Report of Ageing Workshop on Cod held at Vigo, Spain, October 1975[1]

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Abstract

From age readings of cod otoliths by ageing experts at the Workshop, significant variation in age determination was found among the individual readers. Such differences could seriously affect the results of population analyses. The detailed examination of selected otolith photographs was carried out in order to determine some of the reasons for the discrepancies. It was concluded that further work on age determination should be undertaken in an effort to reduce subjective errors in ageing and to develop a set of guidelines for otolith interpretation in cod.

Introduction

Differences in the age compositions of some fish stocks, as derived from sampling data reported by the various Member Countries of ICNAF, were apparent at the April 1975 Meeting of the Assessments Subcommittee (ICNAF, 1975). Because accurate age determinations are essential for the analytical assessment of fish stocks, an ageing workshop was proposed to ascertain if the discrepancies are due to variation in the interpretation of otoliths among the age-readers of the various countries and, if so, whether the differences are significant. The Workshop was subsequently established by the Standing Committee on Research and Statistics (STACRES) to examine ageing material for both cod and silver hake from various Northwest Atlantic stocks (ICNAF, 1975), with E.C. Lopez-Veiga (Spain) and R. Wells (Canada) as Coordinators.

Problems associated with the age determination of fish are not new to ICNAF. An exchange of cod otoliths started in 1958 (ICNAF, 1958) showed good agreement but pointed out some of the difficulties in interpretation. In 1962 a workshop on ageing techniques was held at Bergen, Norway (ICNAF, 1963), and in the period 1963-67 a series of samples of cod otoliths and photographs were circulated among ICNAF scientists (Kohler, 1964; Blacker, 1968, 1974). Many publications dealing with the biological basis of age determination, ageing techniques, mechanical aids, validation studies and the sources and effects of errors are present in the literature.

This paper describes the proceedings of the Workshop which took place at the Institute of Fisheries Investigations, Vigo, Spain, during 20-25 October 1975, with the

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participation of experts from Canada, Federal Republic of Germany, Poland, Portugal, Spain and USA (Appendix I). Because of illness, the USSR expert could not attend before 3 November, at which time he had the opportunity to study part of the material on cod which had been examined earlier during the Workshop. In view of the absence of the USSR expert during the scheduled period of the Workshop, the work was devoted entirely to the examination of ageing material for cod, with the problem of attempting to resolve the discrepancies in silver hake ageing having to be necessarily deferred to a later workshop.

Materials and Methods

Ageing material for the studies on cod were provided by Canada and Spain as follows:

ICNAF Div.	Sample 1 (Spain)	Sample 2 (Canada)
2J	-	49
3K	55	46
3L	106	49
3NO	-	49
3O	52	49
3Ps	52	49
4Vn	51	-
5Z	52	-

Each age reader was provided with a binocular microscope and the otoliths were read in a darkened room using reflected light. The otoliths, broken across the sulcus, were mounted in blocks of modelling clay and arranged in trays, each containing 25 specimens, so that no delay was encountered in obtaining the otoliths for study.

During the first day of the Workshop, various parts of Sample 1 were aged by those who had arrived by that date. On the following day, after discussion by all participants, it was decided to proceed with Sample 2, since both photographs and projector slides of these otoliths were available. After all of the otoliths were read, sufficient time was available to study about 60 slides in detail, and the various interpretations of age were noted and discussed. The actual age determinations for Samples 1 and 2 by the individual readers are listed in Appendix II (Tables A and B).

Cod Otolith Sample 1

Agreement between Pairs of Readers

Table 1 shows the percentage agreement between pairs of readers for the various areas separately and combined. Agreement ranged from 0% by readers 3 and 9 for Subdiv. 3Ps to 77% by readers 8 and 9 in the same area. Agreement between pairs of readers for all areas combined ranged from 8% (readers 1-3) to 63% (readers 8-9), the 76% agreement by readers 5 and 8 being for one area only. Out of 84 possible comparisons of reader pairs, 60% or more agreement was achieved by eleven pairs of readers. The average agreement by all pairs of readers for all areas was only 39%.

The frequency distribution of reader pairs in relation to the percentage agreement achieved for each area is given in Table 2. Agreement was slightly better than 50% on the average for the Div. 3K and 5Z otoliths, although in the latter area only three pairs of readers out of 10 achieved agreement at 50% or better. Agreement was relatively poor for Div. 3L and 3O, with only one pair of readers achieving agreement at 50% or better for each area. For Subdiv. 3Ps, the frequency distribution is bimodal with 10 pairs of readers recording less than 30% agreement on the one hand and one-half of the total numbers of pairs achieving 50% or better on the other. The percentage agreements were less variable for Subdiv. 4Vn, but only 3 of 10 pairs of readers achieved agreement at 50% or more. For all areas combined, the frequency distribution tends to be symetrical about the mean (at 39%) with about one-third of the reader pairs achieving less than 30% agreement and about the same number achieving agreement at 50% or better.

An indication of reader bias with respect to pairs of readers and to the group as a whole for all areas combined is shown in Table 3. The bias between readers, defined as the percentage of otoliths over-aged minus the percentage under-aged, ranged from -84 (readers 1 and 3) to +83 (readers 3 and 10). Reader 2 had little bias on the

Table 1. Percentage agreement between pairs of readers by area for Sample 1.

Readers compared	Percentage agreement							Readers compared	Percentage agreement						
	3K	3L	30	3Ps	4Vn	5Z	Total		3K	3L	30	3Ps	4Vn	5Z	Total
1 - 2	-	-	-	56	28	68[a]	55	3 - 9	-	48	6	0	-	-	15
1 - 3	-	9	-	8	-	-	8	3 - 10	-	20	-	15	-	-	18
1 - 4	-	35	-	52	58	37	44	4 - 5	-	-	-	-	-	45	45
1 - 5	-	-	-	-	-	51	51	4 - 7	-	27	-	15[a]	39	-	30
1 - 7	-	-	-	13	35	-	22	4 - 8	-	30	-	77[a]	43	48	44
1 - 8	42	9	-	66[a]	35	45	42	4 - 9	-	37	-	69[a]	-	-	45
1 - 9	51	26	-	66[a]	-	-	50	4 - 10	-	23	-	65[a]	-	-	35
1 - 10	-	9	-	48	-	-	32	5 - 8	-	-	-	-	-	76[a]	76[a]
2 - 3	-	-	4	50	-	-	29	6 - 8	-	-	21	-	-	-	21
2 - 4	-	47	-	38	48	45	45	6 - 9	-	-	33	-	-	-	33
2 - 5	-	-	-	-	-	47	47	7 - 8	-	33	-	18	51	-	34
2 - 7	-	41	-	31	35	-	36	7 - 9	-	36	-	22	-	-	29
2 - 8	-	49	17	57	55	45	48	7 - 10	-	41	-	29	-	-	35
2 - 9	-	48	38	57	-	-	50	8 - 9	67[a]	57	57	77[a]	-	-	63[a]
2 - 10	-	46	-	61[a]	-	-	54	8 - 10	-	49	-	63[a]	-	-	54
3 - 4	-	12	-	15	-	-	14	9 - 10	-	38	-	58	-	-	45
3 - 6	-	-	25	-	-	-	25								
3 - 7	-	-	-	46	-	-	46	No. of pairs	3	24	9	28	10	10	84
3 - 8	-	42	10	12	-	-	18	Average (%)	53	34	23	42	43	51	39

[a] Agreement 60% or more.

Table 2. Frequency distribution of pairs of readers by percentage (agreement) groups for Sample 1.

Percentage groups	No. of pairs of readers						
	3K	3L	30	3Ps	4Vn	5Z	Total
0-9	-	3	2	2	-	-	7
10-19	-	1	2	6	-	-	9
20-29	-	4	2	2	1	-	9
30-39	-	6	2	2	4	1	15
40-49	1	9	-	2	2	6	20
50-59	1	1	1	6	3	1	13
60-69	1	-	-	6	-	1	8
70-79	-	-	-	2	-	1	3
Total	3	24	9	28	10	10	84
Average agreement	53	34	23	42	43	51	39

average with respect to the groups as a whole. Readers 1, 4, 5, 8 and 9 tended to under-read with respect to the group, whereas readers 3, 6, 7 and 10 tended to over-read. Reader 5 (55%), followed by readers 2, 8 and 9 achieved the best average agreement with respect to the group, while the poorest results were achieved by readers 3 and 6.

Agreement with Modal Ages

For each specimen, except those for which no clear mode was evident (about 20% of the total), the modal age was determined from the ages estimated by the various readers. The resultant anomalies (estimated age minus modal age) were determined for each reader and area together with the mean deviations and the standard errors (Table 4). With respect to the modal ages, the mean deviation provides an indication of bias and the standard error gives a measure of consistency. For all areas combined, the mean deviation was minimal for readers 2 and 8, followed by readers 1 and 9 who tended to over-read the modal ages. The greatest positive bias was reflected in the ageing of reader 3 who on the average determined the ages at about 1 year older than those pertaining to the modes. Readers 6, 7 and 10 tended to over-read the modal ages but to a lesser extent than reader 3. Consistency in ageing at or close to the modal ages was best for readers 2, 8 and 9 (lowest standard error values) and was poorest for readers 3 and 6 (highest standard error values).

Table 3. Bias between pairs of readers in ageing Sample 1.

Reader	Bias between pairs of readers[a]										Average bias	Average agreement
	1	2	3	4	5	6	7	8	9	10		
1	●	-26	-84	17	49	-	-71	-24	-22	-68	-29	38
2	26	●	-67	29	45	-	-17	2	12	-23	1	46
3	84	67	●	78	-	50	-30	65	83	42	55	22
4	-17	-29	-78	●	-23	-	-42	-30	-21	-51	-36	38
5	-49	-45	-	23	●	-	-	-16	-	-	-22	55
6	-	-	-50	-	-	●	-	54	59	-	21	26
7	71	17	30	42	-	-	●	37	67	33	42	33
8	34	-2	-65	30	16	-54	-37	●	21	-23	-9	44
9	22	-12	-83	21	-	-59	-67	-21	●	-44	-30	41
10	68	23	-42	51	-	-	-33	23	44	●	19	39

[a] Percentage over-aged minus percentage under-aged.

Percentage agreement with the modal ages was highest for readers 5, 8 and 9 (>80%), with the last two having consistently achieved better than 75% agreement for each of the areas concerned (Table 4). Readers 1, 2, 4 and 10 achieved 62-70% agreement for the combined areas, but there was considerable variation among areas in some cases. Agreement by reader 3 was extremely variable, ranging from 12 to 86% for three areas with a weighted average of 26% for the areas combined. For all readers and areas combined, average agreement with the modal ages was about 65%.

