

Zoology. — *On the thickness of the layer of blubber in Antarctic Blue and Fin Whales.* II. By E. J. SLIJPER (Institute of Veterinary Anatomy, State University, Utrecht). (Communicated by Prof. G. KREDIET.)

(Communicated at the meeting of September 25, 1948.)

5. *The increase in thickness of the layer of blubber during the Antarctic whaling season.*

To get an impression about the increase in thickness of the blubber during the season, in a great number of diagrams the absolute thickness of the blubber was plotted against the time at which the whales were caught. Separate diagrams were made for the different species and the different points of the body where the measurements were taken, and different symbols were used for the different size-groups and sexes, for pregnant and lactating whales (fig. 6). Some of these diagrams are given

Fig. 6. Explanation of symbols used in fig. 7—12.

<i>Blue Whales</i>		<i>Fin Whales</i>	
		<i>Females</i>	
○	< 77' (23.5 m)	< 65' (19.8 m)	sexually immature
●	77' — 80' (23.5—24.4 m)	< 65' (19.8 m)	sexually mature
●	81' — 85' (24.7—25.9 m)	65' — 70' (19.8—21.3 m)	
●	> 85' (25.9 m)	> 70' (21.3 m)	
◆		pregnant	
★		lactating	
		<i>Males</i>	
▲	< 74' (22.6 m)	< 63' (19.2 m)	sexually immature
▲	74' — 80' (22.6—24.4 m)	< 63' (19.2 m)	sexually mature
▲	81' — 85' (24.7—25.9 m)	63' — 70' (19.2—21.3 m)	
▲	> 85' (25.9 m)	> 70' (21.3 m)	

in fig. 7—9 (first season) and 10—12 (second season). Moreover for the second season the average thickness of the blubber was calculated per month, per species-, sex- and size-group, and so a great number of curves, represented in fig. 13—16 was obtained.

These diagrams and curves show that there is a fairly great individual variability, so that in future a great number of measurements must be made. They show also a large variability due to sex, length and condition of the whales which have already been discussed sub 3. Besides there is

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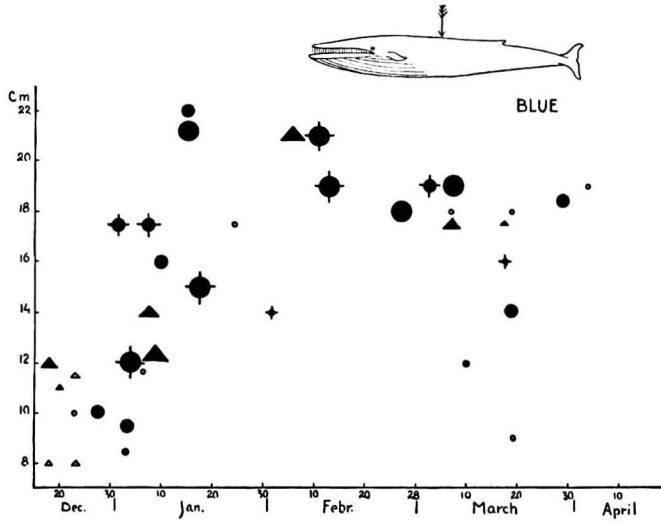


Fig. 7.

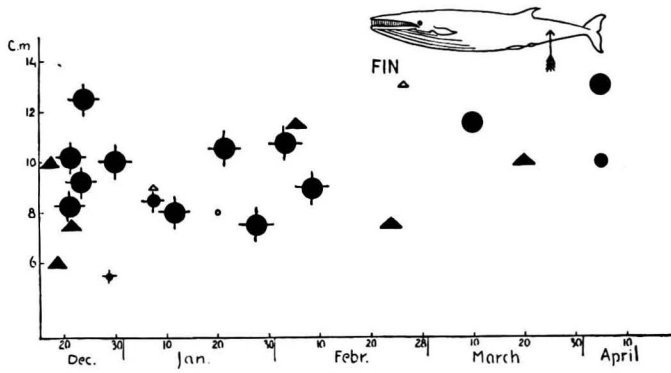


Fig. 8.

