Studies on the Sperm Whale with Deformed Lower Jaw with Special Reference to its Feeding

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INTRODUCTION

The sperm whale, *Physeter catodon* L. is the largest *Odontocete* which attains the maximum body length of 54 to 59 feet in male, while that of 37 to 43 feet in female (Nishiwaki, 1965).

Its slender lower jaw with long symphysis, the two halves of the jaw have become fused, are extreme characteristic in its shape comparing with that of other *Odontocetes.* The measurements expressed as percentage of total length, but they are tip of snout to angle of gaspe (containing projection of snout beyond tip of lower jaw) are 24.00 per cent in male and 16.19 per cent in female (Matthews, 1938).

The first record of the deformed jaw in sperm whale had been described by Beale (1839) as far as I know, after that the deformity have been reported by Murie (1865), Fischer (1867), Thomson (1867), Bennett (1932), Sleptozov (1955), Clarke (1957), Nasu (1958), Spaul (1964) and others. The list of records of deformed lower jaw of sperm whale was given by Clarke (1957).

According to Nishiwaki (1965), deformed jaw would appear at the ratio of two thousand whales to one, and is generally credited with the frequency as mentioned by Beale (1839) and Thomson (1867), but the problem of deformity in sperm whale seem to be of interest in considering the behaviour of the whale, especially its feeding.

MATERIALS

The materials treated in this paper have been obtained from data of biological investigation by Japanese whaling fleets in the Antarctic waters from 1954/55 to 1961/62 seasons and in the North Pacific waters from 1954 to 1965 seasons. And I also used the materials collected by the Whale Research Institute in the Japanese adjacent waters from 1957 to 1964 seasons.

These materials include three, ten and twelve examples of deformed or damaged lower jaws in sperm whales respectively.

The following points on each sperm whale with deformed or damaged jaw are examined and described here.

Sex
Body length
Date of capture (or treated)
Position caught
External parasites on the lower jaw (*Conchoderma*)
Thickness of blubber
Stomach contents
Weight of testis

Besides following two foreign specimens are added.

A specimen (No. 7914) of the Museum of Comparative Zoology at Harvard College, U. S. A..
A specimen of the Whaling Museum at New Bedford, Mass., U. S. A..

Both specimens seem to be younger *Physeter* from the size of jaws. According to the private communication from Dr. Willium E. Schevill* and Mr. George Bowditch**, there are no data either on size and sex of two specimens or where they were caught. Therefore here the condition of deformity is only discussed.

DEFORMITY AND FUNCTION OF TEETH

The lower jaw of sperm whale carries from sixteen (minimum) to thirty teeth (maximum), twenty three in average on one side (Ohsumi, 1963); the number on each side is not necessarily equal. Sperm whale teeth are thecodon condition; when the mouth is closed the tips of the teeth fit into sockets, that is to say, *alveolus dentalis* of jaw bone near the outer margine of the palate (Fig. I. in Plate I).

In the sperm whales the functional teeth are restricted to the lower jaw. Clarke (1957) pointed out that like female *Ziphioid* whales, where functional teeth never erupt, young sperm whales with still toothless jaws seem to find not difficulty in searching the squids which they are their staple food; of nine Azores whales past weaning which had unerupted teeth, eight had stomachs containing small or moderate amounts of squid and the stomach of ninth was crammed full with the bulky squid *Cucioteuthis unguilatus*.

Nishiwaki *et al.* (1958) noted that the eruption of teeth is closely related with age of whales. According to Ohsumi (1963), on both sexes the teeth of fifty per cent whales are erupted at an age approaching nine years, which agrees with the age of sexual matuarity, thus it can be said that teeth are connected with the reproductive behaviour of sperm whales.

Caldwell *et al.* (1966) reported that Rice, one of them, examined many large fresh squids taken from sperm whale stomachs, and only rarely has noted tooth marks on

* received on 30, Jan., 1964
** received on 1, Feb., 1964

them; usually they are almost completely undamaged.

The above is an evidence the sperm whales do not use their teeth as a major mechanism for feeding, but for fighting or as a means for caressing (Ohsumi, 1963; Caldwell *et al.*, 1966).

The sperm whale teeth, generally canine-like conical teeth curved, neither have any function for gnawing its prey in its mouth off, nor crushing or grinding it down, but only for "seizing" it unlike that of typical terrestrial mammals.

That neither blindness, deformed jaw, nor worn teeth also seem to interfere markedly with feeding have been noted by several authors (Beale, 1839; Bullen, 1899; Clarke, 1957; Ash, 1962; Spaul, 1964 and others).

I caluculated the feeding rates of sperm whales with deformed or damaged jaws (the number with stomachs containing food in % of the total number with deformed or damaged jaws), using data collected in the Antarctic waters from 1954/55 to 1961/62 seasons and in the North Pacific waters from 1954 to 1965 seasons.

The former was 75 per cent, and the latter, 73 per cent. The stomach of a whale-(individuals of No. 1 in Table 1.) taken in the North Pacific waters had contained thirty squids (size and species, unknown).

In the waters adjacent to Japan, however only one whale (individuals of No. 18 in Table 1.) of twelve had stomach containing squids. This low frequency is partly because stomachs contents are liable to be washed away as the abdomen of whales caught are immediately split by whalers in the coastal whaling of Japan.

I intend to report here four whales with damaged or "short" jaws (individuals of No. 12, 14, 21, and 24), however there are no detailed records about two whales (individuals of No. 12 and 14).

The teeth of a whale (No. 24) became worn and rounded, especially markedly in eight to nine teeth of the tip on both sides, but the whale was in good condition except the lower jaw (Fig. 1. and 2. in Plate 3.) The teeth of the second example (No. 21) with a longer jaw than that of the former were also worn and rounded to a lesser extent (Fig. 2. in Plate 2.), but Fig. 1. in Plate 2. seem to prove that it was natural except the "short" jaw.

Therefore it can be said that such "short" jaws might not interfere with feeding though the stomachs contents were not found from both animals. A whale (No. 12) from the Antarctic waters had a stomach containing squids.

The sperm whale's method of looking for food is not definitely known. Scammon (1874) said as follows in quoting from hypothesis by several authors; that after descending to the desired depth an animal drops its lower jaw nearly to a right angle with the body, thereby exhibiting its polished white teeth, which attract within its reach the swimming food. Heezen (1957), in attempting to explain how sperm whales become entangled in deep-sea submarine cables, suggests that the animals skim along the bottom with the lower jaw in the sediments, searching for food. Nemoto and Nasu (1963), who have examined the stone and other aliens in the stomachs of sperm whales in the Bering Sea, presumed as to the whale's method of feeding as follows; the whale must have digged deep sea sponge which have attached to the sea bottom with lower jaw and swallowed it with other bottom living food such as crubs and rays *etc*..

As my personal opinion, these method in seeking for food as above mentioned seem to be impossible for the whales with "short" jaw or crooked or curved one to the left with the body as shown in Fig. 1. in Plate 2., Fig. 1. in Plate 10., Fig. 1. in Plate 12., and Fig. 1. in Plate 7. *etc*..

