscure.

As has been mentioned already, the fact that the peripheral males can hardly intrude or settle in the central part and the additional fact that the boundary between the central part and the peripheral part is distinct, means that the members' life area or their behavioral pattern is strictly restricted according to class or status. In other words, it means that the troop which restricts the behavioral pattern of each individual can be said to have a strictly integrated society.

Consequently, it can be said that of these five troops O troop has the most strictly integrated society, and that I and K troops were the most loosely integrated, while S and T troops have an intermediately integrated society. It is worth noticing that the strong interrelationship observed between such tendencies as may be seen in social integration and collectivity, as stated previously, when feeding seemed to show the

members' characters concerning tolerance. It means that the individual with rejective character is not tolerant of other individuals' behavior, and as a result, the behavioral patterns of the individuals are severely restricted, and the troop composed of such individuals comes to have a strictly integrated society. On the other hand, the troop composed of individuals who are tolerant of other individuals' behavior comes to have a loosely integrated society.

IV. DISCUSSION

1. Model of Social Structure Due to Rejectiveness and Aggressiveness

Generally speaking, when peripheral males intrude into the central part of a troop, the females quarrel with them, trying to drive them away. In such cases, the intruders are generally observed to avoid the trouble and to return to the peripheral part, but if they dare to stay there the quarrels between them and the females will grow, and they will, in the end, be driven away by a control attack by the leaders or by high-ranking individuals, who take up the females' quarrel.

If the females, however, are indifferent or tolerant of the approach of the intruders, they won't receive any control attack from the leader, and they will be able to behave comparatively freely. That is because high-ranking males, such as the leaders, do not attack the intruders positively if quarrels do not arise between them and females.

Therefore, it can be suggested that the primary factor that decides the difficulty of a peripheral males' intrusion into the central part lies in the females' attitude toward him, in other words, in their rejective character. However rejective the leaders may be, their number is small in relation to the full membership of the central part, and the intruders can move around keeping out of their way. But, as the females comprise most of the members of the central part and are overspread there, it is completely impossible for the intruders to move around keeping away from contact with them.

On the other hand, however rejective the females may be, if the leader is a mild and non-aggressive individual making no control attack, the intruders can easily move around in the central part. The reason is that although the ordinary males, who have not established complete superiority over the females, rank higher than the females, they run away keeping out of trouble because they avert the control attack of the high-ranking males such as leaders. In addition, the females can challenge the intruders, who are originally superior to them, to a fight only when they can obtain the dependence effect of leaders. If the leader is less-aggressive this dependence effect does not work, and the females cannot remain superior to the intruders. Therefore, the secondary factor that decides the difficulty of the peripheral males' intrusion into the central part is found in the positiveness for control attack that the high-ranking males such as leaders have, this is, their aggressive character.

Now, through investigating the aggressiveness of the high-ranking males, such as leaders, and the rejectiveness of the females, and presuming a social structure due to the combination of aggressiveness and rejectiveness, the following can be suggested: (A) Troops composed of aggressive leaders and rejective females: the dispersive

troop. Peripheral males find it difficult to intrude into the central part. A strictly integrated society.
(B) Troops composed of aggressive leaders and tolerant females: the gregarious troop. Peripheral males find it relatively easy to intrude into the central part. A rather loosely integrated society.
(C) Troops composed of less-aggressive leaders and rejective females: the dispersive troop. Peripheral males can intrude into the central part rather easily. A rather loosely integrated society.
(D) Troops composed of less-aggressive leaders and tolerant females: the gregarious troop. Peripheral males can intrude into the central part most easily. The most loosely integrated society.

Among the above-mentioned models, the most strictly integrated society is (A), while (D) is the most loosely integrated. (B) and (C) have an intermediate model of social structure, and a difference between them is recognized in the collectivity of the whole troop. Furthermore, there might be such a difference that the development of clique-differentiation in females, which is assumed to be ascribed to the degree of rejectiveness in each female, as observed in O troop, is observed in (C) but not in (B).

2. The Leader as the Decisive Factor of Social Structure

Kawai (1964), through observation of the Takasakiyama and the Ohirayama troops, which exhibited transformation in social structure accompanied by a change of leaders who had different behavioral patterns, attached importance to the character of the leader as being the decisive factor in determining the form of social structure. The case of the Takasakiyama troop referred to by Kawai was reported on in detail by Mizuhara (1964). It is one in which the position of the No.1 leader was succeeded to by the relatively less aggressive *Titan* after the death of the aggressive *Jupiter*, and a transformation in the social structure accompanied it. It was reported that the very strictly integrated society was obviously transformed, after the change of leader, into a loose society.