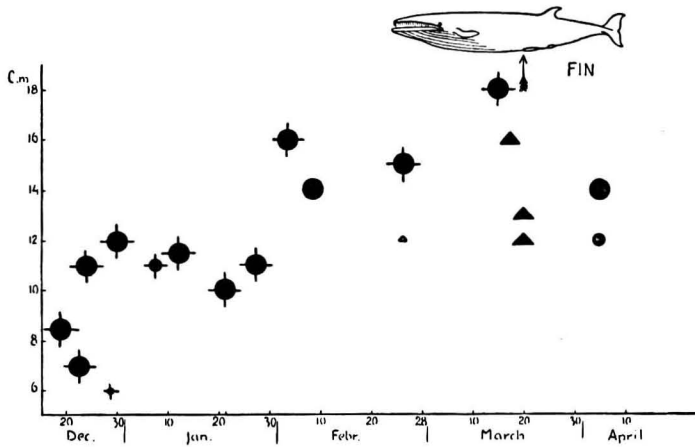


Fig. 9.

Fig. 7—9. Diagrams indicating the increase in absolute thickness of the *layer of blubber* in *Whales* measured at the point indicated by the arrow during the season 1946—1947.
For explanation of symbols see fig. 6.

a very large variability in the course of the curves according to the points of the body where the measurements were taken, although no distinct type of curve appears to refer to any special point of the body. The conclusion, however, may be drawn that the point where the blubber was measured by MACKINTOSH and WHEELER (1929; lateral side midway between the dorsal fin and the anus) is not a very favourable one, since the layer of blubber at this point is comparatively thin and consequently the increase is also comparatively small. The courses of all separate curves and diagrams of a certain season can be summarized in one single resultant, represented in fig. 17 (1946—1947) and 18 (1947—1948). Then it appears that the curves for the measurements taken at the dorso-median line just cranially of the dorsal fin and at the ventro-median line just cranially of the anus, show the greatest resemblance with the resultant-curve. Thus if in future it will not be possible to take measurements at several different points of the body, preference should be given to these two points, the more so as the layer of blubber is fairly thick here.

The curves of MACKINTOSH and WHEELER (1929) have been made according to the relative thickness of the blubber. This, however, may not be considered an objection to compare them with our data, since it is shown in fig. 17 that there is a perfect correlation between the curve for the relative and for the absolute thickness of the blubber. Although the curves of MACKINTOSH and WHEELER (1929) show a marked variability as to sex, size and condition of the animals, it is also possible to construct a resultant, which has been given in fig. 19. Grateful acknowledgement is made to Dr N. A. MACKINTOSH (London) for his letter of July 29th, 1947 in which he communicates the results of a large number of blubber-measurements of Fin Whales also taken at South Georgia. Dr MACKINTOSH writes that "it now seems that the average blubber-thickness at South Georgia generally tends to fall off a little from about October to December and increases from about January to April" (see fig. 19). From all those curves and diagrams the conclusion may be drawn that the increase in thickness of the layer of blubber takes place in about the same way in Blue and Fin Whales, as well as in whales of different sex and size.

It is very striking that the two curves of the blubber-thickness of the whales caught by "Willem Barendsz" (fig. 18, 20) show a perfect correlation with the curve for the increase in the output of oil per B.W.U. during the season. For S. Georgia there are no data available about the increase of the output during the season. Now it is a matter of fact that the output of oil in whales quite certainly is not determined by the thickness of the blubber alone. Apart from more or less thorough methods in processing the carcasses on board of the factory-ships (p. 1124), the yield of oil depends on the absolute size of the whales (in calculating B.W.U. the size is not taken into account), the thickness of the blubber, the percentage of fat in the blubber (this, however, increases probably proportionally with