The materials reported here give no proper evidence how sperm whales with deformed or "short" jaws look for food, however these animals seem to answer that life of aquatic mammals have some advantage over that of typical terrestrial mammals, in considering sperm whales with deformed or "short" lower jaws which pursuing their prey.

DEFORMITY AND EXTERNAL PARASITES

According to Clarke (1966), the two *Conchoderma* species, *C. auritum* and *C. virgatum*, appear to be the only true stalked barnacles so far as recorded whales. Among toothed whales *C. auritum* occurs occasionally on the sperm whale (on 2.5 per cent of 6, 411 sperm whales from many seas).

Clarke (1957), as well as Tomilin (1957) has described *C. auritum* occupies a characteristic position on the sperm whales body, that is to say, the base of the front teeth.

Several authors have reported *Conchoderma* on deformed jaws of sperm whales (Clarke, 1957; Nasu, 1958; Slijper, 1962 in fig. 229, but on a fractured jaw., Spaul, 1964 and Clarke, 1966).

The attachment of the parasites on the deformed jaw, as Clarke (1957) has already reported a heavy infestation of *C. auritum* along the length of the tooth rows, is not restricted to the front teeth.

I intend to report here six cases out of eleven deformed whales from the North Pacific waters and five out of twelve from the Japanese adjacent waters. *Conchoderma* was parasitic on the deformed jaws of eleven whales (individuals of No. 1, 2, 3, 4, 10, 11, 16, 17, 18, 26, and 28). The parasites of No. 26 attached to the front three mandibular teeth of the right side (Fig. 2. in Plate 4.). The parasites of No. 28 attached to the first and the second tooth of the tip of broken jaw (Fig. 1. in Plate 5.). The two examples of the attachment of the parasites along the tooth rows as well as on the front teeth, both whose position are nearly the same, were found in No. 10 and No. 11 (Fig. 2. in Plate 6. and Fig. 2. in Plate 7.). The parasites of four whales above mentioned were all *Conchoderma auritum*. There are no detailed records about the rest shown in Table 1.

Clarke (1966) calculated the infestation rates of *C. auritum* on normal, deformed and damaged jaws examined in Chile and Peru between 1959 and 1962 and he concluded

TABLE 1. LIST OF SPERM WHALES WITH DEFORMED OR DAMAGED LOWER JAW RECORDED IN NORTH PACIFIC, ANTARCTIC AND JAPANESE ADJACENT WATERS

Locality	Serial Number	Sex	Body Length in feet	Date of Capture	Position caught	External Parasites (*Cochoderma*)	Thickness of Blubber in cm	Stomach Contents	Weight of Testis in Kg L.	R.	Remarks
NORTH PACIFIC	1	M	46	20, June 1954	50°-25′N 178°-00′W	+	13.5	squid	3.9	4.3	The posterior portion bends strikingly to the right.
	2	M	48	22, Mar. 1956	52°-08′N 176°-47′W	+	11.0	none	4.6	4.5	The jaw bends like a swirl to the right (Nasu, 1958).
	3	M	47	23, May 1956	52°-10′N 175°-55′W	+	13.0	squid	3.5	4.2	The jaw bends strikingly to the left.
	4	M	39	3, June 1956	51°-59′N 177°-21′W	+	?	squid	1.6	2.2	The jaw bends to the right in U shape.
	5	M	40	10, June 1958	53°-37′N 167°-44′W	−	10.5	none	1.0	1.2	The jaw bends like a hook to the right.
	6	M	46	19, June 1958	51°-30′N 179°-37′E	−	12.0	fish	4.8	4.8	The posterior portion bends to the left.
	7	M	47	5, July 1959	52°-23′N 176°-05′E	−	9.5	squid	4.9	4.5	The jaw bends to the left.
	8	M	46	17, June 1960	52°-27′N 176°-00′E	−	13.0	squid	3.6	4.8	The posterior portion is deformed.
	9	M	50	29, June 1960	53°-06′N 172°-14′E	−	11.0	squid	3.8	3.8	The length of 60 cm from the tip bends at an angle of 90° to the right.
	10	M	46	2, July 1960	55°-04′N 177°-12′W	+	14.0	squid	4.6	4.6	The jaw heavily at an angle of 120° bends to the left Fig. 1 and 2 in Plate 6.
	11	M	48	2, Aug. 1965	53°-09′N 171°-13′W	+	11.0	squid	2.9	3.1	The jaw bends heavily to the right. Fig. 1 and 2 in Plate 7.
ANTARCTIC	12	M	50	26, Dec. 1954	63°-56′S 179°-33′W	−	11.0	squid	3.6	2.6	The jaw is broken at the half length.
	13	M	44	10, Dec. 1956	60°-06′S 126°-14′W	−	8.5	squid	?		The jaw bends to the right. (Nasu, 1958)
	14	M	52	26, Dec. 1960	66°-12′S 177°-27′E	−	13.0	none	?		The posterior portion is lost at the length of two third from the tip.
	15	M	39	4, Nov. 1961	41°-40′S 116°-57′E	−	9.5	squid	1.6	1.7	The jaw bends to the right at the middle.
JAPANESE ADJACENT WATERS	16	F	36	16, Sept. 1957	42°-48′.5″N 141°-10′E	+	?	?	——		The jaw bends like a swirl to the right. (Nasu, 1958)
	17	M	37	10, Nov. 1957	**	+	?	?	?		The jaw bends to the left (Nasu, 1958) .Plate 12.
	18	F	35	3, Oct. 1959	42°-05′N 144°-55′E	+	9.0	squid	——		The posterior portion bends to the right.
	19	F	36	3, Oct. 1959	42°-04′N 144°-56′E	−	?	none	?		The jaw bends to the left.
	20	F	36	15, Sept. 1960	***	−	?	none	——		The posterior portion bends slightly to the right.
	21	M	30	21, June 1961*	**	−	?	none	0.7	1.1	The jaw is torned less than the half length off. Fig. 1. and 2. in Plate 2.
	22	M	33	13, July 1963*	**	−	8.5	none	0.6	0.7	The jaw bends slightly upwards. Fig. 2. in Plate 1.
	23	M	40	30, July 1963*	40°-01′N 147°-36′E	−	10.0	none	1.9	1.9	The jaw bends slightly to the left.
	24	F	36	11, Aug. 1963*	36°-55′N 143°-42′E	−	?	none	——		The jaw almost torned off. Fig. 1. and 2. in Plate 3.
	25	M	32	12, Aug. 1963*	**	−	?	none	lost		The jaw bends slightly to the left. Fig. 1. in Plate 4.
	26	M	37	18, Aug. 1963*	37°-18′N 145°-53′E	+	?	none	0.85		The posterior portion bends to the right. Fig. 2 in Plate 4.
	27	F	36	27, Aug. 1963*	38°-03′N 143°-57′E	−	?	none	——		The jaw bends extremely to the right. Fig. 3. in Plate 4.
	28	F	31	29, Aug. 1963*	36°-37′N 144°-11′E	+	?	none	——		The jaw bends to the left. Fig. 1. and 2. in Plate 5.
	29	F	36	17, Aug. 1964*	36°-21′N 144°-39′E	−	7.5	none	——		The jaw bends slightly to the right.