Considering the results for the various areas separately (Table 4), agreement with the modal ages was generally good (63-94%) for the three readers who studied the material for Div. 3K, the overall average being 80%. Agreement was also reasonably consistent among the five readers for Div. 5Z (59-90%) and for Subdiv. 4Vn (52-78%), the averages being 73% and 67% respectively. For the remaining areas, the results were somewhat more variable. For Div. 3L, the percentage agreements by the eight readers (27-90%) averaged 65%; agreements by seven readers were generally good (50-90%), but reader 1 (27%) under-read the modal ages by nearly 1 year on the average. For Div. 3O, agreements by the five readers (14-84%) averaged 56%; agreements by three readers were generally good (58-84%), but reader 3 (14%) over-read the modal ages by 1.7 years on the average and reader 2 (47%) under-read by 0.5 years. For Subdiv. 3Ps, agreements by the eight readers (12-87%) averaged 63%; agreements by six readers were very good (71-87%), but reader 3 (12%) over-read the modal ages by nearly 1 year and reader 7 (23%) over-read by slightly more than 1 year on the average.

Cod Otolith Sample 2

Agreement between Pairs of Readers

Table 5 shows the percentage agreement between pairs of readers for the various areas separately and combined. Agreement ranged from 0% (readers 8-16 and 14-16) for Div. 3K to 96% (readers 9-14) for Subdiv. 3Ps. Agreement between pairs of readers for all areas combined ranged from 19% (readers 16-17) to 69% (readers 8-9). Out of 629 possible comparisons of reader pairs, 60% or better agreement was achieved by 108 pairs (17%) of readers. The average agreement by all pairs of readers for all areas was 42%, only slightly higher than for Sample 1.

The frequency distribution of reader pairs in relation to the percentage agreement achieved for each area is given in Table 6. For all pairs of readers, agreement ranged from 27% for Div. 3K to 66% for Subdiv. 3Ps, the average for all areas being 42%. The results were relatively poor for Div. 2J and 3K with only 7 and 2 pairs of readers respectively achieving agreement at 50% or more. Agreement was slightly better for Div. 3L, 3NO and 3O but the variation was great, with values ranging from 7 to 72% for Div. 3L, 12 to 75% for Div. 3NO and 11 to 81% for Div. 3O, and with considerably less than one-half of the pairs of readers achieving agreement at 50% or better. For Subdiv. 3Ps, the frequency distribution is bimodal (as for Sample 1) with about one-quarter of the reader pairs recording less than 50% agreement. For the remaining pairs of readers, agreement was reasonably good with the majority achieving 70% or higher.

Table 4. Anomalies from modal ages of otoliths in Sample 1 by reader and area, together with the mean deviations, standard errors and percentage agreements.

Reader	ICNAF Div.	Deviations from modal ages -3	-2	-1	0	1	2	3	>3	Total read	Mean deviation	Standard error	Percentage agreement
1	3K	-	2	9	29	5	1	-	-	46	-0.13	0.110	63
	3L	1	1	8	4	1	-	-	-	15	-0.80	0.240	27
	3Ps	-	-	8	22	1	-	-	-	31	-0.23	0.089	71
	4Vn	-	1	10	12	-	-	-	-	23	-0.52	0.120	52
	5Z	-	-	-	28	8	2	-	-	38	0.32	0.093	74
	Total	1	4	35	95	15	3	-	-	153	-0.16	0.058	62
2	3L	-	-	13	47	4	1	-	-	65	-0.11	0.070	72
	30	-	2	5	7	1	-	-	-	15	-0.53	0.220	47
	3Ps	-	-	1	32	10	-	-	-	43	0.21	0.071	74
	4Vn	-	-	-	27	10	2	-	-	39	0.36	0.094	69
	5Z	-	-	2	25	11	-	-	-	38	0.24	0.088	66
	Total	-	2	21	138	36	3	-	-	200	0.09	0.044	69
3	3L	-	-	-	12	2	-	-	-	14	0.14	0.097	86
	30	-	-	-	5	13	12	3	4	37	1.68	0.190	14
	3Ps	-	-	1	3	19	2	-	-	25	0.88	0.120	12
	Total	-	-	1	20	34	14	3	4	76	1.13	0.122	26
4	3L	1	7	20	33	1	-	-	-	62	-0.58	0.099	53
	3Ps	-	-	-	20	5	-	-	-	25	0.20	0.082	80
	4Vn	-	1	7	28	3	1	-	-	40	-0.10	0.110	70
	5Z	-	2	11	24	4	-	-	-	41	-0.27	0.110	59
	Total	1	10	38	105	13	1	-	-	168	-0.27	0.057	63
5	5Z	-	3	1	37	-	-	-	-	41	-0.17	0.085	90
6	30	-	-	1	11	5	2	-	-	19	0.42	0.180	58
7	3L	-	-	3	19	11	4	1	-	38	0.50	0.118	50
	3Ps	-	-	-	10	21	9	2	1	43	1.14	0.140	23
	4Vn	-	-	8	27	3	2	-	-	40	-0.02	0.110	68
	Total	-	-	11	56	35	15	3	1	121	0.56	0.088	46
8	3K	-	-	-	40	8	-	-	-	48	0.17	0.054	83
	3L	-	-	5	64	10	4	-	-	83	0.16	D.065	77
	30	-	-	3	30	5	-	-	-	38	0.05	0.075	79
	3Ps	-	2	3	39	1	-	-	-	45	-0.15	0.075	87
	4Vn	-	-	2	31	6	1	-	-	40	0.15	0.084	78
	5Z	-	-	4	31	5	-	-	-	40	0.02	0.076	78
	Total	-	2	17	235	35	5	-	-	294	0.08	0.030	80
9	3K	-	-	2	45	1	-	-	-	48	-0.02	0.036	94
	3L	-	-	15	66	2	-	-	-	83	-0.18	0.053	90
	30	1	1	3	32	1	-	-	-	38	-0.18	0.110	84
	3Ps	-	-	5	39	1	-	-	-	45	-0.09	0.053	87
	Total	1	1	25	182	5	-	-	-	214	-0.12	0.030	85
10	3L	-	-	3	51	17	2	2	-	75	0.32	0.083	68
	3Ps	-	-	1	33	8	3	-	-	45	0.29	0.093	73
	Total	-	-	4	84	25	5	2	-	120	0.31	0.062	70

Table 5. Percentage agreement between pairs of readers by area for Sample 2.

Readers compared	Percentage agreement							Readers compared	Percentage agreement						
	2J	3K	3L	3NO	30	3Ps	Total		2J	3K	3L	3NO	30	3Ps	Total
1 - 2	29	30	41	33	57	42	36	5 - 12	19	43	44	50[a]	48	83[a]	52
1 - 3	40	26	47	48	58	70[a]	49	5 - 13	-	38	47	63[a]	56	78[a]	57
1 - 4	38	20	36	38	45	73[a]	42	5 - 14	31	35	42	72[a]	60[a]	88[a]	55
1 - 5	33	35	47	50	48	79[a]	51	5 - 15	25	29	42	50	49	79[a]	49
1 - 7	40	42	26	38	45	70[a]	43	5 - 16	17	12	23	27	49	76[a]	38
1 - 8	29	19	44	55[a]	36	76[a]	43	5 - 17	40	19	12	12	13	43	23
1 - 9	25	28	47	75[a]	38	78[a]	48	7 - 8	33	23	32	44	31	69[a]	39
1 - 11	25	31	47	51	42	79[a]	46	7 - 9	28	27	39	40	33	67[a]	39
1 - 12	50	21	47	55[a]	55[a]	78[a]	51	7 - 11	18	37	41	49	48	71[a]	44
1 - 13	31	24	43	72[a]	81[a]	71[a]	54	7 - 12	41	16	39	48	47	73[a]	44
1 - 14	29	30	45	55	72[a]	77[a]	50	7 - 13	24	33	53	52	44	60[a]	45
1 - 15	35	28	51	53	42	77[a]	48	7 - 14	33	36	45	38	53	67[a]	45
1 - 16	22	23	18	28	46	58	34	7 - 15	23	24	51	60	40	67[a]	45
1 - 17	23	10	30	37	23[a]	33	26	7 - 16	13	5	8	12	25	55	20
2 - 3	40	27	45	33	60[a]	38	40	7 - 17	31	26	12	22[a]	22	53	29[a]
2 - 4	31	12	30	26	46	36	31	8 - 9	76[a]	70[a]	50	70[a]	60[a]	92[a]	69[a]
2 - 5	19	20	35	31	43	44	34	8 - 11	16	32	46	52	44	90[a]	47
2 - 7	35	23	21	16	29	29	25	8 - 12	37	37	47	57	43	80[a]	50
2 - 8	39	16	47	33	41	44	37	8 - 13	48	43	44	70[a]	38	69[a]	53
2 - 9	35	20	45	24	41	44	35	8 - 14	59	33	45	63[a]	44	86[a]	56
2 - 11	31	16	37	18	37	44	31	8 - 15	43	26	46	49	50	80[a]	49
2 - 12	55	29	41	38	56	42	44	8 - 16	30	0	21	31	27	63[a]	29
2 - 13	33	28	42	28	53	43	38	8 - 17	14	23	26	21	19	37	24
2 - 14	41	22	35	36	45	46	37	9 - 11	20	43	44	53	40	88[a]	48
2 - 15	33	13	35	20	45	45	32	9 - 12	29	43	52	57	43	73[a]	50
2 - 16	36	22	20	19	36	39	29	9 - 13	45	38	55	63[a]	38	74[a]	53[a]
2 - 17	27	19	30	43	24	36	30	9 - 14	55	37	67[a]	57	44	96[a]	60[a]
3 - 4	39	34	27	28	55	76[a]	44	9 - 15	38	30	49	54	45	80[a]	50
3 - 5	38	43	40	50	56	74[a]	52	9 - 16	26	5	15	29	33	71[a]	31
3 - 7	44	24	33	35	44	64[a]	41	9 - 17	17	26	12	29	11	45	24
3 - 8	40	27	41	61	46	78[a]	49	11 - 12	31	35	56[a]	48	50	78[a]	50
3 - 9	42	40	52	54	46	73[a]	51	11 - 13	15	24	69[a]	65[a]	56[a]	74[a]	51
3 - 11	17	29[a]	50[a]	50	59[a]	75[a]	47[a]	11 - 14	27	41	56	40	70[a]	86[a]	53
3 - 12	48	63[a]	72[a]	62[a]	72[a]	75[a]	65[a]	11 - 15	31	30	50	63[a]	49	82[a]	51
3 - 13	31	25	50	68[a]	71[a]	78[a]	54[a]	11 - 16	24	5	19	22	39	70[a]	32
3 - 14	39	36	40	45	68[a]	71[a]	50	11 - 17	40	24	27	22[a]	15	38	28
3 - 15	36	30	50	40	58	72[a]	48	12 - 13	33	43	56	68[a]	47	68[a]	53
3 - 16	21	5	13	33	45	51	29	12 - 14	47	33	41	51	56	75[a]	50
3 - 17	22	30	29	26	26	39	29	12 - 15	44	36	54	47	59	78[a]	54
4 - 5	7	20	29	45	44	65[a]	39	12 - 16	20	7	13	26	41	62[a]	29
4 - 7	38	41	43	48	31	76[a]	46	12 - 17	24	23	27	24[a]	30	32	27
4 - 8	49	36	19	39	52	76[a]	45	13 - 14	36	33	50	68[a]	78[a]	79[a]	57
4 - 9	47	36	29	35	37	78[a]	44	13 - 15	33	20	47	58	57	71[a]	48
4 - 11	23	36	46	54	58	84[a]	51	13 - 16	38	8	20	31	50	61[a]	37
4 - 12	32	27	31	28	57	75[a]	43	13 - 17	19	21	31	33	19	28	25
4 - 13	58	44	32	47	68[a]	74[a]	55	14 - 15	55	28	54	43	61[a]	78[a]	53
4 - 14	35	29	31	46	63[a]	82[a]	47	14 - 16	27	0	23	24	55	85[a]	35
4 - 15	32	30	44	46	56	76[a]	48	14 - 17	27	26	17	20	15	40	25
4 - 16	33	5	7	12	28	67[a]	26	15 - 16	23	2	19	14	33	68[a]	28
4 - 17	14	26	23	29	24	39	26	15 - 17	30	21	22	31	20	35	27
5 - 7	33	27	41	48	33	73[a]	44	16 - 17	20	5	16	22	18	31	19
5 - 8	19	35	40	53	48	78[a]	49								
5 - 9	25	43	52	50	47	86[a]	54	No. of pairs	104	105	105	105	105	105	629
5 - 10	38	39	42	52	55	84[a]	54	Average (%)	32	27	38	42	45	66	42