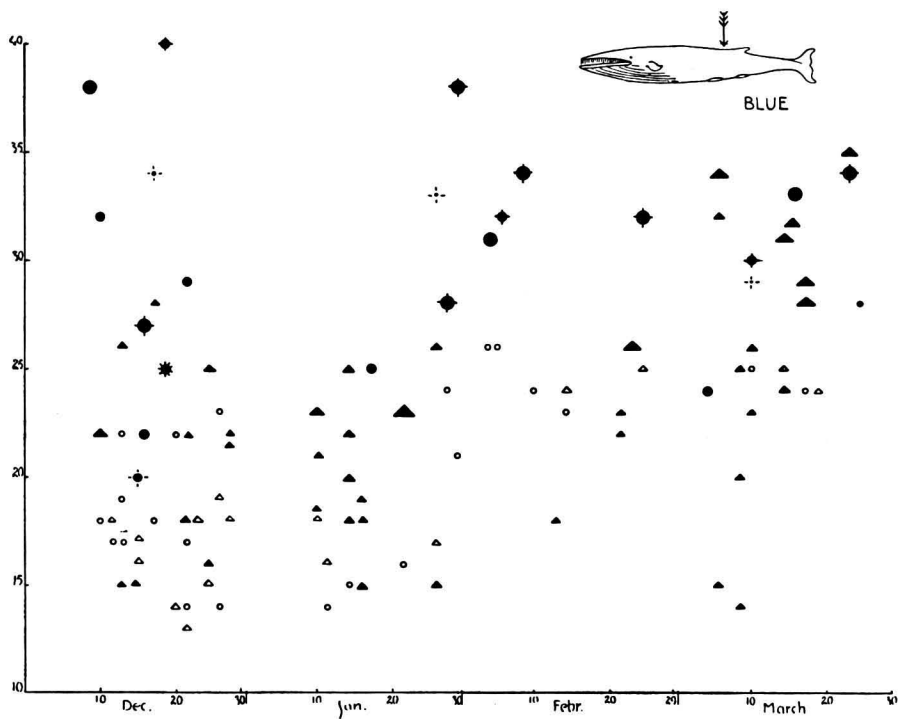


Fig. 10. Diagram indicating the increase in absolute thickness of the *layer of blubber* in *Blue Whales* measured at the dorso-median line just cranial of the dorsal fin during the season 1947-1948. For explanation of symbols see fig. 6.

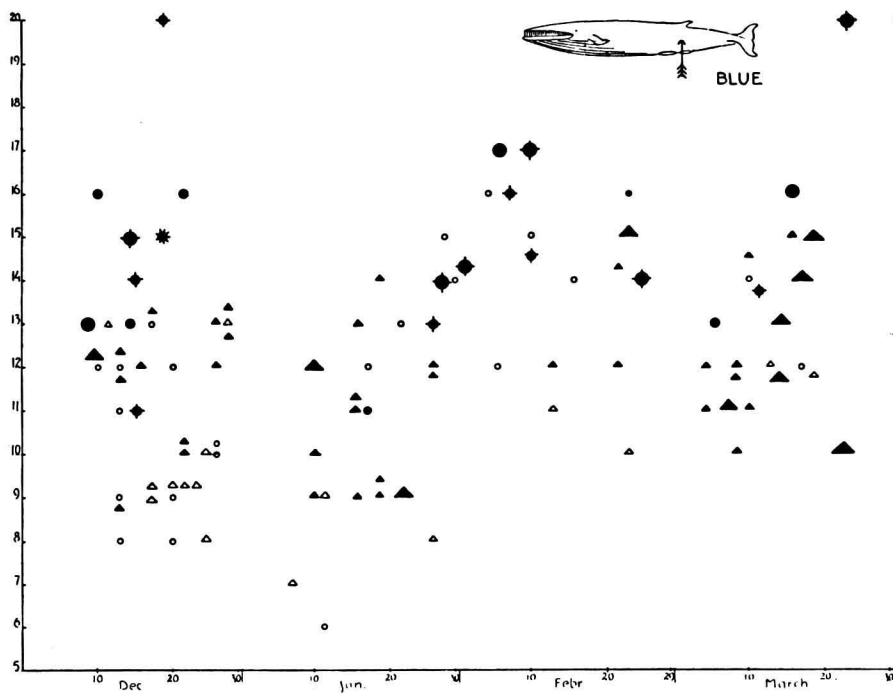


Fig. 11. Diagram indicating the increase in absolute thickness of the *layer of blubber* in *Blue Whales* measured at the lateral side midway between the dorsal fin and the anus during the season 1947-1948. For explanation of symbols see fig. 6.

increasing blubber-thickness; see page 1037), as well as on the percentage of fat in the meat, the bones and the internal organs of the whales.