* Date treated at a land station

** Off Sanriku, Honshu *** Off Kushiro, Hokkaido as follows; the incidence on bent lower jaws increases with increasing curvature, until nearly all examples of the strongly curved or scrolled jaw bear the parasite, though not all deformed or damaged jaws are infested. Further Clarke reported infestation is heaviest on the teeth and it extends along the tooth row with increasing curvature.

TABLE 2. INFESTATION RATES OF *CONCHODERMA* ON SPERM WHALES WITH DEFORMED OR DAMAGED JAWS

	No. examined	No. with *Conchoderma*	% with *Conchoderma*	Locality & Season	Reference	Remarks
Lower jaw normal	6411	—	2.5*	various seas	Clarke (1966)	*C. auritum* ***Conchoderma* & *C. auritum*
Deformed jaw	11	6**	55.0	North Pacific (1954-64)	present paper	
	12	5**	42	Japan (1957-64)	present paper	
Damaged or "short" jaw	2	0	0.0	Antarctic (1956/57-62/63)	present paper	
	2	0	0.0	Japan (1961-63)	present paper	

I also caluculated the infestation rates of *Conchoderma* on deformed and damaged or "short" jaws of sperm whales captured in the North Pacific, the waters adjacent to Japan and the Antarctic. Table 2. shows the result. The values of deformed jaws are considerably higher than the values of lower jaw normal (from various seas) given by Clarke, though here *C. auritum* is not separated from *C. virgatum*.*

Thus we can reach the conclusion that the sperm whales with deformed jaws and damaged or "short" jaws are easy to be infested by *Conchoderma* than those with normal jaws as some parts of the palate become permanently exposed because of their deformity.

* There are only five records of *C. virgatum* on sperm whales from Ireland, Azores and Peru so far; all individuals attached on *Pennella* and *C. auritum* (Clarke, 1966).

TABLE 3. INCIDENCE RATES OF DEFORMED LOWER JAW IN SPERM WHALES

Locality	Season	No. of whales examined			No. of whales with deformed jaws			% with deformed jaws		
North Pacific	1954	Males Females	490 0	490	Males Females	1 0	1			0.204
	1956	Males Females	1593 0	1593	Males Females	3 0	3			0.188
	1958	Males Females	1499 0	1499	Males Females	2 0	2			0.133
	1959	Males Females	1798 2	1800	Males Females	1 0	1			0.056
	1960	Males Females	1799 1	1800	Males Females	3 0	3			0.167
	1965	Males Females	2434 26	2460	Males Females	1 0	1			0.041
Total		Males Females	9613 29	9642	Males Females	11 0	11			0.114
Antarctic	1956/57	Males Females	1427 0	1427	Males Females	1 0	1			0.070
	1961/62	Males Females	1053 11	1064	Males Females	1 0	1			0.094
Total		Males Females	2480 11	2491	Males Females	2 0	2			0.080
Japanese adjacent waters	1957	Males Females	1039 1322	2361	Males Females	1 1	2			0.085
	1959	Males Females	922 1182	2104	Males Females	0 2	2			0.095
	1960	Males Females	997 1111	2108	Males Females	0 1	1			0.047
	1963	Males Females	760 954	1714	Males Females	4 2	6			0.350
	1964	Males Females	948 851	1799	Males Females	0 1	1			0.056
Total		Males Females	4666 5420	10086	Males Females	5 7	12	Males Females	0.107 0.129	0.119
Grand totals		Males Females	16759 5460	22219	Males Females	18 7	25			0.112

FREQUENCY OF DEFORMED JAW AND DAMAGED OR "SHORT" JAW

Nishiwaki (1965) mentioned deformed jaws would occur at the ratio of two thousand whales to one. Also Clarke (1966) stated deformity occurs more often than he had previously supposed, from finding the fact that he has examined 188 whales with deformed jaws (made up as follows, slightly curved, 168, moderately curved, 13 and strongly curved, 7) and 9 whales with damaged or "short" jaws (made up as follows, "short" jaw, 6 and damaged jaw, 3).

TABLE 4. INCIDENCE RATES OF DAMAGED OR "SHORT" LOWER JAW IN SPERM WHALES

Locality	Season	No. of whales examined			No. of whales with damaged or "short" jaws			% with damaged or 'short' jaws
Antarctic	1954/55	Males	967	967	Males	1	1	0.103
		Females	0		Females	0		
	1960/61	Males	1551	1551	Males	1	1	0.064
		Females	0		Females	0		
Total		Males	2518	2518	Males	2	2	0.079
		Females	0		Females	0		
Japanese adjacent waters	1961	Males	979	2101	Males	1	1	0.048
		Females	1122		Females	0		
	1963	Males	760	1714	Males	0	1	0.058
		Females	954		Females	1		
Total		Males	1739	3815	Males	1	2	0.052
		Females	2076		Females	1		
Grand totals		Males	4257	6333	Males	3	4	0.063
		Females	2076		Females	1		

I caluculated the frequency of deformed jaw and damaged or "short" one (the number of deformed jaws or damaged jaws in % of the total number of sperm whales taken in each region) as shown in Table 3 and 4, using data reported by the Whales Research Institute and the Japan Whaling Association.

The frequency of deformity does not conspicuously vary with three regions, though the value of the Antarctic waters is the lowest. the frequency of damaged jaw also does not conspicuously vary with two regions between the Antactic waters and the Japanese adjacent waters.

The values which I got show that deformed jaws will occur more frequently than damaged or "short" jaws in each region. The value of the waters adjacent to Japan suggests that the frequency of deformity dependent upon sex marks no great difference.

CAUSE OF DEFORMITY

A comparative review of all reports and the materials treated here explains that deformity is rarely occurred in the upper jaw* but in the lower jaw and it ranges from simple bends or curve (See Fig. 2. in Plate 1. and Fig. 1. in Plate 4.), moderate bends or curve (See Fig. 1. and 2. in Plate 6. and Fig. 1. and Fig. Plate 7. etc.) then to complex torsion or scroll formation (See Fig. 1. in Plate 11.) dependent upon the intensity of differential growth and development.

I think therefore it is difficult to classify the pattern of deformity unless the cause of deformity is pathologically or anatomically determined. I regret to say I could not perform some pathological investigation on deformed or "short" jaws because almost all specimens treated here were not preserved.

As to the fractures of mandibular bones in sperm whales, several cases have been reported by some authors (Murphy, 1947; Sleptozov, 1955; Slijper, 1962 in fig. 229 and Ash, 1962).

Ash (1962) clearly distinguished between a twisted jaw and a broken one. I also think four cases previously stated (individuals of No. 12, 14, 21 and 24) must be differentiated from a type of deformity of the lower jaws.

A whale with broken jaw as shown in Fig. 1. and 2, in Plate 5., which probably broken by accident when treated at Ayukawa land station, Miyagi Pref., was determined to have been deformed because there was a marked fovea which have been formed by having been touched with a part of deformed jaw on the left palate of upper jaw.