Judging from the above-mentioned models of social structure, it would seem likely that the social structure might be transformed by a change to a leader with a different character. For example, the change from an aggressive leader to a less aggressive one, or *vice versa*, will transform the troop from (A) to (C) or (B) to (D). In the Takasakiyama troop, although there is no conclusive evidence, the transformation might have been from (A) to (C).

There was also an example in K troop on Shodoshima Island, in which the position of No.1 leader passed from the less aggressive *Fudo* to the more aggressive *Atlas*. This may seem to be a transformation of (D) to (B) of the above-mentioned models, but in reality a change of social structure was scarcely observed. Is it possible, then, to say that there is little difference in (D) and(B) in respect of social structure? In K troop, *Atlas* occupied the position of No.2 leader among the six leaders, and even before the change played the role of leader in such behavior as control attack and attack against an enemy, ignoring the less aggressive *Fudo*. Therefore, it may be possible that this troop was in the (B) state and influenced by the behavioral pattern of the aggressive *Atlas*, not the less aggressive *Fudo*, even before the change.

If the above-mentioned view is correct, it can be said that when there are more than two leaders, the more aggressive one influences the troop. In that sense, when there is a leader with a marked degree of aggressiveness, it may be easily believed that the character of that leader determines the social structure. But a great difference in social structure was recognized between the Takasakiyama troop under the control of *Jupiter* and K troop under the control of *Atlas*, although both were aggressive leaders. This, I think, means that the leader's character is not the only main factor in determining social structure, and I suggest that what brought about the difference directly between both troops should rather be found, in this case, in the rejective character of the females; namely, it is the difference between (A) and (B).

As far as we try to pursue monistically the decisive factor of peculiarity in each troop in respect to social structure, we will be confused if we seek it in the leaders in some cases and in the females in other cases. The writer, however, pursued the decisive factor in the characteristic behavior of the females and the high-ranking males such as leaders, as has been stated already concerning the models of social structure, and came to the conclusion that the pattern of social structure was decided by the interaction of both.

It was possible, to a certain degree, to apply this dualistic assumption to all cases, i.e., to the case of the Takasakiyama troop where the social structure was transformed by the change of leader and to the case of K troop where no transformation was recognized, and furthermore to the case where, though under the control of the leaders with a similar character, a difference was observed in the social structure. Therefore, this presumption seems to be nearer to the truth than the hypothesis of KAWAI, who took the view that the character of the leader was the main factor.

3. SYSTEM AS THE DECISIVE FACTOR OF SOCIAL STRUCTURE

KAWAI (1964) took into consideration the possibility of the social system being another decisive factor of peculiarity in the social structure of troops. According to this assumption the peculiarity of the social structure is systematized as an organizing principle, and its peculiarity is succeeded to through the generations.

Although KAWAI does not affirm this hypothesis, if this view is correct it is possible to treat the social structure observed in troops of Japanese monkeys as a cultural phenomenon, and it includes a great problem. But in this regard we lack enough data to discuss and prove it, and as KAWAI has stated, it must be solved in the future.

Now, as has been mentioned already, the writer has searched for the main factor that causes the peculiarity of social structure in the behavioral pattern of the leaders and females. The existence of individual personality has already been set forth by ITANI (1957) and KAWAMURA (1959a), and the difference in the behavioral pattern toward the environment as a troop was clarified by KAWAMURA (1956b, 1959b), YAMADA (1957), and ITANI (1958), through the investigation of the differences in the troops' attitude toward unusual food. But the problem of how such peculiairty in the behavioral patterns was built and succeeded to remains mere conjecture. Isn't it possible, however, to assume the following?

A child who is brought up by a mother with a certain characteristic behavior will acquire, under her influence, the same kind of behavioral pattern. In the same way, an

individual under the control of a leader with a certain characteristic behavior may soon acquire that same behavioral pattern. This means not only that they merely imitate the behavioral patterns of the elder or high-ranking individuals but also that the elder or high-ranking individuals must have an influence on the formation of the character of the individuals, if Japanese monkeys have such an 'identification mechanism' as IMANISHI (1957) reported.

Can't it be assumed that the generation brought up under the influence of the behavioral patterns or character of high-ranking or elder individuals acquires a behavior characteristic of or similar to that of the former generation and, as a consequence, forms a troop which has the same kind of social structure as the former generation had? The peculiarity of social structure seems to have been passed down in this way.