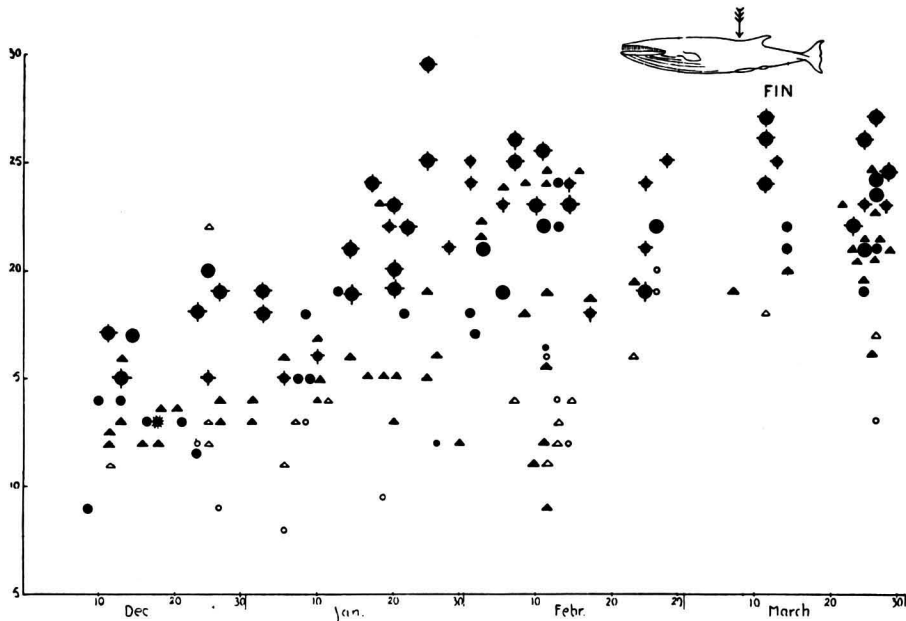


Fig. 12. Diagram indicating the increase in absolute thickness of the layer of blubber in *Fin Whales* measured at the dorso-median line just cranial of the dorsal fin during the season 1947—1948. For explanation of symbols see fig. 6.

Unfortunately no reliable data are known about this subject and also the researches made on board "Willem Barendsz" by FELTMANN, SLIJPER and VERVOORT (1948) did not permit to draw any conclusions about the increase of the fat-percentage of meat and bone during the season. HEYERDAHL (1932; p. 94) supposed that the deposit of fat would take place at first in the internal organs, then in the meat and the internal layer of the blubber and finally in the outer layer of the blubber. For the present I cannot agree with this opinion since, according to a superficial impression I got during the first season of "Willem Barendsz", the fat of the internal organs did not increase to a marked degree before the last part of the season.

It would be very tempting to consider the correlation between the curves for the blubber-thickness and for the output of oil as an argument that the internal fat (meat, bone etc.) increases proportionally with the fat in the blubber and that consequently the thickness of the blubber might be considered a reliable indication for the oil-production of a certain animal. It is, however, highly probable that other factors also play an important part in modelling the shape of the output-curve. For example it might be supposed that an increase in thickness of the blubber or an increase in fat-percentage of the organs would cause a rise of the curve but that at the same time a

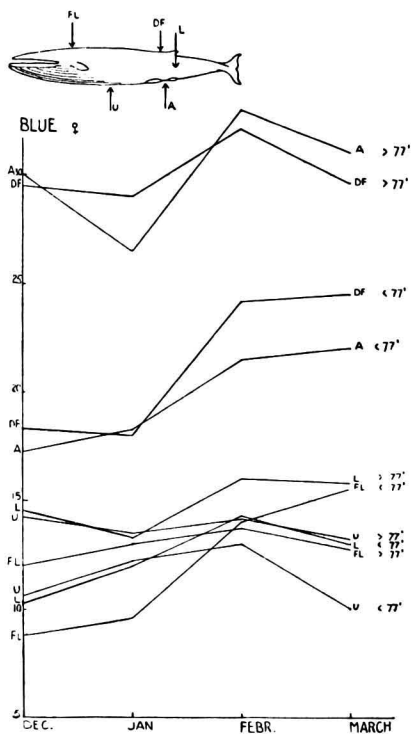


Fig. 13.

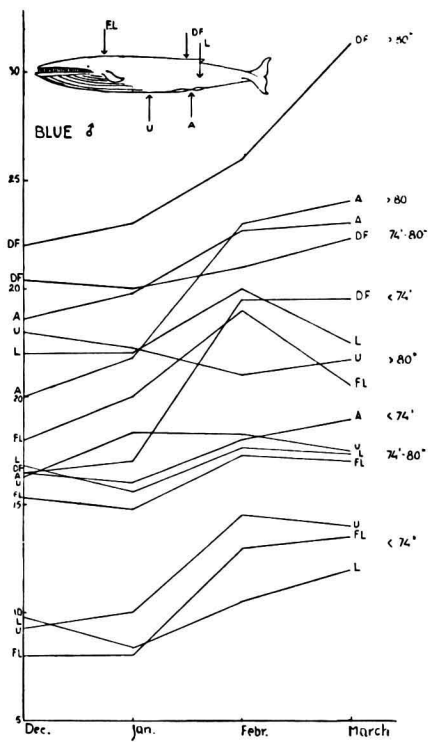


Fig. 14.

Fig. 13—14. Curves indicating the average absolute thickness of the *layer of blubber* in *Blue Whales* during the season 1947—1948, calculated per month for the different groups of size and the different points of the animals.