Such foveae, however were not found on the upper jaws of the whales of No. 21 and No. 24 (See Fig. 2. in Plate 2. and Fig. 1. in Plate 3.).

Shaler (1873) also reported that a whale had captured with the lower jaw torn almost completely off.

There was a clear evidence of healing or junction, namely, well-marked excessive production of callus in the natural repairs of the fractured mandibular bones on both sides in a wild Japanese sika deer, *Cervus nippon centralis* KISHIDA captured in Honshu (Kobayashi and Nakamura, unpublished), but in the lower jaws of sperm whales limited to three specimens among animals with deformed jaws treated here, there is no evidence of a break and a healing (See Fig. 1. in Plate 8., Fig. 1. in Plate 11. and Fig. 1. in Plate 12.). According to Murphy (1947), a sperm whale with broken but healed jaw has been captured.

* I have no any information about the deformity of upper jaw in sperm whale, but a female Blue white dolphin, *Stenella caeruleo-alba* with upper jaw bent slightly upwards as well as lower jaw had been taken (Tobayama and Uchida, 1964).

As to the direction of bends or scroll, according to the materials containing two foreign specimens treated here, but individuals of No. 8, 12, 14, 21, and 24 in Table I. are excluded, and to a few records by Nasu (1958), the direction to the right with the body were found in fourteen whales, while to the left, in nine whales; this fact shows there is no a constant pattern about the direction of bends or curvature.

As the deformed part of lower jaw had not been touched with the palate of upper jaw, a part of palate is liable to be narrowed comparing with that of normal one (See Fig. 1. in Plate 1.), which is an evidence that the whales with deformed or "short" jaws have lived for a certain period of time since the jaws were deformed (See Fig. 2. in Plate 2, Fig. 1. in Plate 3., Fig. 2. in Plate 6. and Fig. 1. in Plate 7. etc.).

Bull sperm whales fight with their jaws (Shaler, 1873; Hopkins, 1922). Fighting beween males has been given as a cause of the deformity by some writers (Beale, 18 39; Thomson, 1867 and Sleptozov, 1955), but the type of deformity treated here is not necessarily characteristic of the bull sperm whales. There were seven females (except individuals of No. 24 in Table 1.) among the whales with deformed jaws captured in the waters adjacent to Japan. The sperm whales caught in the Antarctic waters and in the North Pacific waters were almost all males as shown in Table 3.

This fact may be connected that the deformity did not appear in sperm females in this two regions.

The sockets of upper jaw in sperm whales arise from being tossed by the erupted teeth of lower jaw. (See Fig. 1. in Plate 1.). Several whales with deformed or "short" jaws had socket marks in the palate of upper jaws (individuals of No. 24, 25, 26, 27, and 28 in Table 1.), but these marks can not be found in the whales with deformed or "short" jaws as shown in Fig. 2. in Plate 2., Fig. 2. in Plate 6. and Fig. 2. in Plate 7.; the sockets of palate would disappear to be covered with right and left lips as the whales could not close properly their mouth because of their deformity which probably have extended over a long period of time. As to the "short" jaw, the disappearance of sockets might be influenced by having been tossed with the worn and rounded teeth of lower jaw. Whether socket marks are existed or not in the palate of whales with deformed jaws seem to be dependent upon the intensity of deformity and the time elapsed after their lower jaws have been deformed.

The above is an evidence which the lower jaw was deformed after the teeth had been erupted, namely, it is presumed that a type of deformity and "short" jaw were formed *a posteriori.*

From finding that there were no any signs of fractures as already mentioned the type of deformity treated here will be due to another cause.

I also think, as suggested by Murie (1865) and Spaul (1964), the mandibular bone might be deformed when it was in a state of pathological softness; the lower jaw with this condition might be damaged by some external force to be deformed into different shape, then.

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SUMMARY

1. Using the results of biological investigation of Japanese whaling fleets in the North Pacific waters (from 1954-1965), the Antarctic waters (from 1954/55-1961/62) and the Japanese adjacent waters (from 1957-1964), twenty five sperm whales with deformed jaws and four whales with damaged or "short" jaws were studied.

2. The stomachs of 73 per cent of sperm whales with deformed or damaged jaws taken in the North Pacific waters, and while 75 per cent in the Antarctic waters, were crammed with foods, which will be an evidence that sperm whales do not use their teeth as a major mechanism for feeding.

3. The infestation rates of *Conchoderma* on the sperm whales with deformed jaws from the North Pacific waters and the Japanese adjacent waters are considerably higher than of lower jaws normal, namely, deformed jaws are easy to be infested by the parasites than normal jaws because of their deformity.

4. The frequency of deformed jaws as well as damaged or "short"- jaws do not conspicuously vary with region. Deformed jaws occur more frequently than damged or "short" jaws. The type of deformity treated here is not necessarily restricted to sperm males, and the frequency of deformity dependent upon sex marks no great difference. The total frequency of deformed jaw is 0.112 per cent, and that of damaged jaw is 0.063 per cent.

5. Deformed jaws and "short" jaws seem to be formed *a posteriori* and some pathological studies about the deformed mandibular bones will make the cause of them clear.

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抄　録

特異な奇型がマッコウクジラ *Physeter catodon* L. の長大な下顎に出現することは古くから注目されていた。古くは Beale (1839) により，次いで Murie (1865), Fischer (1867), Thomson (1867), Bennett (1932), Sleptozov (1955), Clarke (1957), Nasu (1958) 及び Spaul (1964) 等により，いずれも少数例が記載されている。その後数例が断片的に報告された (Clarke, 1966) が，マッコウクジラの下顎奇型はごく稀に出現すると記載されたり，逆に珍しくないとされたり，報告者により見解の相異が生じた。Clarke (1966) は1959年から62年にかけてペルーとチリで得られた多数の下顎奇型を調査した経験から､以前考えられた(Clarke, 1957) よりも，この型の奇型は高い頻度で出現すると報告した。

マッコウの下顎にみられる奇型はごく単純な彎曲からラセン状にねじれた複雑な形態までおよび，その発達の程度に応じて種々の変異を示す (PLATE 1 ～12参照)。

著者は1954年から65年にかけての北太平洋，1954年から61年にかけての南氷洋及び1957年から64年にかけての日本沿岸に於ける各漁期に得られたマッコウのうちから下顎奇型（短い下顎及び損傷を受けた下顎を有する個体も含む）を有するマッコウに関するデータ（鯨類研究所資料）を集め（Table. 1), 加えて Nasu (1958) により報告され，後に下顎骨標本として鮎川鯨類博物館（宮城県）に保存された日本沿岸の一例も参考とした (PLATE. 12 参照)。更にマサチュセッツの Woods Hole 海洋研究所の Willium E. Schevill 博士とニューベッドフォードの捕鯨博物館々長, George Bowditch 氏の御協力を得て, ハーバード大学の比較動物学博物館の一標本，と捕鯨博物館の一標本を資料に加えることができた (PLATE 8～11参照)。

著者はこれらの資料に基づいて、奇型下顎を有するマッコウの摂餌法からみた歯の機能，外部寄生虫との関係，奇型の出現率，奇型の原因について論じた。

マッコウの下顎には片側，最小16本，最大30本、平均23本の機能歯がある（大隅, 1963) がこれらの歯がはたして食物を摂るのにどれほど役に立つかは以下の事実からみて，疑問視されてきた。