[a] Agreement 60% or more.

Table 6. Frequency distribution of pairs of readers by percentage (agreement) groups for Sample 2.

Percentage groups	No. of pairs of readers						
	2J	3K	3L	3NO	3O	3Ps	Total
0-9	1	11	2	-	-	-	14
10-19	13	10	12	7	7	-	49
20-29	27	40	16	21	10	2	116
30-39	38	30	16	18	15	12	129
40-49	18	12	38	19	36	12	135
50-59	6	-	18	24	24	4	76
60-69	-	1	2	11	7	14	35
70-79	1	1	1	5	5	44	57
80-89	-	-	-	-	1	14	15
90-99	-	-	-	-	-	3	3
Total	104	105	105	105	105	105	629
Average agreement	32	27	38	42	45	66	42

Indication of reader bias with respect to pairs of readers for all areas combined is given in Table 7. Variation was quite large, ranging from -75 (readers 7 and 16) to +65 (readers 2 and 7). Reader 16 consistently over-read with respect to the group, while readers 7, 11 and 15 under-read relative to most of the other readers. Reader 13 (49%) achieved the best average agreement with respect to the group, followed closely by readers 14, 12, 3, 8 and 9, while the poorest results were recorded by readers 16 and 17.

Table 7. Bias between pairs of readers in ageing Sample 2.

Reader	Bias between pairs of readers (% over-aged minus % under-aged)															Average bias	Average agreement
	1	2	3	4	5	7	8	9	11	12	13	14	15	16	17		
1	●	21	9	-31	-6	40	1	1	22	11	-1	7	20	-54	5	3	45
2	-21	●	-34	-56	-26	65	19	20	44	36	30	32	42	-37	32	10	34
3	-9	34	●	-32	11	35	-10	-15	16	1	-7	-1	13	-62	-9	-3	46
4	31	56	32	●	33	4	-38	-40	-12	-28	-32	-24	-13	-72	-17	-9	42
5	6	26	-11	-33	●	40	0	-2	13	4	9	7	19	-55	4	2	47
7	-40	-65	-35	-4	-40	●	-43	-46	-18	-37	-38	-36	-23	-75	-27	-38	39
8	-1	-19	10	38	0	43	●	-3	29	12	0	15	23	-16	8	10	46
9	-1	-20	15	40	2	46	3	●	30	16	0	13	27	-55	7	9	46
11	-22	-54	-16	12	-13	18	-29	-30	●	-15	-22	-17	-5	-66	-15	-20	45
12	-11	-36	-1	28	-4	37	-12	-16	15	●	-9	-1	13	-66	1	-4	47
13	1	-30	7	52	-9	38	0	0	22	9	●	21	22	-52	8	6	49
14	-7	-32	1	29	-7	36	-15	-13	17	1	-21	●	14	-60	0	-4	48
15	-20	-42	-13	13	-19	23	-23	-27	5	-13	-22	-14	●	-65	-10	-16	45
16	54	37	62	72	55	75	60	55	66	66	52	60	65	●	44	59	30
17	-5	32	9	17	-4	27	-8	-7	15	-1	-8	0	10	-44	●	2	26

Agreement with Modal Ages

Modal ages were derived in the same way as for Sample 1, except that no clear mode was evident for about 10% of the specimens examined. Anomalies (estimated age minus modal age) were determined for each reader and area, together with the mean deviations and standard errors (Table 8). For all areas combined, the average deviation was minimal for readers 3, 12 and 14, although in each case there was considerable variation between areas. Readers 1, 5, 8, 9, 13 and 17 tended to over-read the modal ages (0.08-0.17) while readers 11 and 15 tended to under-read to a somewhat greater extent (0.20-0.28). The greatest positive bias was reflected in the ageing of reader 16 who

Table 8. Anomalies from modal ages of otoliths in Sample 2 by reader and area, together with the mean deviations, standard errors and percentage agreements.

Reader	ICNAF Div.	Deviations from modal ages <-3	-3	-2	-1	0	1	2	3	>3	Total read	Mean deviation	Standard error	Percentage agreement
1	2J	-	-	2	9	17	6	1	-	-	35	-0.14	0.15	49
	3K	-	-	-	5	11	8	5	2	-	31	0.61	0.21	35
	3L	-	-	-	3	24	10	1	-	-	38	0.24	0.10	63
	3NO	-	-	-	2	27	1	4	2	-	36	0.36	0.16	75
	3O	-	-	1	7	25	8	1	-	-	42	0.02	0.12	60
	3Ps	-	-	-	3	35	5	-	-	-	43	0.05	0.07	81
	Total	-	-	3	29	139	38	12	4	-	225	0.17	0.06	62
2	2J	-	1	1	3	20	13	1	-	-	39	0.18	0.15	51
	3K	-	-	-	3	9	14	10	1	-	37	0.92	0.16	24
	3L	-	-	-	5	24	12	2	1	-	44	0.32	0.13	55
	3NO	-	-	1	2	17	10	8	2	-	40	0.70	0.17	43
	3O	-	-	2	2	24	9	3	2	-	42	0.36	0.10	57
	3Ps	-	-	-	1	19	24	1	-	-	45	0.56	0.09	42
	Total	-	1	4	16	113	82	25	6	-	247	0.50	0.06	46
3	2J	1	1	3	11	22	1	-	-	-	39	-0.59	0.15	56
	3K	-	-	-	7	19	9	1	-	-	36	0.11	0.12	53
	3L	-	1	-	3	31	8	1	1	-	45	0.16	0.13	69
	3NO	-	-	1	1	32	12	-	-	-	46	0.20	0.09	70
	3O	-	-	-	3	34	5	-	-	-	42	0.05	0.07	81
	3Ps	-	-	-	8	33	1	-	-	-	42	-0.17	0.07	79
	Total	1	2	4	33	171	36	2	1	-	250	-0.03	0.05	68
4	2J	-	-	3	7	22	5	-	-	-	37	-0.22	0.13	59
	3K	1	1	3	13	18	1	-	-	-	37	-0.68	0.16	49
	3L	-	2	8	12	18	4	-	-	-	44	-0.68	0.16	41
	3NO	-	1	4	16	20	2	-	-	-	43	-0.58	0.13	47
	3O	-	-	2	12	29	-	1	-	-	44	-0.32	0.10	66
	3Ps	-	-	3	2	41	-	-	-	-	46	-0.17	0.08	89
	Total	1	4	23	62	148	12	1	-	-	251	-0.44	0.05	59
5	2J	1	1	1	2	6	1	-	-	-	12	-0.83	0.42	50
	3K	-	-	1	4	20	7	2	1	-	35	0.23	0.16	57
	3L	-	-	-	6	22	14	1	-	-	43	0.23	0.11	51
	3NO	-	-	-	2	20	6	-	-	-	28	0.14	0.10	71
	3O	-	-	1	2	29	9	2	2	-	45	0.33	0.13	64
	3Ps	-	-	-	1	44	-	1	-	-	46	0.02	0.05	96
	Total	1	1	3	17	141	37	6	3	-	209	0.13	0.06	67
7	2J	1	-	4	11	21	2	1	-	-	40	-0.48	0.16	53
	3K	-	1	4	12	13	5	-	-	-	35	-0.51	0.17	37
	3L	-	2	4	15	22	-	-	-	-	43	-0.67	0.13	51
	3NO	-	1	2	20	22	-	-	-	-	45	-0.60	0.10	49
	3O	-	2	7	16	19	1	-	-	-	45	-0.78	0.13	42
	3Ps	-	-	1	8	37	-	-	-	-	46	-0.22	0.07	80
	Total	1	6	22	82	134	8	1	-	-	254	-0.54	0.05	53
8	2J	-	-	-	2	30	3	3	2	-	40	0.33	0.14	75
	3K	1	-	1	3	22	6	4	-	-	37	0.05	0.24	59
	3L	-	-	-	2	29	9	3	2	-	45	-0.42	0.13	64
	3NO	-	-	-	4	35	5	2	-	-	46	0.11	0.09	76
	3O	-	-	2	11	25	7	1	-	-	46	-0.13	0.12	54
	3Ps	-	-	-	2	40	4	-	-	-	46	0.04	0.05	87
	Total	1	-	3	24	181	34	13	4	-	260	0.15	0.05	70
9	2J	-	-	-	3	29	3	2	3	-	40	0.33	0.15	73
	3K	1	-	-	3	26	5	1	-	1	37	0.05	0.25	70
	3L	-	-	1	3	30	10	1	-	-	45	0.16	0.10	67

Table 8. (continued)