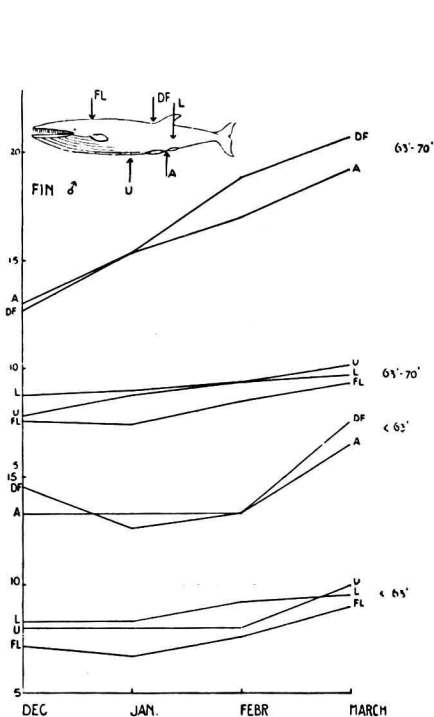


Fig. 15.

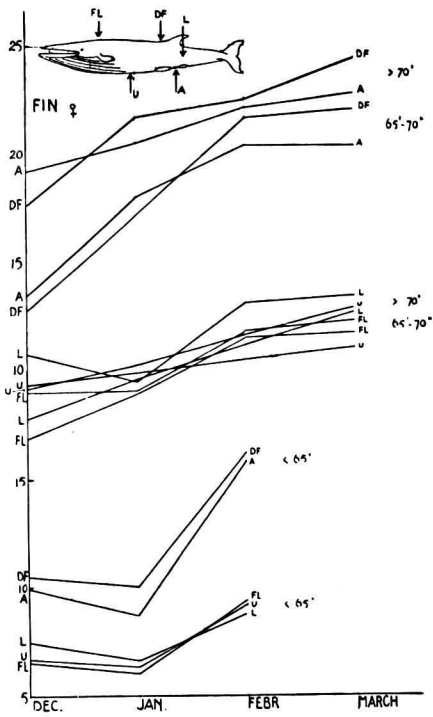


Fig. 16.

Fig. 15—16. Curves indicating the average absolute thickness of the *layer of blubber* in *Fin Whales* during the season 1947—1948 calculated per month for the different groups of size and the different points of the animals.

decrease of the average size of the animals or a decrease of the number of pregnant females would cause a decline. It will be shown that the data collected on the two expeditions of "Willem Barendsz" are able to give

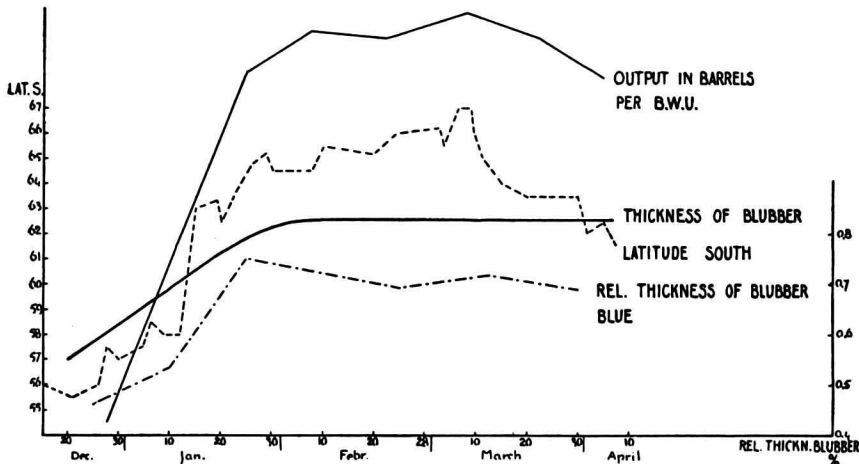


Fig. 17. Curves indicating the increase in absolute and relative thickness of the layer of blubber, the output in barrels per B. W. U. (see fig. 5) and the latitude South at which whaling took place. All curves bear on f.f. "Willem Barendsz" during the season 1946—1947.

a better insight in this question. This requires, however, at first a discussion about the circumstances under which the expeditions were operating during the two seasons.