離乳後の歯の崩出していない若い個体も餌を摂ることができる (Clarke 1957) し，胃内に発見される餌(イカ類) に歯の跡がみられない (Caldawell *et al.,* 1966)。マッコウの50%に歯が露出する年令はオス，メス共に九才であり，この年令はマッコウの性的成熟年令と一致することから，歯の崩出は生殖のための闘争の武器，あるいは愛撫の手段としての目的もあるのではないかと考えられる（大隅, 1963)。

更に盲目，彎曲した下顎の奇型，短い顎，摩耗した歯が摂餌を妨害しないであろうことも注目されてきた（Beale, 1839; Bullen, 1899; Clarke, 1957; Ash, 1962; Spaul, 1964など)。

下顎奇型（短い顎及び損傷を受けた顎を含む）を有するマッコウの索餌率は，北大平洋産では73%，南氷洋産では75%で，共に高い値を示した。日本沿岸産ではわずか一頭に胃内容物が認められたが，日本沿岸捕鯨では捕獲後腹部が裂かれるので，胃内容物が流出する傾向にあることが索餌率の頻度の低い原因の一つと考えられる。

ここでは下顎の奇型を"短い顎"及び損傷を受けた顎から区別した。共にその出現率を求めたところ，後者よりも前者の方が多く出現し，「彎曲した下顎奇型」はおよそ 900頭に 1 頭の割合で出現するという結果を得た (Table 2, 3)。この型の奇型に海域，性による出現率の差は認められなかった。マッコウの上顎口蓋のソケットは崩出した下顎歯の突き上げによって生じる。彎曲した下顎及び"短い顎"をもった個体の上顎口蓋にソケットの跡がみられる例が多いことは

下顎の彎曲及び“短い顎”は下顎歯の崩出後に生じたことを示している。即ち奇型は後天的に形成されたと考えられる。いわゆる彎曲する型の奇型は闘争の結果よりはむしろ他の原因に帰すべきであると考える。彎曲した下顎骨の病理学的な精査がその原因を明らかにするであろう。

下顎奇型にみられる特徴の一つとして外部寄生虫との関係がある。鯨類からは *Lepadidae* のうちミミエボン *Conchoderma auritum* とカルエボン *C.virgatum* の2種が記録される。歯鯨類のうちマッコウには主に *C.auritum* が2.5%の割合で付着し，その Infestation rates は低い(Clarke 1966)。Clarke は1959年から62年にかけてペルーとチリで調査した彎曲した下顎をもつマッコウ 188頭を，わずかに彎曲するもの，中庸に彎曲するものから顕著に彎曲するものまで，下顎の奇型を三段階に分けて，各々 *C.auritum* による Infestation rates を求め，彎曲が顕著になれば Infestation rates が高くなるという結論に達した。著者は奇型の発達段階による区別はしなかったが，北太平洋産で55.0%，日本沿岸産で42%という Clarke と同様な高い Infestation rates を得た (Table. 5.)。これは正常なかみ合わせが行なわれない彎曲した部分が常時露出されたため *Conchoderma* に付着されやすかったことを説明している。このかみ合わせに関連していえることは，左右の口唇が被いかぶさり口蓋が狭くなることで，この型の下顎奇型の特徴の一つであり，奇型形成後かなり長い期間生存してきたことを示すものであろう。下顎彎曲，短い顎，及び損傷を受けた顎は索餌に影響を与えず，マッコウクジラの直接の死亡原因には結びつかない。

EXPLANATION OF PLATES

PLATE 1

Fig. 1. The normal lower jaw of the sperm whale, *Physeter catodon* L..

Fig. 2. Deformed lower jaw. Sperm male 33 feet, in the Japanese adjacent waters, 13 July, 1963. (Photo. by Mr. Makoto Tanaka)

PLATE 2

Fig. 1. and 2. Sperm male with "short" jaw 30 feet, in the Japanese adjacent waters, 21 June, 1961. (Photo. by Dr. Tadayoshi Ichihara)

PLATE 3

Fig. 1. and 2. Sperm female with "short" jaw 36 feet, in the Japanese adjacent waters, 11 Aug., 1963.

PLATE 4

Fig. 1. Deformed lower jaw. Sperm male 36 feet, in the Japanese adjacent waters, 12 Aug., 1963.

Fig. 2. Deformed lower jaw. Sperm male 37 feet, in the Japanese adjacent waters, 18 Aug., 1963.

Fig. 3. Deformed lower jaw. Sperm female 36 feet, in the Japanese adjacent waters, 27 Aug., 1963.

PLATE 5

Fig. 1. and 2. Deformed lower jaw. Sperm female 31 feet, in the Japanese adjacent waters, 29 Aug., 1963.

PLATE 6

Fig. 1. and 2. Deformed lower jaw. Sperm male 46 feet, in the North Pacific, 2 July 1960. (Photo. offered by Dr. Takahisa Nemoto)

PLATE 7

Fig. 1. and 2. Deformed lower jaw. Sperm male 48 feet, in the North Pacific, 2 Aug., 1965. (Photo. by Hisashi Ono)

PLATE 8

Fig. 1. Deformed lower jaw. A specimen preserved at the Museum of Comparative Zoology at Harvard College. (Photo. by Mr. Donald W. Bourne)

PLATE 9

Fig. 1. *Ditto.*

PLATE 10

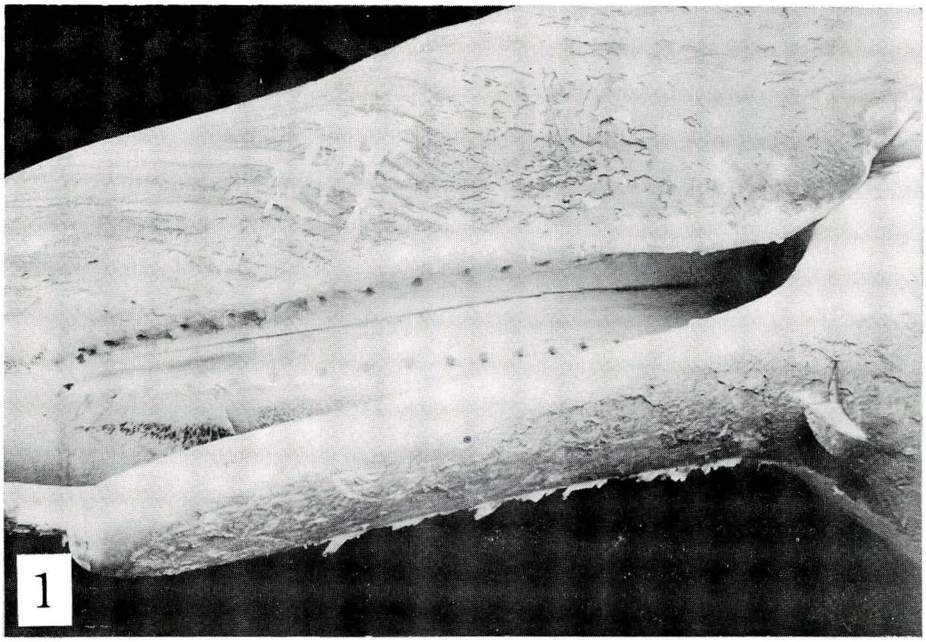
Fig. 1. Deformed lower jaw. A specimen preserved at the Whaling Museum at New Bedford. (Photo. by Dr. Willium E. Schevill)