In reality it may not be so simple. The increase of population with the lapse of time, other changes in the social environment, and the transition of the natural environment will not leave the character or the behavioral pattern of the individuals what they were in former generations. Nevertheless, if there is a general tendency, however small, for the characteristic behavior to be succeeded to from generation to generation, the peculiarity of social structure in troops will be also succeeded to.

In this respect can't we recognize a kind of premonitory phenomenon of succession to the social system in which the factor supporting the social structure is succeeded to through the generations, even if the social structure itself is not directly succeeded to, as KAWAI assumed it to be?

4. POPULATION AS THE DECISIVE FACTOR OF SOCIAL STRUCTURE

MIZUHARA (1957) conducted a comparative investigation of the Takasakiyama and Taishakukyo troops and remarked that there was a great difference in social structure between them, and, at the same time, as the main factor that caused the difference he pointed out the difference in population of the two troops.

The Takasakiyama troop, at the time he investigated it, had the population of about 440, with many age groups covering young and old individuals. On the other hand, the Taishakukyo troop was a small troop with about 30 individuals and lacked some age groups. He took the view, from this fact, that the difference in composition due to a troop's population difference brings about such a qualitative difference as one troop having a specific status which another doesn't, and that this produces the difference in social structure.

There is a great possibility that the difference in social structure among troops which have a great difference in population or in composition is decided by the rule which was offered by MIZUHARA. For example, the Minoo-B troop, reported on by KAWAMURA and KAWAI (1956), KAWAMURA (1958), and YAMADA (1963), had such a particular composition that there were no adult males except temporarily residing solitary males, and therefore it had a particular social structure without any male leaders or sub-leaders. If this troop is compared with other ordinary troops, it can be concluded that the primary factor that brings about the peculiarity of social structure lies in the troop's particular composition.

But the cause that brought about the particular composition of this troop is fonud

in the fact that all of the males of the troop left the troop to become solitary males and that the powerful males, who joined the troop later, could not assume leadership in spite of ranking highest in the order and were, in the end, obliged to leave the troop again. Furthermore, it was because of this particular behavioral pattern that the females did not follow the males, and what caused such characteristic behavior was the existence of powerful and particular females, called 'chief females,' who led the troop.

Taking the above-mentioned view as the main factor of peculiarity in the social structure of this troop may be pursued, superficially, in its particular composition. But what caused the peculiarity of the composition was, after all, the behavioral pattern of the members.

In the next place, among the troops with similar population or composition a difference in social structure was also recognized, as has been mentioned already. Namely, there was a difference, more or less, in social structure between O and T troops, both of which were composed of 52 members, and the large S, I, and K troops, all of which had almost the same population. Among these five troops, T and S troops were the most similar in social structure, though they were greatly different in population. Furthermore, it was O troop with 52 individuals and not the large troops that was most similar in social structure to the Takasakiyama troop, a large troop. The above-mentioned facts cannot be elucidated by MIZUHARA's population assumption.

I have already mentioned the difference in social structure due to population difference. For example, the ratio of leaders or central males to all males changes as the population changes. But even the ratio is changed not only by the difference in population but also by the difference in behavioral patterns of the members who composes the troop, as already mentioned. I wish, therefore, to point out that the peculiarity of social structure which has no direct relation to the number of population undoubtedly does exist.

5. GENETICS AS THE DECISIVE FACTOR OF SOCIAL STRUCTURE

The writer has pursued the peculiarity of social structure in the troop in the characteristic behavior of its members. This characteristic behavior is supposed to be attributed to the character of each individual, and the peculiarity of the character is assumed to be formed a posteriori under the influence of environmental factors. But, in reality, it might possibly be decided genetically.

Generally speaking, troops of Japanese monkeys are repulsive toward other troops, there being no possibility of free mating among troops. Especially when the troops live in places distant from one another or when they are screened geographically by the sea or rivers, it seems likely that they are more strictly isolated genetically. There may be another possibility that such isolation brings about the genetically nervous type, which is peculiar to breeding groups, and that that decides the characteristic behavior of the individuals or the troop.

But on Shodoshima Island, the five troops have overlapping nomadic areas and their movement is not interrupted geographically at all. Furthermore, there are neither mating season time lags nor behavioral differences among the troops. If there

is anything that checks their mating with other troops it is the repulsiveness of the troop toward others, which is a social factor.