It appears from fig. 18 and 20 that the shape of the output-curves for

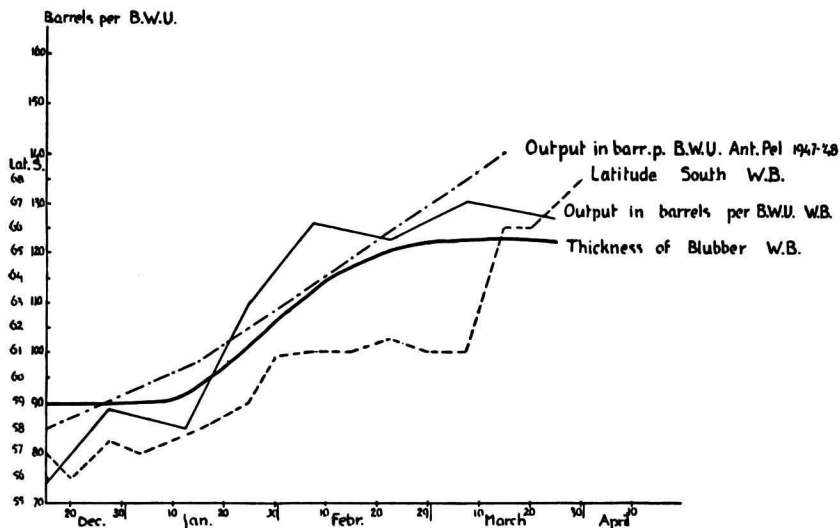


Fig. 18. Curves indicating the increase in absolute thickness of the layer of blubber, the output in barrels per B. W. U. (see fig. 5) and the latitude South at which whaling took place. The curves bear on f.f. "Willem Barendsz" during the season 1947—1948 and on the average figures for Antarctic pelagic whaling during the same season published by PAULSEN (1948).

both seasons differs markedly from the shape of the curves that are normally obtained in Antarctic pelagic whaling. The shape of the curve for the Norwegian expeditions shows that for the season 1946—1947 this difference probably does not depend on general seasonal influences, but that it must have been caused by the very abnormal conditions under which whaling took place on "Willem Barendsz" during its first season. In the first period of this season (17-12-'46—13-1-'47) the expedition operated between 7° and 2° E. and 56°—58° S., during the second period (14-1-'47—7-4-'47) between 7° and 26° W. and 63°—67° S. This means that during the first period whaling was carried on in an area far north of the boundary of the pack-ice, whereas most factory-ships start the season at the boundary of the pack-ice or even in the outer zone of the ice.

TABLE 6.

Some data about the composition of the catch of "Willem Barendsz" compared with average figures for Antarctic pelagic whaling and for South Georgia.

	"Willem Barendsz"			Antarctic pelagic 1934—1939 whole season ¹⁾	South Georgia 1934—1939 whole season ¹⁾
	Season 1946—1947		Season 1947—1948 whole season		
	First period 17-12—13-1	Whole season			
Average length of animals in Eng. feet					
Blue	77.8	78.3	75.8	78.1	73.4
Fin	67.5	68.6	67.8	67.6	64.8
Immature animals in % of total number of animals of the group					
Blue ♂ (<74')	35.0	22.3	40.0	26.2	
♀ (<77')	37.4	26.9	57.6	35.2	
Fin ♂ (<63')	10.1	9.6	10.2	16.4	
♀ (<65')	13.3	9.2	15.2	19.1	
Pregnant females in % of total number of adult females					
Blue	25.2	45.4	63.8	66.2	
Fin	57.2	40.0	53.0	79.6	

¹⁾ From International Whaling Statistics XVI and MACKINTOSH (1942; p. 277).

Now the data collected in table 6 and fig. 21—24 show that during the first period there was a higher percentage of Fin Whales in the catch than may be considered as normal for Antarctic pelagic whaling. The percentage more resembled that of S. Georgia, an island which is situated at about 54° 30' S. The length of the Blue Whales was under the average of the other part of the season and also under the average for factory-ships. The average length of the Fin Whales was normal. The percentage of immature Blue Whales was higher than normal, that of the Fin Whales

showed no marked differences with the average in other seasons. During the whole season 1946—1947 the percentage of pregnant females was lower than normal. The curve for the Fin Whales, however, has a normal

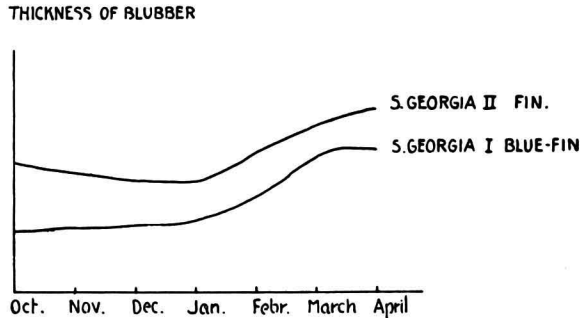


Fig. 19. Curves indicating the increase in relative thickness of the layer of blubber during the Antarctic whaling season at *South Georgia*. I = average curve for Blue and Fin Whales during the seasons 1925—1926 and 1926—1927 according to MACKINTOSH and WHEELER (1929); II = average curve for a larger number of Fin Whales according to a letter received from Dr MACKINTOSH.