PLATE 11

Fig. 1. *Ditto.*

PLATE 12

Fig. 1. Deformed lower jaw. A specimen preserved at the Whale Museum at Ayukawa, Miyagi Pref., reported by Nasu (1958).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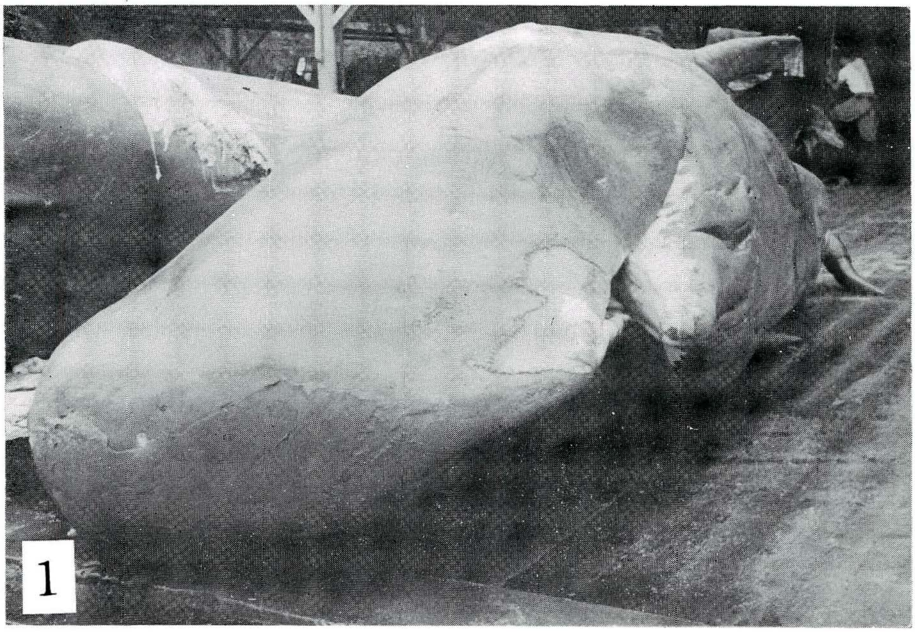
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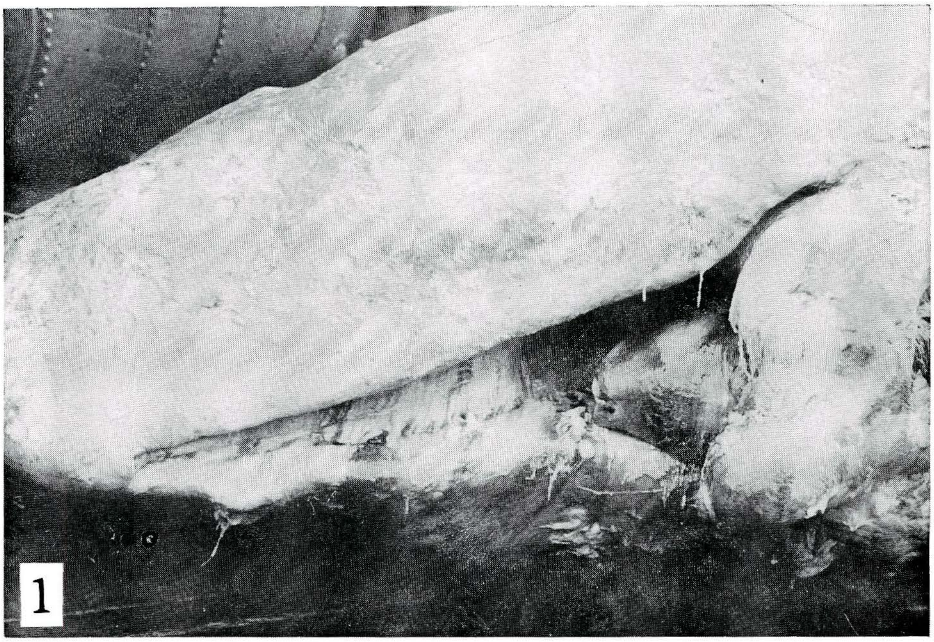

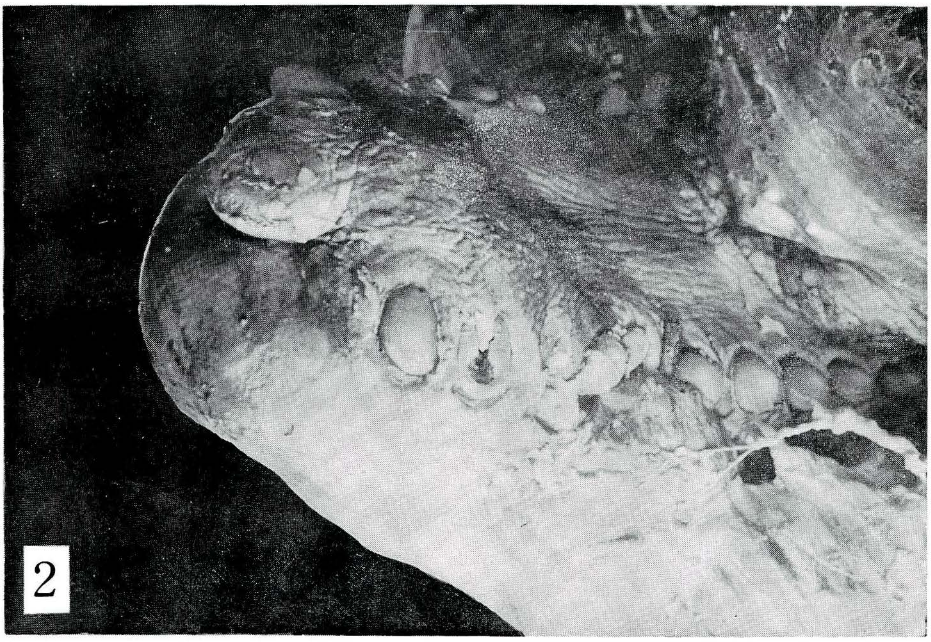

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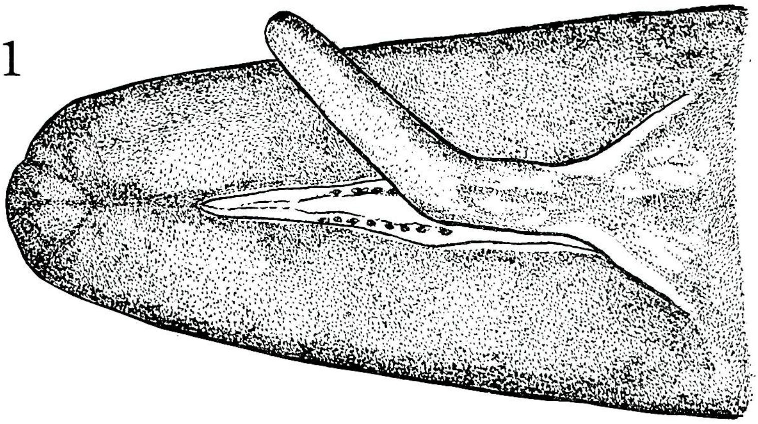