Each troop on Shodoshima Island was repulsive toward all others and tried to keep away from direct contact with other troops, but they were not completely closed to themselves. For example, during the mating season solitary males joined the troop or, if not actually joining, many solitary males approached the troop and mated with the females. Although the original troop of these solitary males was not precisely identified, some individuals were obviously confirmed to have come from other troops. In the Arashiyama-A and -B troops, both troops exchanged males, and, as a result, almost all of the adult males of each troop came from the other troop.[19]

Solitary males, in this way, promate mating among the repulsive troops and carry genes from one troop to another. The frequency, even if the instance of the Arashiyama-A and -B troops was exceptional, was not regarded as being low for each Shodoshima Island troop, and these five troops were not genetically isolated. Therefore, it is difficult to conclude that the differences in the troops' behavioral patterns and in their social structures are decided, on the whole, genetically.

6. The Problems and Further Study of This Investigation

I have already mentioned my skeptical view of population size as being the main decisive factor of the peculiarity in social structure. It was because I emphasized that the difference in population does not directly relate to the difference in social structure and that the peculiarity of social structure without any relation to the population size does exist; I did not intend to neglect population size, in all respects, as the decisive factor of the social structure, however.

The change of population size itself is a transformation of the social environment, and it is possible for it to influence individual behavior and to produce some changes in behavioral patterns, and changes in behavioral patterns may possibly bring about a transformation of the social structure.

Granting that a change in population is not directly connected with the individual's behavioral pattern, an individual such as a leader, for example, who performs the central role in the troop does not increase in proportion to the increase of population. As a result, as the population increases leaders will be unable to control all of the individuals, thus weakening the social integration, and the social structure will possibly undergo change. And isn't this the general transformation process of social structure in the Takasakiyama troop, as reported by Mizuhara (1964), or the fission process of the troop, as reported by Sugiyama (1960) and Furuya (1960)? But such a problem can be clarified only through long-term, careful, and continuous investigation of one and the same troop, and it must be left to future discussion.

The next problem is that of ranking order, which is one of the important main factors in the social order of a society of Japanese monkeys. I have briefly referred to ranking as a general phenomenon but have not discussed it in detail, but that does not mean that ranking has little importance on the decision of social structure.

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19) N. Koyama (1970) and personal communication from K. Norikoshi.

For instance, in the comparison of adult males such as leaders, sub-leaders, ordinary males, and semi-solitary males, it was natural that the class which performed the more central roles should rank higher. Moreover, comparing upper ordinary males with lower ordinary males, both belonging to the sub-class of ordinary males, upper ordinary males, who were nearer the central part, ranked higher, as had been expected, and the primary factor that brought about such a difference in behavioral patterns was supposed to lie in the ranking. Likewise, the differentiation of females was also related to ranking.

In regard to the relation among leaders, however, it cannot by any means be said that the high-ranking leaders actively perform the main role, such as attacks for maintaining the society, and in some troops the less aggressive high-ranking leaders seldom perform this role. Thus, no correlation seems to be found between the behavioral patterns of the leaders and their ranking. In addition, in regard to females, the peripheral females in S and I troops ranked higher than many ordinary females, though in O troop they ranked lowest.

The more important point is this: among the ordinary males in I and K troops, the central ordinary males, though occupying the place nearest the leaders as far as their life area was concerned, did not necessarily rank high, and even ranked lower than some lower ordinary males, much lower than the upper ordinary males, without question. There was also an example, as was observed in some sub-leaders in K troop, that, though only temporarily, they ranked lower than an upper ordinary male. The central young males in S, T, and O troops ranked highest among fellows of their own age, but the reason they did not move to the periphery is not to be found in their high-ranking but in the other point which I have already mentioned.

Although it cannot be denied that ranking is of great importance in social order, there is a lot of characteristic behavior of individuals which has no relation to ranking. Ranking has been the basis of many investigations on natural societies of Japanese monkeys up to now and has obtained considerable results in its own way, but I paid attention to many behavioral characteristics which do not directly relate to ranking and tried to clarify the social structure as independently of ranking as possible.

It goes without saying, however, that ranking is an important problem. As a future peoblem, the social structure and its dynamics remain to be elucidated on the basis of ranking and all the other factors of social order.

In conclusion, I should like to refer to the importance of character in the individual and of his characteristic behavior for the purpose of elucidating social structure. It may be what is called the individuality or personality of the individual. When I referred to the characteristic behavior of the individual in the troop, I explained it in relation to the average value of the total members of the troop, and I know that the value itself may not be exact enough to go through strict analysis and investigation.

As a further problem, the behavioral patterns of the members composing each troop should be observed and grasped individually and the social interaction among the individuals should be analyzed. By doing so, the peculiarity of social structure and/or its dynamics will be clarified

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