shape, whereas that for the Blue Whales shows abnormally low percentages in the first period. Summarizing it may be said that during the first period the composition of the catch showed much more resemblance with the figures from *S. Georgia* (see also MACKINTOSH and WHEELER, 1929; table p. 456) than with those of Antarctic pelagic whaling. The

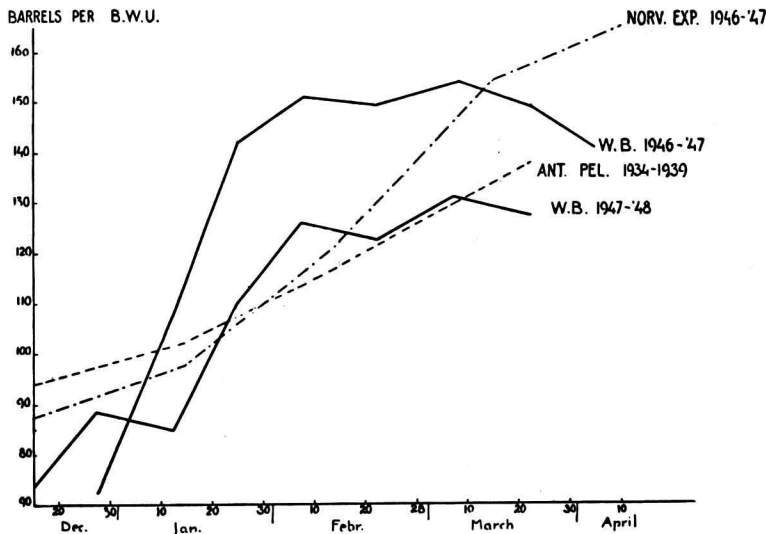


Fig. 20. Curves indicating the increase in output of oil per Blue Whale Unit during the Antarctic whaling season. The curves bear on the two seasons of f.f. "*Willem Barendsz*", on the average of *Antarctic pelagic whaling* from 1934—1939 (according to BERGERSEN LIE and RUUD, 1939) and on the results of the *Norwegian expeditions* during the season 1946—'47 (according to PAULSEN, 1947).

sudden rise of the output-curve in January shows a distinct correlation with the curve for latitude South (fig. 17) and the possibility may not be

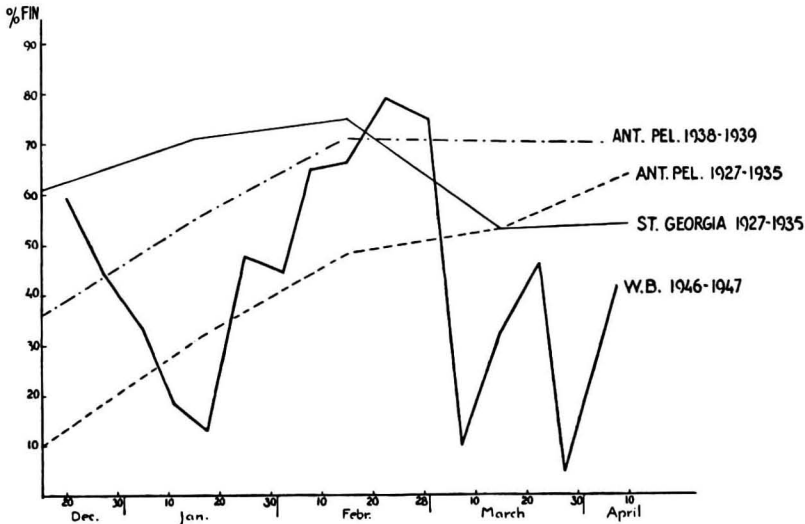


Fig. 21. Curves indicating the variations in the *percentage of Fin Whales* in the catch of "Willem Barendsz" during the season 1946—1947. The other curves bear on average figures for *Antarctic pelagic whaling* and whaling at *S. Georgia* in different seasons (according to MACKINTOSH, 1942).

excluded that the curve for the thickness of blubber would also have shown a more sudden rise if more data had been available.