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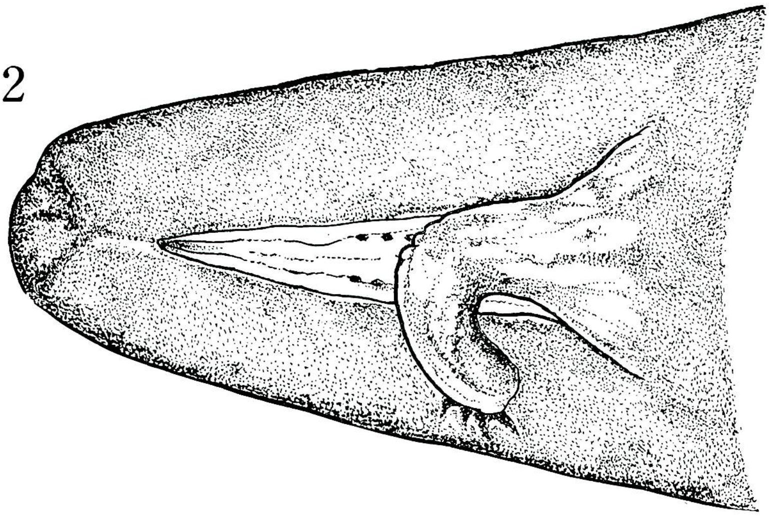

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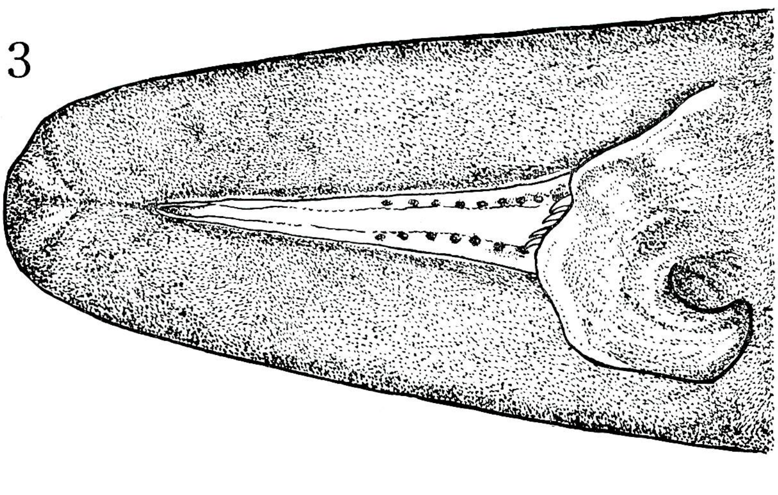