Reader	ICNAF Div.	Deviations from modal ages <-3	-3	-2	-1	0	1	2	3	>3	Total read	Mean deviation	Standard error	Percentage agreement
	3NO	-	-	-	2	37	4	3	-	-	46	0.17	0.09	80
	3O	-	-	1	6	24	12	2	1	-	46	0.24	0.13	52
	3Ps	-	-	-	1	43	1	1	-	-	46	0.04	0.05	93
	Total	1	-	2	18	189	35	10	4	1	260	0.17	0.04	73
11	2J	-	3	8	10	13	4	1	-	-	39	-0.74	0.19	33
	3K	-	-	1	8	22	1	1	1	-	34	-0.12	0.15	65
	3L	-	-	1	6	33	3	1	1	-	45	0.00	0.11	73
	3NO	1	1	1	10	27	3	2	-	-	45	-0.27	0.15	60
	3O	-	1	5	8	30	1	-	-	-	45	-0.44	0.12	67
	3Ps	-	1	-	2	43	-	-	-	-	46	-0.11	0.07	93
	Total	1	6	16	44	168	12	5	2	-	254	-0.28	0.06	66
12	2J	1	-	2	7	23	4	1	-	-	38	-0.24	0.16	61
	3K	-	-	-	3	24	9	1	-	-	37	0.22	0.10	65
	3L	-	-	1	7	31	6	-	-	-	45	-0.07	0.09	69
	3NO	-	1	1	3	32	7	-	-	-	44	-0.02	0.11	73
	3O	-	-	3	3	36	3	1	-	-	46	-0.09	0.10	78
	3Ps	-	-	-	3	39	2	-	-	-	44	-0.02	0.05	89
	Total	1	1	7	26	195	31	3	-	-	254	-0.04	0.04	73
13	2J	-	-	-	-	14	10	3	-	-	27	0.59	0.13	52
	3K	-	-	-	6	17	5	4	1	-	33	0.30	0.18	52
	3L	-	-	-	5	20	3	1	-	-	29	0.00	0.12	69
	3NO	-	-	-	2	26	2	-	-	-	30	0.00	0.07	86
	3O	-	-	-	5	19	2	2	-	-	28	0.04	0.14	68
	3Ps	-	-	-	7	35	3	-	-	1	46	0.02	0.13	76
	Total	-	-	-	25	131	25	10	1	1	193	0.14	0.05	68
14	2J	-	-	2	5	28	2	3	-	-	40	-0.03	0.13	70
	3K	-	1	5	7	22	2	-	-	-	37	-0.49	0.15	59
	3L	-	-	-	9	27	6	3	-	-	45	0.07	0.12	60
	3NO	-	-	-	7	29	9	1	-	-	46	0.09	0.10	63
	3O	-	-	-	2	23	3	1	-	1	30	0.23	0.16	77
	3Ps	-	-	-	1	42	2	1	-	-	46	0.07	0.06	91
	Total	-	1	7	31	171	24	9	-	1	244	-0.01	0.05	70
15	2J	-	-	-	10	22	5	3	-	-	40	0.03	0.13	55
	3K	1	1	4	11	16	3	1	-	-	37	-0.62	0.22	43
	3L	-	1	1	8	31	2	2	-	-	45	-0.16	0.12	69
	3NO	1	1	2	12	28	2	-	-	-	46	-0.46	0.13	61
	3O	-	1	1	7	32	3	-	-	1	45	-0.11	0.14	71
	3Ps	-	-	-	2	41	3	-	-	-	46	0.02	0.05	89
	Total	2	4	8	50	170	18	6	-	1	259	-0.20	0.05	66
16	2J	-	-	-	-	12	16	5	2	-	35	0.91	0.14	34
	3K	-	1	-	-	1	13	9	4	6	34	1.91	0.26	3
	3L	-	-	-	-	9	14	8	5	4	40	1.53	0.20	23
	3NO	-	-	-	-	11	15	4	7	2	39	1.36	0.21	28
	3O	-	-	-	-	18	12	4	2	6	42	1.23	0.24	43
	3Ps	-	-	-	-	34	7	1	3	-	45	0.40	0.12	76
	Total	-	1	-	-	85	77	31	23	18	235	1.18	0.08	36
17	2J	-	-	6	12	9	4	-	3	-	34	-0.32	0.24	26
	3K	-	2	5	6	12	4	1	3	-	33	-0.21	0.27	36
	3L	-	-	-	8	7	7	3	3	3	31	0.90	0.32	23
	3NO	-	-	1	6	11	8	4	2	-	32	0.44	0.22	34
	3O	-	1	4	9	6	9	6	-	-	35	0.03	0.24	17
	3Ps	-		1	15	21	4	3	-	-	44	-0.16	0.13	48
	Total	-	3	17	56	66	36	17	11	3	209	0.08	0.10	32

on the average over-read the modal ages by more than 1 year (1.18). Reader 2 over-read by 0.5 years, while readers 4 and 7 under-read by about the same value. The average deviation from modal ages ranged from -0.83 by reader 5 for Div. 2J to +1.91 by reader 16 for Div. 3K. While some readers (2, 9 and 16) consistently over-read the modal age for all areas and some (readers 4 and 7) consistently under-read, others (e.g. readers 3, 5 and 17) had large positive deviations for some areas and negative deviations for others.

Considering the results for the various areas separately (Table 8), agreement with the modal ages was generally good for Subdiv. 3Ps (42-96%) with 13 of the 15 readers achieving better than 75% agreement with the modal ages, the average for all readers being 81%. For the specimens examined from Div. 3NO and 3O, the percentage agreements by the 15 readers (17-86%) averaged about 60%, with nine of the readers achieving better than 60%. For Div. 3L (23-73%), eight readers recorded better than 60% agreement with the modal ages, the overall average being 56%. The percentages for Div. 2J and 3K were somewhat less, averaging 53 and 47% respectively, with only four readers achieving better than 60% agreement. Readers 9 and 12 achieved the highest percentage agreement (73%) with the modal ages over all areas, while the lowest values were recorded by readers 16 and 17 (36 and 32% respectively).

Differences in Age Composition and Average Length-at-age

An age-length key for each reader of Sample 2 was derived from the age determinations listed in Appendix II (Table B). These keys were each applied to an arbitrary length frequency, resulting in the age frequencies listed for the various readers in Table 9. Also listed in the last column of Table 9 is the age frequency derived from the age-length key of modal ages of the Sample 2 specimens. The Kolmogorov-Smirnov two-sample test (Siegel, 1956) was used to test whether the individual age frequencies were significantly different from that of the modal ages. The age frequencies for readers 3, 5, 8, 9, 12 and 13 were not significantly different from the modal age frequency at $p = 0.05$, all others being significantly different even at $p = 0.01$. The same test was used to determine whether these six age compositions were significantly different from each other. None were different at the $p = 0.01$ level of significance, but the results at the $p = 0.05$ level are as follows:

Reader	Reader						Significance	
	3	5	8	9	12	13	No	Yes
3	-	No	Yes	No	No	Yes	3	2
5	No	-	Yes	No	No	Yes	3	2
8	Yes	Yes	-	No	No	No	3	2
9	No	No	No	-	No	No	5	0
12	No	No	No	No	-	Yes	4	1
13	Yes	Yes	No	No	Yes	-	2	3

It is obvious from this analysis that age composition data, derived from the age determinations of different age readers, may differ significantly, and that such discrepancies would greatly affect stock assessment calculations, particularly if only a limited amount of data was available. Although the differences displayed in the above table for the six readers whose age frequencies were not significantly different from the modal age frequency would probably not be critical to assessment work, a very different result would accrue if the only age composition data available were those of reader 14 on the one hand or reader 16 on the other (modal ages 5 and 7 respectively, Table 9). Similarly, recruitment prospects for age-groups 2 and 3 would appear to be much better from the age frequency of reader 11, for example, than would be the case if the only data available were those of readers 2 and 16.

Average length-at-age values, derived from the age determinations of the various readers for Sample 2 (Appendix II, Table B), are given in Table 10. Considerable variation in average length-at-age is apparent for some readers when compared with the values pertaining to the modal ages. As was indicated for the age compositions, variation from the modal ages is minimal for readers 3, 5, 8, 9, 12 and 13. The greatest negative bias relative to the modal ages is exhibited by readers 2 and 16, and the greatest positive bias by readers 7 and 11.

Table 9. Length distributions derived from age-length keys constructed from the age determinations of the various readers for Sample 2 (see Appendix II).

Age (yr)	Age reader															Modal age
	1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	
2	-	-	-	-	4	-	-	-	14	-	-	12	5	-	22	-
3	27	18	38	54	52	56	38	31	80	30	32	52	69	15	44	35
4	143	64	101	213	126	199	146	128	144	131	177	164	196	54	82	141
5	235	127	196	244	154	277	222	219	244	197	193	225	201	130	225	201
6	194	310	342	273	297	261	279	265	270	313	276	202	258	154	211	304
7	193	242	185	127	197	123	154	217	122	197	138	183	131	232	177	182
8	111	143	95	49	72	40	62	59	56	77	59	67	64	192	156	73
9	57	52	21	24	60	35	60	45	32	40	67	52	39	81	27	41
10	33	21	10	15	21	3	24	21	16	6	34	28	21	68	22	9
11	5	12	7	1	5	5	10	8	20	8	10	11	13	41	18	13
12	1	6	4	-	7	-	4	7	1	1	7	3	3	7	4	2
13	1	-	-	-	-	-	1	1	-	-	2	1	-	14	4	-
14	-	4	-	-	-	-	-	-	-	-	-	-	-	2	8	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
NK	-	-	-	-	5	-	-	-	-	-	5	-	-	5	-	-

Table 10. Mean length-at-age values derived from the ageing data of the various readers for Sample 2 (see Appendix II).

Age (yr)	Age reader															Modal age
	1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	
2	-	-	-	-	40.0	-	-	-	40.3	-	-	38.0	54.2	-	35.3	
3	37.1	35.3	37.2	40.1	37.4	38.9	38.2	36.9	39.9	37.4	35.8	39.1	41.0	34.9	39.9	36.8
4	43.7	40.2	45.4	46.4	45.2	46.5	42.2	42.0	46.3	43.8	43.9	44.4	45.8	45.2	46.4	43.0
5	49.0	47.0	46.7	51.2	48.9	51.5	48.0	47.5	50.7	48.6	51.8	50.0	51.3	46.4	51.2	48.1
6	53.4	50.8	54.8	57.9	54.2	57.6	55.3	54.4	57.5	54.7	53.6	55.1	55.8	52.0	55.1	55.4
7	61.7	57.8	60.2	62.2	60.0	65.8	60.6	60.2	61.2	60.3	60.4	60.7	64.0	52.9	57.4	61.3
8	63.4	64.3	68.8	72.7	63.5	71.8	70.1	72.0	70.9	69.7	67.7	70.5	62.7	56.4	60.0	69.0
9	66.9	66.1	73.2	68.3	67.1	63.3	72.1	72.4	73.8	70.0	67.5	68.2	74.0	59.2	68.6	73.0
10	66.5	70.5	67.9	70.1	71.5	79.2	71.4	71.7	70.8	69.2	69.1	68.8	62.8	66.9	65.6	66.7
11	66.1	75.5	81.4	82.0	84.1	70.1	74.1	78.1	60.4	60.0	57.0	74.5	72.9	69.5	68.1	62.1
12	79.0	70.3	43.0	-	51.4	-	81.2	77.3	82.0	82.0	70.3	83.4	80.3	72.9	75.4	82.0
13	82.0	-	-	-	-	-	79.0	79.0	-	-	82.0	76.0	-	68.3	81.4	-
14	-	43.0	-	-	-	-	-	-	-	-	-	-	-	82.0	55.9	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	43.0	-	-

Examination of Differences in Age Reading Through Photographs

Following the interpretation of the otoliths and the assignment of ages by the various readers, about 60 otoliths were reviewed by means of slides and the various interpretations noted on photographs. After the Workshop concluded, the Coordinators carried out a more detailed examination of the major discrepancies in the age readings in order to better point out the sources of the discrepancies. Photographs of the selected otoliths, containing notations of the interpretations, are presented in Appendix III, together with brief descriptions of the main differences between the various interpretations. Comments of a more general nature are given in the following paragraphs.