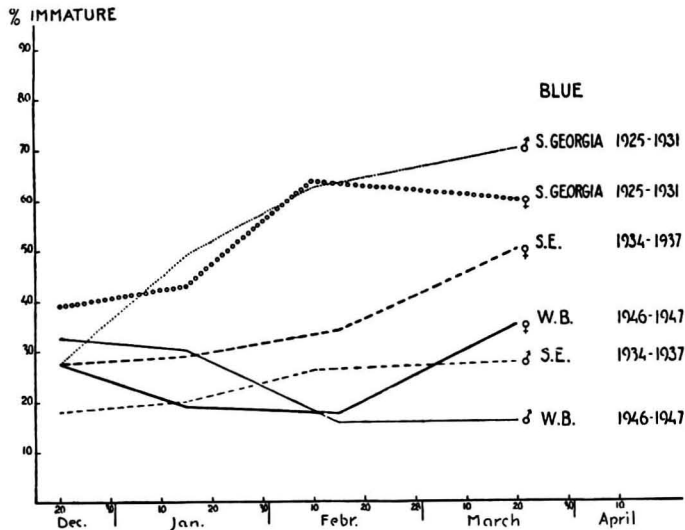


Fig. 22. Curves indicating the variations in the *percentage of immature Blue Whales* ($\delta < 74'$; $\eta < 77'$) in the catch of f.f. "Willem Barendsz" during the season 1946—1947. The curves indicate average data calculated per month. They represent percentages of the total number of male or female Blue Whales that have been caught. The other curves bear on average data from *South Georgia* (season 1925—'31) and on data from f.f. "Southern Empress" collected in area IV during the seasons 1934—'37 (MACKINTOSH, 1942).

In the season 1947—1948 the expedition operated from 8-12-'47 until 30-3-'48 in area II and III (from 17° E.—36° W.). Up to 10-3-'48 whaling was carried on between 55° and 61° S. and during the last part of the season between 66° and 68° S. In the Western parts of the Antarctic 1947—1948 seems not to have been a quite normal season, since the continuous north wind prevented the drifting of the pack-ice, at least at different localities. Up to the beginning of March "Willem Barendsz" could not get into the pack-ice. Now it is a well-known fact that Blue Whales and especially the adult animals live mostly in the outer zone of

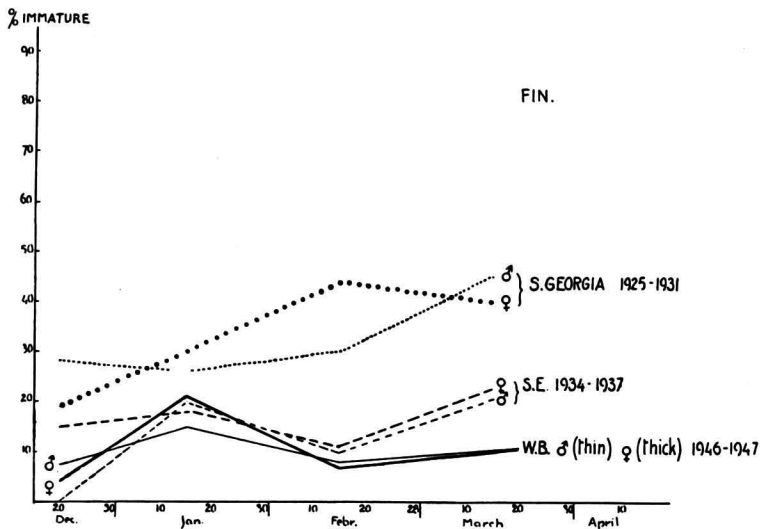


Fig. 23. Curves indicating the variations in the percentage of immature Fin Whales ($\delta < 63'$; $\eta < 65'$) in the catch of f.f. "Willem Barendsz" during the season 1946—1947. See fig. 22.

the pack-ice, whereas the majority of the Fin Whales are found in a zone just North of the boundary of the ice. This fact explains the very high percentage of Fin Whales in the catch (fig. 25). Probably weather-conditions have also influenced the composition of the catch of other expeditions. For according to the survey of PAULSEN (1948) a very high percentage of Fin Whales has been found in the catch of factory-ships operating in area II, III and IV (77 %, see also fig. 5). The three expeditions that operated in area V, however, showed a Fin Whale percentage of 50 %. As far as is known at present they could already get into the ice at the beginning of the season, but this seems to have been also possible in area IV. The average output per B.W.U. of all factory-ships, as well as the quite normal shape of the output-curve given in fig. 18, show that weather-conditions have not influenced the results of Antarctic whaling on the whole in the same way as the results of "Willem Barendsz". Apparently the Fin Whales were comparatively fat, a supposition that is supported by the very high output at South Georgia.

(To be continued.)