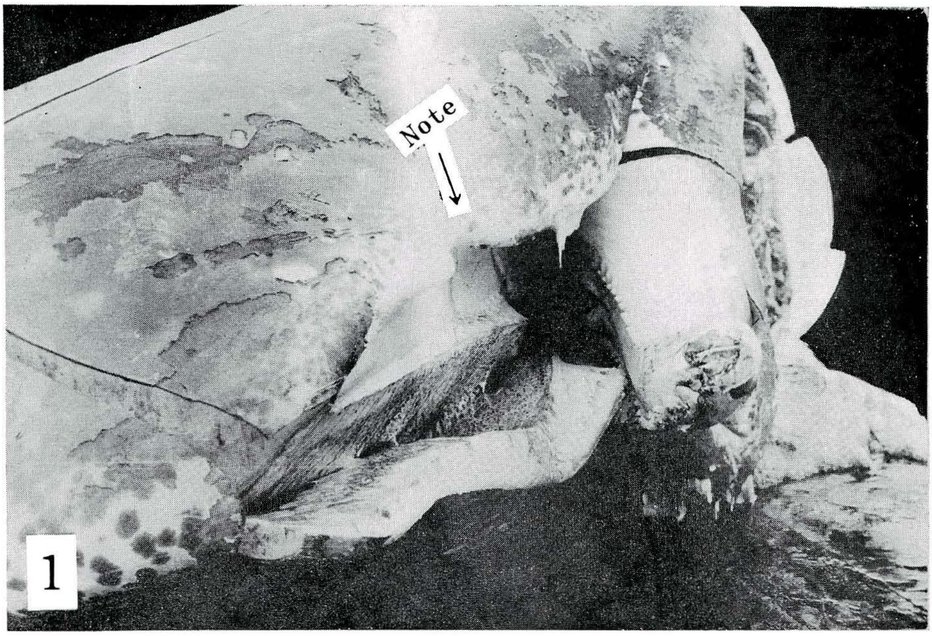
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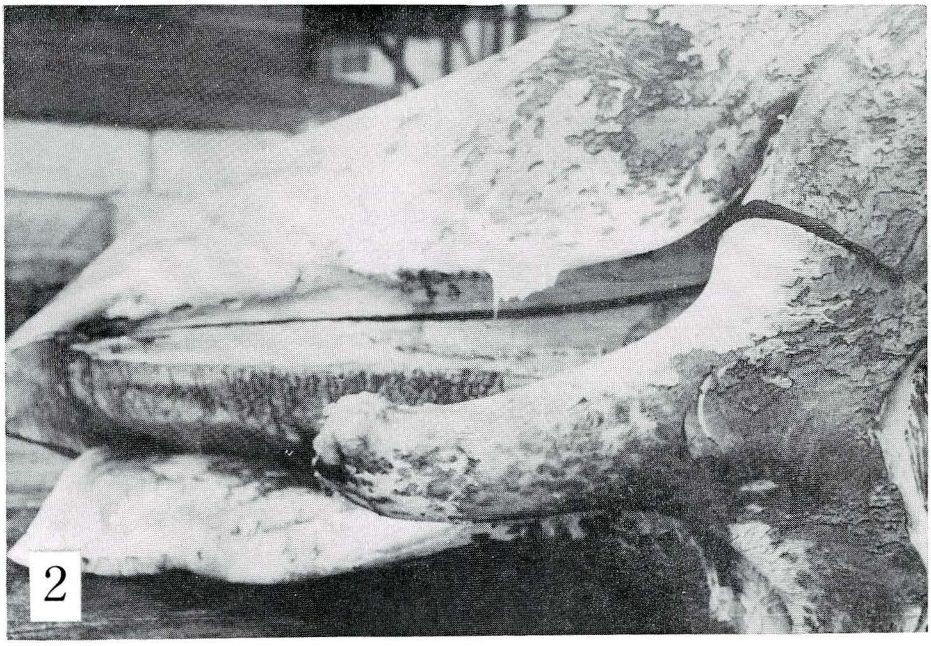
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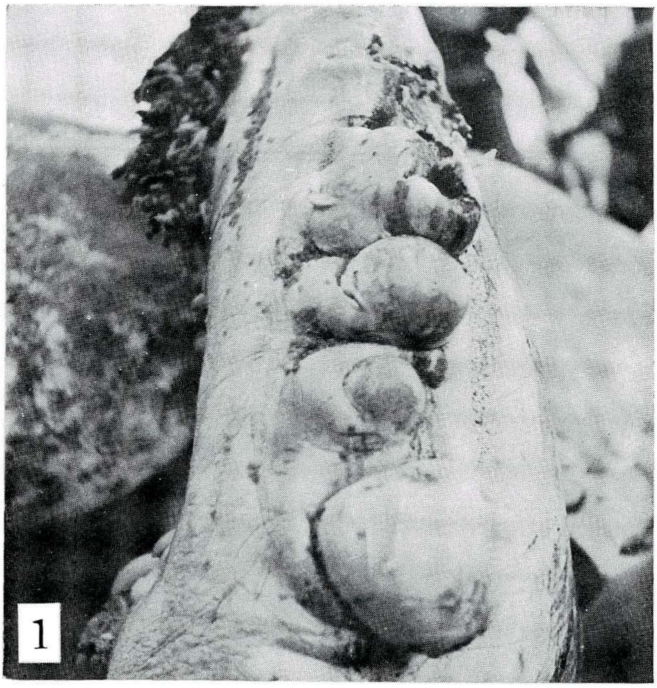
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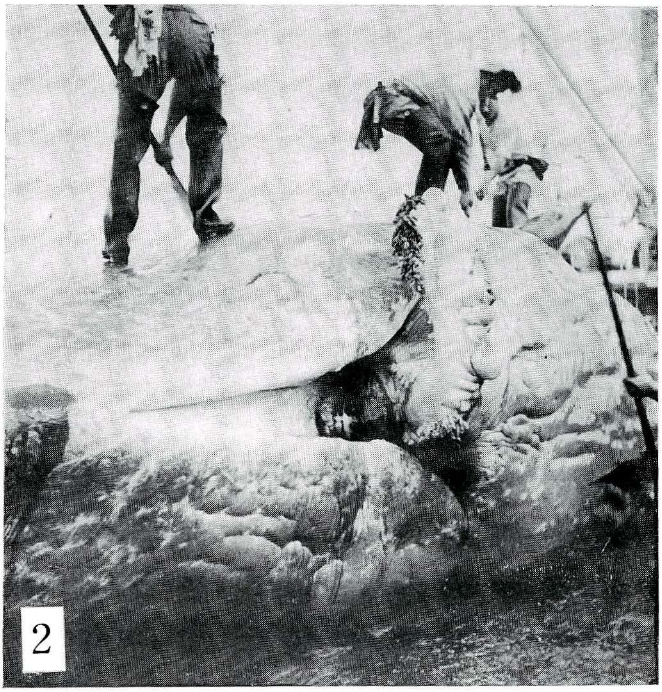
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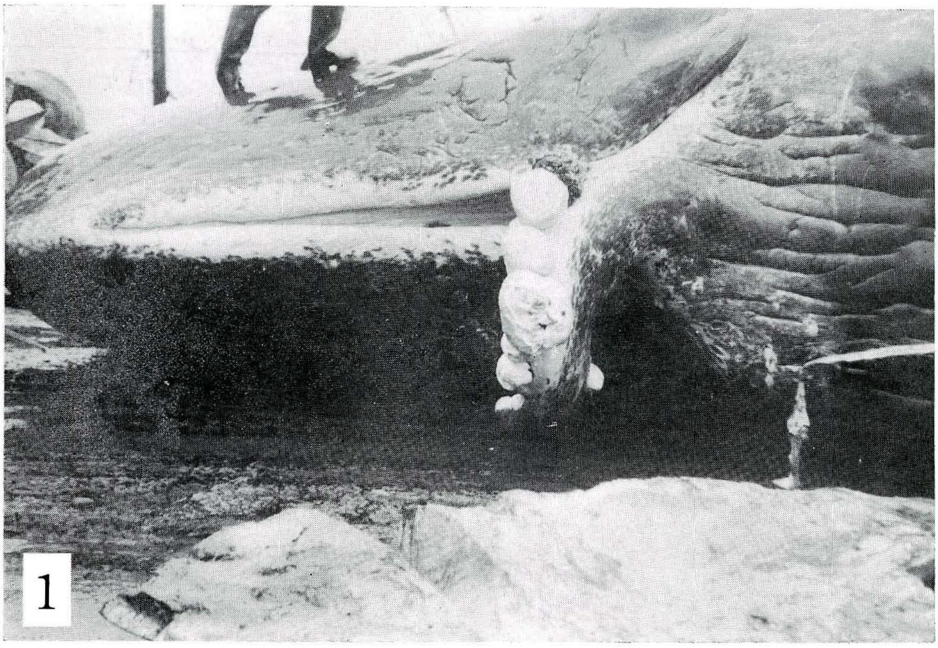
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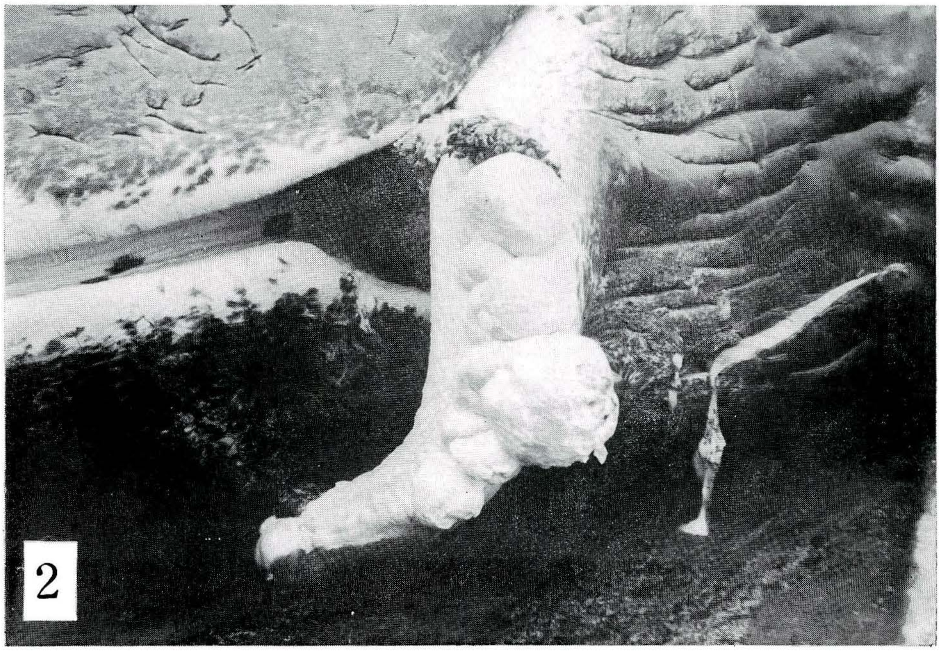
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