Some otoliths offered no difficulty and agreement was unanimous (e.g. otoliths 2J-58, 3L-55 and 3L-268), but many of the specimens were subject to two or more different interpretations.

Difficulties were encountered in determining the first annulus. Often a check occurs in the opaque zone before the first annulus is laid down (3Ps-127), and in some cases it was difficult to agree whether the ring is a check or the first annulus (e.g. 3L-189 and 3Ps-101). This difficulty may be compounded by cutting the otolith off-centre, thus giving a deformed annulus such as the figure-eight shape in otolith 3Ps-192. Typical first year annuli are shown in otoliths 3Ps-37, 3Ps-104 and 3Ps-155. The second annulus often appears to be characteristically clear (e.g. 3L-268 and 3Ps-104).

Different interpretations of splits or checks were the main reasons for much of the disagreement. Some otoliths (e.g. 2J-12) show many checks. In otoliths 2J-58 and 3L-134, it was agreed that a definite check occurs in the opaque zone before the second annulus and that otolith 3L-189 shows a check before the third annulus. Definite checks are also present in the second annulus of otolith 3Ps-48 and in the third annulus of otoliths 2J-85 and 3L-102. Doubtful checks are very common (e.g. otoliths 3L-6, 3L-183 and 3NO-27).

A problem was also encountered in determining whether the edge of the otolith was opaque or hyaline (e.g. 3L-183, 3L-268 and 3Ps-101). In a number of cases it was difficult to determine if there are one or more annuli at the edge (e.g. 2J-300, 3L-189, 3NO-1, 3O-65 and 3Ps-37).

Discussions and Conclusions

The Workshop participants concluded that the discrepancies in age reading between readers were due to the absence of clear criteria for otolith interpretation. A major source of variation in age reading is associated with the interpretation of particular rings as checks or annuli. Other difficulties involve the determination of the first annulus and the recognition of annuli at or near the edge of the otolith for older specimens. Some of the major problems are summarized as follows:

a) Splits and checks and how these may be distinguished from annuli.

b) The nucleus and determination of the first annulus.

c) Otolith edge - recognition of type (hyaline or opaque) and seasonal deposition of opaque and hyaline material.

d) The effects of cutting the otolith "off centre".

e) Peculiarities in the otoliths from specific areas (e.g. a very small first annulus in Subdiv. 4Vn cod; a very strong check before the second annulus in Div. 5Z cod).

In order to minimize the variation in interpretation and reduce subjective errors in ageing, studies should be made as the basis for establishing guidelines for otolith interpretation. These guidelines should be clearly described and illustrated by photographs, sketches, etc. In order to establish objectivity in ageing among different readers, such studies will require a great deal of tedious work. Initially, the emphasis could be placed on studies for a particular area or stock and a set of guidelines developed which could be modified as required for other areas or even for other species. Until such studies are made and guidelines adopted by age readers, the variation in interpretation of cod otoliths will not likely diminish to any significant extent.

As has been the concern of the Assessments Subcommittee in its analyses of practically all fish stocks, ageing data are in many cases incomplete, and age compositions for various areas and time periods have to be derived from age-length keys of only one or two readers. Consequently, differences in age reading of the magnitude resulting from this Workshop could seriously affect the results of population analyses. The ageing problems seem to be more critical for the northern divisions (2J, 3K and 3L) than further south, and the importance of resolving them is further stressed by the fact that nearly one-half of the annual cod catch in the Northwest Atlantic is taken in these three divisions.

In view of the urgency to resolve the problems associated with age determination of cod in various areas, the Workshop participants recommend (a) that STACRES urge its scientists to initiate studies and present papers on the interpretation of ages of, including validation of ages, seasonal deposition of material at the otolith edge, effects of cutting otoliths off-centre, and peculiarities in the otoliths of specific areas; and (b) that STACRES take whatever action is necessary to ensure that discrepancies in age composition data are eliminated or reduced as much as possible, perhaps by establishing a workshop to study the problems in a specific area and to develop a set of guidelines for otolith interpretation.

Acknowledgements

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facilities and thank Ms Aida F. Rios and Ms Ignacia Montemayor for assistance during the Workshop, and are extremely grateful for the work of Ms E.L. Rowe and Mrs C. Riche of the Newfoundland Biological Station who photographed the otoliths and prepared copies of the photographs for study at the Workshop and inclusion in this report. Above all, this study could not be undertaken without the cooperation of the Workshop participants.

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APPENDIX I

List of Participants in Ageing Workshop at Vigo, Spain, October 1975

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Mr A.I. Postolaky[1]

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Ms L.G. Nasarova[1]

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[1] Did not participate during the scheduled period of the Workshop but examined some of the material later.

APPENDIX II

Table A. Age readings for otolith sample 1.

Area	Spec. No.	Len. (cm)	Readers 1	2	3	4	5	6	7	8	9	10	Age mode
3K	586	58	6	-	-	-	-	-	-	6	6	-	6
	587	61	6	-	-	-	-	-	-	7	6	-	6
	588	61	6	-	-	-	-	-	-	6	6	-	6
	589	61	7	-	-	-	-	-	-	8	6	-	-
	590	61	6	-	-	-	-	-	-	7	7	-	7
	591	61	5	-	-	-	-	-	-	6	5	-	5
	592	61	-	-	-	-	-	-	-	6	6	-	6
	593	61	6	-	-	-	-	-	-	6	6	-	6
	594	61	7	-	-	-	-	-	-	8	7	-	7
	595	61	5	-	-	-	-	-	-	6	6	-	6
	596	61	6	-	-	-	-	-	-	6	6	-	6
	597	64	7	-	-	-	-	-	-	8	6	-	-
	598	64	7	-	-	-	-	-	-	8	7	-	7
	599	64	8	-	-	-	-	-	-	6	6	-	6
	600	40	4	-	-	-	-	-	-	6	5	-	-
	601	40	5	-	-	-	-	-	-	5	5	-	5
	602	40	3	-	-	-	-	-	-	4	4	-	4
	603	40	4	-	-	-	-	-	-	4	4	-	4
	604	40	4	-	-	-	-	-	-	5	4	-	4
	605	40	5	-	-	-	-	-	-	5	5	-	5
	606	40	4	-	-	-	-	-	-	4	4	-	4
	607	40	-	-	-	-	-	-	-	5	4	-	-
	608	40	2	-	-	-	-	-	-	4	4	-	4
	609	40	-	-	-	-	-	-	-	5	4	-	-
	610	43	5	-	-	-	-	-	-	5	5	-	5
	611	43	5	-	-	-	-	-	-	5	5	-	5
	612	43	4	-	-	-	-	-	-	5	5	-	5
	613	43	6	-	-	-	-	-	-	5	5	-	5
	614	43	6	-	-	-	-	-	-	6	5	-	6
	615	43	4	-	-	-	-	-	-	5	5	-	5
	616	43	5	-	-	-	-	-	-	5	5	-	5
	617	43	5	-	-	-	-	-	-	5	5	-	5
	618	43	6	-	-	-	-	-	-	5	5	-	5
	619	43	5	-	-	-	-	-	-	5	5	-	5
	620	43	5	-	-	-	-	-	-	5	5	-	5
	621	43	-	-	-	-	-	-	-	5	5	-	5
	622	43	4	-	-	-	-	-	-	5	5	-	5
	623	46	5	-	-	-	-	-	-	6	5	-	5
	624	46	5	-	-	-	-	-	-	5	6	-	5
	625	46	4	-	-	-	-	-	-	5	5	-	5
	626	46	5	-	-	-	-	-	-	6	5	-	5
	627	46	4	-	-	-	-	-	-	5	5	-	5
	628	46	4	-	-	-	-	-	-	5	5	-	5
	629	46	4	-	-	-	-	-	-	6	6	-	6
	630	46	5	-	-	-	-	-	-	5	5	-	5
	631	46	7	-	-	-	-	-	-	6	6	-	6
	632	46	7	-	-	-	-	-	-	6	6	-	6
	633	46	6	-	-	-	-	-	-	6	6	-	6
	634	46	6	-	-	-	-	-	-	6	5	-	6
	635	46	7	-	-	-	-	-	-	5	4	-	-
	636	46	6	-	-	-	-	-	-	7	5	-	-
	637	46	5	-	-	-	-	-	-	6	5	-	5
	638	43	5	-	-	-	-	-	-	6	6	-	6
	639	49	6	-	-	-	-	-	-	6	6	-	6
	640	49	6	-	-	-	-	-	-	6	6	-	6
3L	1	61	5	-	6	4	-	-	-	5	5	5	5
	2	61	6	-	7	5	-	-	-	7	6	7	7
	3	61	6	-	5	5	-	-	-	7	5	6	5
	4	64	6	-	7	7	-	-	-	7	7	7	7
	5	64	5	-	5	5	-	-	-	7	5	8	5

Table A. (continued)

Area	Spec. No.	Len. (cm)	Readers 1	2	3	4	5	6	7	8	9	10	Age mode
3L	6	64	6	-	6	5	-	-	-	6	6	8	6
(cont'd)	7	64	5	-	8	6	-	-	-	7	7	7	7
	8	73	6	-	9	5	-	-	-	7	6	7	-
	9	73	6	-	7	5	-	-	-	9	7	7	7
	10	73	5	-	7	5	-	-	-	8	6	7	-
	11	73	6	-	8	6	-	-	-	8	7	7	-
	12	73	6	-	7	5	-	-	-	7	7	8	7
	13	73	7	-	8	6	-	-	-	8	8	9	8
	14	73	3	-	7	5	-	-	-		6	7	7
	15	73	-	-	9	5	-	-	-	7	7	9	-
	16	73	6	-	8	5	-	-	-	7	7	7	7
	17	76	8	-	10	7	-	-	-	9	9	10	-
	18	76	-	-	7	5	-	-	-	8	7	10	7
	19	76	8	-	10	6	-	-	-	10	8	11	-
	20	76	6	-	8	6	-	-	-	9	8	10	-
	21	76	5	-	8	5	-	-	-	8	7	7	-
	22	76	6	-	7	6	-	-	-	8	7	7	7
	23	76	8	-	9	7	-	-	-	9	9	9	9
	24	76	6	-	8	6	-	-	-	7	7	11	-
	25	76	6	-	9	6	-	-	-	9	9	8	9
	26	76	-	9	-	-	-	-	9	8	8	10	-
	27	76	-	9	-	-	-	-	7	7	7	8	7
	28	58	-	7	-	-	-	-	7	6	6	9	-
	29	79	-	9	-	-	-	-	11	11	10	10	-
	30	79	-	8	-	-	-	-	9	10	8	9	-
	31	40	-	6	-	-	-	-	6	4	5	5	-
	32	40	-	5	-	-	-	-	5	4	5	5	5
	33	40	-	6	-	-	-	-	6	5	4	5	-
	34	40	-	5	-	-	-	-	5	5	4	5	5
	35	43	-	6	-	-	-	-	7	7	7	7	7
	36	43	-	-	-	-	-	-	6	4	4	5	4
	37	43	-	4	-	-	-	-	6	4	4	6	4
	38	43	-	4	-	-	-	-	6	5	5	5	5
	39	43	-	5	-	-	-	-	6	5	4	5	5
	40	58	-	5	-	-	-	-		5	5	4	5
	41	43	-	5	-	-	-	-	5	5	5	5	5
	42	43	-	5	-	-	-	-	4	5	4	5	5
	43	43	-	5	-	-	-	-	5	5	5	5	5
	44	43	-	5	-	-	-	-	5	4	5	4	5
	45	43	-	4	-	-	-	-	5	4	4	4	4
	46	43	-	5	-	-	-	-	8	5	5	5	5
	47	46	-	5	-	-	-	-	-	4	5	4	-
	48	46	-	5	-	-	-	-	5	5	4	5	5
	49	46	-	5	-	-	-	-	5	5	5	5	5
	50	46	-	5	-	-	-	-	5	4	5	5	5
	51	46	-	5	-	-	-	-	7	5	5	5	5
	52	46	-	5	-	-	-	-	6	5	5	5	5
	686	61	-	5	-	5	-	-	-	6	6	7	-
	687	61	-	5	-	5	-	-	-	6	6	6	6
	688	61	-	5	-	6	-	-	-	7	6	-	6
	689	61	-	6	-	6	-	-	-	7	6	-	6
	690	61	-	6	-	6	-	-	-	6	6	-	6
	691	61	-	7	-	6	-	-	-	6	6	-	6
	692	64	-	6	-	6	-	-	-	7	6	-	6
	693	64	-	6	-	5	-	-	-	6	6	-	6
	694	67	-	6	-	7	-	-	-	7	7	8	7
	695	67	-	5	-	5	-	-	-	6	6	6	6
	696	67	-	5	-	5	-	-	-	6	6	7	-
	697	67	-	6	-	6	-	-	-	7	6	-	6
	698	70	-	7	-	6	-	-	-	9	6	8	6
	699	70	-	7	-	7	-	-	-	9	8	7	7
	700	76	-	7	-	7	-	-	-	8	7	7	7
	701	34	-	3	-	2	-	-	-	3	3	3	3
	702	37	-	3	-	3	-	-	-	4	3	4	3

Table A. (continued)

Area	Spec. No.	Len. (cm)	Readers 1	2	3	4	5	6	7	8	9	10	Age mode
3L (cont'd)	703	37	-	4	-	4	-	-	-	4	3	4	4
	704	37	-	4	-	5	-	-	-	5	3	4	-
	705	40	-	4	-	4	-	-	-	4	3	4	4
	706	40	-	5	-	6	-	-	-	5	4	5	5
	707	40	-	4	-	5	-	-	-	5	4	5	5
	708	40	-	5	-	5	-	-	-	5	5	5	5
	709	40	-	3	-	4	-	-	-	4	5	4	4
	710	40	-	3	-	3	-	-	-	4	4	4	4
	711	40	-	4	-	5	-	-	-	5	4	5	5
	712	40	-	4	-	5	-	-	-	6	5	5	5
	713	40	-	4	-	3	-	-	5	4	4	4	4
	714	40	-	5	-	5	-	-	6	5	5	6	5
	715	40	-	5	-	4	-	-	5	5	5	5	5
	716	40	-	4	-	4	-	-	4	4	4	5	4
	717	40	-	5	-	5	-	-	5	5	4	5	5
	718	40	-	6	-	5	-	-	5	4	5	6	5
	719	43	-	6	-	6	-	-	7	5	5	6	6
	720	43	-	5	-	4	-	-	5	4	4	5	-
	721	43	-	5	-	5	-	-	6	5	5	6	5
	722	43	-	5	-	5	-	-	5	5	5	6	5
	723	43	-	3	-	3	-	-	4	4	4	5	4
	724	43	-	5	-	5	-	-	6	5	5	5	5
	725	43	-	5	-	4	-	-	-	5	5	5	5
	726	43	-	5	-	6	-	-	6	4	4	5	-
	727	43	-	6	-	5	-	-	5	6	6	6	6
	728	43	-	5	-	5	-	-	6	5	5	5	5
	729	43	-	5	-	4	-	-	6	5	4	6	-
	730	43	-	5	-	4	-	-	5	5	4	5	5
	731	43	-	7	-	5	-	-	6	6	6	6	6
	732	43	-	5	-	4	-	-	6	4	4	4	4
	733	46	-	5	-	4	-	-	5	5	5	5	5
	734	46	-	6	-	6	-	-	7	6	6	-	6
	735	46	-	6	-	6	-	-	5	6	5	6	6
	736	46	-	5	-	4	-	-	-	5	5	6	5
	737	46	-	4	-	5	-	-	-	5	5	6	5
	738	46	-	5	-	4	-	-	-	5	4	5	5
	739	46	-	-	-	-	-	-	-	5	5	6	5
30	201	55	-	-	7	-	-	7	-	5	5	-	-
	202	55	-	-	6	-	-	7	-	5	5	-	5
	203	55	-	-	7	-	-	7	-	6	6	-	-
	204	55	-	-	7	-	-	6	-	5	5	-	5
	205	58	-	-	7	-	-	7	-	6	5	-	7
	206	58	-	-	10	-	-	-	-	5	5	-	5
	207	58	-	-	9	-	-	6	-	6	5	-	6
	208	58	-	-	7	-	-	6	-	5	5	-	5
	209	58	-	-	7	-	-	6	-	5	5	-	5
	210	58	-	-	7	-	-	-	-	5	5	-	5
	211	58	-	-	7	-	-	6	-	5	6	-	6
	212	58	-	-	6	-	-	6	-	5	5	-	-
	213	58	-	-	7	-	-	6	-	5	5	-	5
	214	61	-	-	6	-	-	5	-	5	5	-	5
	215	61	-	-	6	-	-	5	-	5	5	-	5
	216	61	-	-	6	-	-	6	-	5	5	-	-
	217	61	-	-	7	-	-	8	-	6	6	-	6
	218	61	-	-	6	-	-	6	-	5	5	-	-
	219	61	-	-	6	-	-	7	-	6	5	-	6
	220	61	-	-	7	-	-	6	-	5	6	-	6
	221	61	-	-	7	-	-	5	-	6	5	-	5
	222	61	-	-	7	-	-	5	-	5	5	-	5
	223	61	-	-	7	-	-	5	-	6	6	-	6
	224	61	-	-	8	-	-	6	-	7	6	-	6
	225	73	-	-	8	-	-	7	-	6	6	-	6
	226	73	-	-	8	-	-	7	-	7	7	-	7

Table A. (continued)

Area	Spec. No.	Len. (cm)	Readers 1	2	3	4	5	6	7	8	9	10	Age mode
30	227	73	-	6	12	-	-	-	-	7	-	-	-
(cont'd)	228	73	-	6	12	-	-	-	-	7	8	-	-
	229	76	-	5	14	-	-	-	-	6	7	-	-
	230	76	-	6	8	-	-	-	-	7	7	-	7
	231	76	-	4	9	-	-	-	-	6	7	-	-
	232	76	-	-	14	-	-	-	-	7	6	-	-
	233	76	-	-	13	-	-	-	-	8	7	-	-
	234	76	-	7	13	-	-	-	-	8	7	-	7
	235	76	-	5	14	-	-	-	-	7	7	-	7
	236	76	-	6	13	-	-	-	-	7	7	-	7
	237	76	-	6	14	-	-	-	-	8	7	-	-
	238	79	-	6	6	-	-	-	-	7	6	-	6
	239	79	-	6	8	-	-	-	-	7	7	-	7
	240	79	-	5	9	-	-	-	-	7	7	-	7
	241	79	-	-	10	-	-	-	-	7	7	-	7
	242	79	-	8	9	-	-	-	-	8	9	-	-
	243	79	-	7	8	-	-	-	-	6	7	-	7
	244	82	-	6	8	-	-	-	-	7	6	-	6
	245	82	-	8	9	-	-	-	-	9	8	-	-
	246	82	-	7	8	-	-	-	-	8	8	-	8
	247	85	-	8	9	-	-	-	-	7	7	-	7
	248	82	-	8	9	-	-	-	-	9	6	-	9
	249	79	-	8	10	-	-	-	-	8	8	-	8
	250	79	-	8	9	-	-	-	-	8	7	-	8
	251	73	-	6	7	-	-	-	-	7	6	-	-
	252	73	-	6	7	-	-	-	-	6	6	-	6
3P	301	64	4	6	6	5	-	-	5	5	5	5	5
	302	31	1	3	3	2	-	-	2	2	2	2	2
	303	34	2	3	3	2	-	-	3	2	2	3	-
	304	34	1	3	3	2	-	-	3	2	2	2	2
	305	34	2	3	3	2	-	-	3	2	2	2	2
	306	34	2	3	3	2	-	-	4	2	2	2	2
	307	37	2	3	3	2	-	-	3	2	2	2	2
	308	37	2	3	3	2	-	-	4	2	2	2	2
	309	37	2	3	3	2	-	-	3	2	2	2	2
	310	37	2	3	4	3	-	-	4	3	3	3	3
	311	37	4	4	4	5	-	-	6	3	3	5	4
	312	37	-	3	3	3	-	-	4	3	2	3	3
	313	49	3	3	4	4	-	-	5	3	3	3	3
	314	55	4	4	3	5	-	-	7	4	4	4	4
	315	55	4	4	5	4	-	-	6	5	4	6	4
	316	55	5	5	6	5	-	-	7	5	5	6	5
	317	55	4	5	5	4	-	-	5	4	4	4	4
	318	55	4	4	5	4	-	-	5	4	4	6	4
	319	55	5	5	5	5	-	-	7	5	4	5	5
	320	55	5	5	6	6	-	-	6	5	5	5	5
	321	55	4	4	6	5	-	-	8	4	4	4	4
	322	55	4	4	5	4	-	-	5	4	4	4	4
	323	55	5	5	6	5	-	-	6	5	5	5	5
	324	55	4	5	7	5	-	-	5	5	5	5	5
	325	55	4	5	6	5	-	-	6	5	5	5	5
	326	55	5	5	7	6	-	-	8	6	6	8	6
	327	55	5	5	-	-	-	-	5	4	4	6	5
	328	58	4	5	-	-	-	-	5	4	5	5	5
	329	58	5	5	-	-	-	-	6	3	5	6	5
	330	58	5	5	-	-	-	-	5	5	5	5	5
	331	58	5	5	-	-	-	-	5	5	5	5	5
	332	58	5	5	-	-	-	-	5	5	5	6	5
	333	58	5	5	-	-	-	-	6	5	5	6	5
	334	58	-	-	-	-	-	-	4	4	5	5	-
	335	58	-	4	-	-	-	-	6	4	5	6	-
	336	58	-	5	-	-	-	-	8	5	5	6	5
	337	58	-	5	-	-	-	-	5	5	5	5	5

Table A. (continued)

Area	Spec. No.	Len. (cm)	Readers 1	2	3	4	5	6	7	8	9	10	Age mode
3P (cont'd)	338	58	-	6	-	-	-	-	7	5	5	6	-
	339	58	-	5	-	-	-	-	6	5	5	5	5
	340	61	-	5	-	-	-	-	6	5	5	5	5
	341	61	-	5	-	-	-	-	6	5	6	7	-
	342	40	-	-	-	-	-	-	-	2	2	3	2
	343	40	-	4	-	-	-	-	5	2	3	4	4
	344	40	-	3	-	-	-	-	3	2	2	2	2
	345	40	-	2	-	-	-	-	4	2	3	2	2
	346	40	-	-	-	-	-	-	-	3	3	2	3
	347	40	-	3	-	-	-	-	4	3	3	3	3
	348	40	-	3	-	-	-	-	4	3	3	3	3
	349	40	-	2	-	-	-	-	5	3	2	3	-
	350	40	-	3	-	-	-	-	3	3	3	3	3
	351	40	-	2	-	-	-	-	-	3	2	3	-
	352	43	-	4	-	-	-	-	5	4	4	4	4
4Vn	401	40	3	3	-	3	-	-	3	4	-	-	3
	402	43	4	3	-	3	-	-	5	4	-	-	-
	403	43	3	3	-	4	-	-	4	3	-	-	3
	404	43	3	4	-	5	-	-	4	4	-	-	4
	405	43	3	4	-	3	-	-	4	4	-	-	4
	406	46	2	-	-	4	-	-	4	3	-	-	4
	407	46	4	4	-	4	-	-	6	4	-	-	4
	408	46	3	4	-	3	-	-	3	4	-	-	3
	409	49	4	5	-	3	-	-	5	5	-	-	5
	410	49	5	5	-	5	-	-	5	5	-	-	5
	411	49	4	6	-	4	-	-	5	4	-	-	4
	412	52	3	5	-	3	-	-	4	4	-	-	-
	413	52	5	6	-	4	-	-	5	5	-	-	5
	414	52	4	6	-	4	-	-	5	5	-	-	-
	415	52	4	5	-	5	-	-	4	5	-	-	5
	416	52	5	5	-	5	-	-	4	5	-	-	5
	417	55	5	6	-	5	-	-	4	5	-	-	5
	418	55	4	5	-	5	-	-	4	5	-	-	5
	419	55	4	5	-	4	-	-	4	5	-	-	4
	420	55	4	5	-	4	-	-	5	5	-	-	5
	421	55	4	5	-	5	-	-	5	5	-	-	5
	422	55	4	4	-	4	-	-	4	4	-	-	4
	423	55	4	5	-	4	-	-	5	5	-	-	5
	424	58	5	6	-	6	-	-	6	6	-	-	6
	425	58	6	7	-	7	-	-	6	7	-	-	7
	426	58	6	6	-	6	-	-	8	8	-	-	6
	427	58	-	6	-	4	-	-	5	5	-	-	5
	428	58	-	7	-	7	-	-	7	8	-	-	7
	429	58	-	7	-	5	-	-	6	6	-	-	6
	430	58	-	5	-	5	-	-	5	5	-	-	5
	431	58	-	6	-	5	-	-	5	5	-	-	5
	432	58	-	6	-	5	-	-	5	5	-	-	5
	433	61	-	8	-	9	-	-	8	8	-	-	8
	434	61	-	6	-	4	-	-	5	5	-	-	5
	435	61	-	7	-	7	-	-	6	7	-	-	7
	436	61	-	6	-	-	-	-	7	8	-	-	-
	437	61	-	7	-	7	-	-	7	7	-	-	7
	438	61	-	7	-	6	-	-	6	7	-	-	-
	439	61	-	6	-	6	-	-	5	5	-	-	-
	440	61	-	7	-	5	-	-	5	5	-	-	5
	441	61	-	6	-	6	-	-	5	5	-	-	-
	442	61	-	6	-	6	-	-	5	5	-	-	-
	443	64	-	-	-	-	-	-	9	8	-	-	-
	444	64	-	7	-	7	-	-	8	7	-	-	7
	445	64	-	6	-	5	-	-	5	4	-	-	5
	446	64	-	9	-	9	-	-	8	9	-	-	9
	447	64	-	8	-	7	-	-	8	8	-	-	8
	448	64	-	7	-	6	-	-	6	7	-	-	-

Table A. (continued)

Area	Spec. No.	Len. (cm)	Readers 1	2	3	4	5	6	7	8	9	10	Age mode
4Vn	449	64	-	7	-	7	-	-	7	8	-	-	7
(cont'd)	450	64	-	5	-	5	-	-	4	5	-	-	5
	451	64	-	6	-	5	-	-	6	5	-	-	-
5Z	486	70	4	4	-	3	4	-	-	4	-	-	4
	487	70	4	5	-	4	4	-	-	4	-	-	4
	488	70	6	6	-	4	5	-	-	5	-	-	-
	489	70	5	5	-	4	4	-	-	4	-	-	4
	490	70	8	7	-	6	8	-	-	8	-	-	8
	491	70	5	5	-	4	4	-	-	4	-	-	4
	492	70	5	5	-	4	4	-	-	4	-	-	4
	493	70	5	5	-	4	5	-	-	4	-	-	5
	494	70	4	4	-	3	4	-	-	4	-	-	4
	495	70	4	4	-	3	4	-	-	4	-	-	4
	496	70	5	5	-	4	5	-	-	5	-	-	5
	497	73	7	6	-	6	7	-	-	7	-	-	7
	498	73	4	4	-	3	4	-	-	4	-	-	4
	499	73	5	6	-	4	5	-	-	5	-	-	5
	500	73	4	4	-	3	4	-	-	4	-	-	4
	501	19	-	-	-	2	1	-	-	1	-	-	1
	502	28	2	2	-	2	2	-	-	2	-	-	2
	503	34	2	2	-	2	2	-	-	2	-	-	2
	504	34	3	2	-	2	2	-	-	2	-	-	2
	505	34	3	2	-	2	2	-	-	2	-	-	2
	506	37	4	3	-	3	2	-	-	2	-	-	-
	507	37	3	2	-	2	2	-	-	2	-	-	2
	508	37	4	2	-	3	2	-	-	2	-	-	2
	509	37	3	3	-	3	2	-	-	2	-	-	3
	510	37	3	3	-	2	2	-	-	2	-	-	2
	511	37	2	2	-	2	2	-	-	2	-	-	2
	512	37	3	3	-	2	2	-	-	2	-	-	2
	513	40	-	3	-	3	2	-	-	2	-	-	-
	514	40	2	3	-	3	2	-	-	2	-	-	2
	515	40	2	3	-	2	2	-	-	2	-	-	2
	516	40	4	-	-	2	2	-	-	2	-	-	2
	517	40	3	3	-	2	2	-	-	2	-	-	2
	518	40	4	4	-	3	2	-	-	3	-	-	-
	519	40	3	3	-	2	2	-	-	2	-	-	2
	520	40	4	4	-	2	2	-	-	3	-	-	-
	521	40	3	2	-	3	2	-	-	3	-	-	3
	522	40	4	4	-	3	2	-	-	3	-	-	-
	523	40	5	-	-	2	2	-	-	3	-	-	2
	524	40	3	3	-	3	2	-	-	2	-	-	3
	525	40	3	3	-	2	2	-	-	2	-	-	2
	526	40	-	2	-	2	2	-	-	3	-	-	2
	527	43	3	3	-	3	3	-	-	3	-	-	3
	528	43	2	2	-	2	2	-	-	3	-	-	2
	529	43	2	2	-	2	2	-	-	3	-	-	2
	530	43	2	2	-	2	2	-	-	3	-	-	2
	531	43	2	2	-	2	2	-	-	2	-	-	2
	532	43	2	2	-	2	2	-	-	2	-	-	2
	533	43	2	3	-	2	2	-	-	3	-	-	2
	534	43	2	2	-	2	2	-	-	2	-	-	2
	535	43	4	3	-	3	2	-	-	2	-	-	-
	536	43	3	3	-	3	2	-	-	2	-	-	3
	537	43	2	3	-	2	2	-	-	2	-	-	2

Table B. Age readings for otolith sample 2.

Area	Spec. No.	Len. (cm)	Sex. mat.	Readers 1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	Age mode
2J	1	34	10	4	4	3	4	-	4	4	4	3	4	4	4	3	5	3	4
	2	37	10	4	3	3	4	-	5	4	4	2	4	4	2	3	-	2	4
	3	37	10	5	4	4	5	-	4	4	4	3	4	4	4	3	5	4	4
	6	40	10	4	3	4	4	-	3	4	4	2	3	4	4	3	4	3	4
	12	40	11	5	6	5	-	-	5	5	5	3	5	6	4	4	6	3	5
	13	43	11	6	5	5	5	-	6	5	5	2	6	6	4	4	7	4	5
	14	46	11	5	6	5	6	-	6	6	6	3	6	6	4	5	7	4	6
	17	49	11	5	7	6	6	-	5	6	6	3	6	7	6	6	-	-	6
	20	49	11	7	7	6	6	7	5	6	6	7	7	-	6	7	7	7	7
	24	52	11	7	7	7	6	7	6	7	7	7	7	-	7	7	8	6	7
	25	52	11	5	6	6	4	5	5	6	6	5	5	-	5	6	6	5	5
	27	55	11	-	9	6	7	6	7	7	7	8	7	-	7	7	-	-	7
	33	58	11	4	4	4	5	-	4	7	7	5	4	5	4	3	4	4	4
	34	58	11	6	6	7	6	-	7	9	8	5	5	9	8	7	-	-	-
	36	61	11	7	8	8	8	-	8	8	7	8	8	8	8	8	8	8	8
	37	61	11	6	7	6	7	-	6	7	7	7	7	9	7	7	9	10	7
	38	64	11	7	-	7	7	-	7	7	7	5	6	9	7	7	7	-	7
	42	67	11	-	8	7	8	-	8	8	8	8	7	10	9	10	11	11	8
	43	67	11	9	11	10	10	-	9	10	10	10	9	10	10	10	10	11	10
	49	70	11	7	8	7	8	-	8	8	8	8	7	9	8	10	8	-	8
	50	70	11	9	8	8	9	-	8	9	10	8	8	9	8	9	9	11	-
	53	73	11	10	8	8	6	7	8	10	9	10	8	-	10	9	-	8	8
	54	76	11	-	10	11	7	12	10	10	11	11	10	-	13	12	11	-	-
	58	37	50	4	5	4	4	-	4	4	4	3	4	4	4	4	5	4	4
	59	40	50	-	4	4	4	-	3	4	4	2	4	4	4	4	4	3	4
	60	43	50	3	5	4	4	-	3	4	4	3	4	4	4	4	4	3	4
	62	43	50	-	5	4	4	-	4	4	7	-	6	-	6	5	7	5	4
	63	46	50	6	6	6	7	-	6	5	7	4	6	7	6	6	7	4	6
	66	49	50	7	6	6	5	6	5	6	6	7	7	-	6	7	7	5	6
	67	52	50	7	7	6	5	6	6	6	6	5	7	-	6	8	8	5	6
	74	55	51	7	6	7	7	-	7	7	7	6	6	7	6	6	8	6	7
	79	58	51	6	6	6	8	-	7	8	7	5	6	10	8	8	9	10	-
	85	61	51	7	7	7	7	-	6	8	7	7	7	7	7	7	7	7	7
	92	64	51	6	8	5	7	-	6	8	7	6	5	7	7	7	8	8	7
	94	64	51	9	9	9	10	-	11	11	10	10	9	12	11	11	11	10	11
	99	67	51	9	9	9	10	-	9	9	9	8	9	10	9	9	10	-	9
	105	70	51	10	8	7	7	9	8	10	9	9	8	-	10	10	11	9	-
	107	73	50	-	7	6	6	6	6	8	8	7	7	-	7	7	-	6	-
	108	73	51	9	9	8	9	10	9	9	9	10	9	-	9	9	10	8	9
	121	76	51	8	10	8	7	9	9	12	12	9	8	-	9	9	10	10	9
	122	76	51	9	10	8	8	7	8	11	11	9	9	-	11	9	10	7	9
	129	79	51	9	8	8	-	-	7	11	11	9	-	11	10	11	13	9	11
	130	79	51	-	9	7	9	7	7	13	13	9	8	-	8	8	9	8	-
	135	82	51	8	9	-	8	-	6	10	10	8	-	9	9	8	-	7	8
	136	82	51	-	12	8	-	9	10	12	12	11	8	-	12	11	13	-	12
	178	79	51	12	11	9	9	7	9	11	11	11	11	-	11	12	11	14	11
	243	46	10	6	6	5	6	-	7	5	5	3	6	6	5	5	7	5	5
	299	85	51	10	11	11	10	-	11	12	12	11	11	12	12	12	13	13	-
	300	85	51	8	10	8	8	-	8	9	9	10	-	10	9	9	11	-	-
3K	317	34	10	4	4	4	3	3	4	3	3	3	4	3	2	2	5	-	3
	318	34	10	4	4	4	4	4	4	4	4	3	4	4	2	4	5	3	4
	320	37	10	-	6	5	5	5	5	4	5	5	6	-	4	6	5	-	5
	321	37	10	7	6	5	5	4	5	4	4	-	4	7	3	4	5	4	4
	322	37	10	-	-	7	4	8	6	4	5	5	7	-	3	3	8	-	-
	326	40	10	4	6	5	3	2	3	4	4	3	4	4	3	3	7	5	-
	327	40	10	4	6	5	4	6	4	5	5	4	5	-	2	4	6	6	4
	328	40	10	4	6	-	5	3	4	5	5	5	5	4	2	4	8	6	5
	330	43	10	5	6	6	5	5	5	5	5	5	6	5	5	5	7	5	5
	331	43	10	-	14	12	9	12	9	4	4	11	11	11	10	10	15	14	11
	332	43	10	4	6	4	4	4	4	5	4	4	4	4	4	4	-	7	4
	334	46	10	8	7	5	5	6	6	6	4	4	5	5	4	8	7	4	-
	335	46	10	5	7	6	4	5	4	6	5	5	5	4	5	3	9	6	5
	336	49	10	4	7	6	6	4	-	5	5	4	6	6	4	3	9	-	-

Table B. (continued)

Area	Spec. No.	Len. (cm)	Sex. mat.	Readers 1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	Age mode
3K	337	49	10	6	6	5	5	6	6	5	5	6	7	7	4	5	7	6	6
(cont'd)	339	49	11	7	7	7	5	8	4	5	5	7	5	5	3	4	9	8	5
	340	52	11	8	8	7	5	7	6	6	6	7	7	6	7	5	8	6	-
	345	49	11	5	6	6	6	5	5	6	6	5	6	6	6	6	8	6	6
	348	55	11	8	7	7	7	8	7	7	7	7	6	7	7	8	8	7	7
	349	61	11	10	8	6	7	9	8	7	7	7	6	9	7	4	11	6	7
	350	64	11	11	12	10	9	10	9	10	10	11	10	10	9	10	11	9	10
	351	70	11	7	7	7	6	8	7	8	8	7	7	9	7	7	10	7	7
	352	61	11	8	7	6	4	6	5	7	7	7	6	5	5	4	10	6	-
	361	52	10	-	5	6	5	6	5	6	6	6	6	5	4	6	9	-	6
	366	34	50	4	6	5	4	3	4	4	4	4	6	3	4	3	6	5	4
	398	55	50	4	6	6	5	4	4	5	6	5	6	5	5	4	7	5	5
	399	55	50	8	8	7	6	7	5	6	6	5	7	-	5	6	8	6	6
	401	52	51	10	10	8	7	9	9	6	7	11	8	-	9	8	13	8	8
	403	58	51	8	7	7	7	-	6	7	7	7	7	7	7	5	8	6	7
	404	61	51	9	9	8	7	-	9	8	8	8	8	8	8	2	10	7	8
	405	61	51	8	7	7	6	7	6	7	7	6	7	9	7	7	8	5	7
	406	55	51	-	7	5	5	5	4	6	7	6	6	5	6	6	7	4	6
	422	67	51	10	8	7	7	8	6	9	9	6	7	8	8	9	10	6	8
	423	79	51	9	7	8	-	10	7	10	10	7	9	-	8	6	11	-	
	428	82	51	9	9	8	6	8	7	10	8	8	8	9	8	7	9	5	8
	429	58	51	-	7	6	6	6	7	7	7	6	6	7	7	6	-	-	-
	430	76	51	8	7	6	6	7	-	8	8	5	6	6	6	5	7	5	6
	464	58	11	8	8	6	7	8	7	7	7	6	7	7	7	7	4	7	7
	465	67	11	-	8	9	5	9	6	9	9	9	9	11	9	9	10	7	9
	470	64	51	7	8	7	6	7	7	7	7	6	8	8	7	6	8	7	7
	517	58	51	7	9	7	6	7	7	6	7	-	7	8	7	5	-	4	7
	530	82	11	13	12	7	-	10	-	10	9	8	7	10	9	7	14	9	-
	531	67	51	-	9	8	6	9	7	10	8	-	9	9	9	11	-	-	9
	548	64	11	6	8	7	6	7	6	9	7	7	7	6	8	7	11	7	7
	583	79	11	6	7	6	6	6	6	8	11	5	7	7	6	4	9	7	6
	635	70	51	8	8	8	7	9	-	9	9	9	9	9	8	8	10	7	9
3L	1	34		5	4	4	3	4	3	4	4	3	4	3	3	3	6	3	3
	2	34		3	4	3	4	3	3	3	4	3	3	3	3	3	3	2	3
	6	37		5	4	5	5	5	4	4	5	4	4	4	3	4	8	5	4
	7	37		4	4	4	4	3	3	4	4	4	4	3	4	4	5	-	4
	10	37		-	5	5	5	6	4	6	6	5	4	4	5	4	8	5	5
	24	40		5	5	6	5	6	5	5	6	5	6	6	5	5	5	4	5
	25	40		5	4	5	4	4	4	4	4	4	5	4	4	4	7	5	4
	26	40		6	5	6	6	6	6	5	6	6	5	6	6	6	6	5	6
	39	43		5	5	5	4	5	4	5	6	4	5	-	4	5	6	5	5
	40	43		6	6	7	6	6	5	5	5	6	7	6	5	5	7	6	6
	41	43		6	6	6	6	6	5	6	5	5	6	5	5	6	7	-	6
	55	46		4	4	7	4	4	3	4	4	4	4	4	4	4	5	-	4
	56	46		5	6	6	5	4	4	5	5	5	5	6	5	5	8	6	5
	57	46		6	6	6	6	6	6	6	6	6	6	6	6	6	7	8	6
	66	49		5	5	6	4	4	4	4	5	4	4	4	5	5	5	-	4
	67	49		6	6	6	6	6	6	6	6	6	6	6	6	6	7	7	6
	68	49		-	7	7	5	7	5	7	7	7	5	6	7	7	8	8	7
	88	52		5	6	6	4	-	6	6	6	5	5	6	5	4	-	-	6
	89	52		5	7	5	4	6	4	5	5	4	4	5	5	4	7	-	5
	90	52		5	7	4	4	5	6	7	6	5	4	5	6	4	8	8	-
	101	55		6	6	5	4	5	5	6	6	6	5	6	5	6	6	6	6
	102	55		7	6	6	6	6	6	7	6	6	6	6	6	6	6	7	6
	103	55		7	7	4	4	7	4	7	5	6	6	6	7	4	7	6	7
	112	58		-	7	6	5	8	-	6	6	6	7	7	6	6	8	-	6
	113	58		-	6	6	5	7	5	6	6	6	6	6	5	5	-	-	6
	114	58		7	6	6	5	6	6	7	6	6	6	6	6	5	-	5	6
	132	61		7	6	6	6	7	5	7	6	6	6	6	6	5	7	-	6
	133	61		6	7	6	5	6	6	6	6	6	6	6	6	6	6	6	6
	134	61		7	8	6	5	6	5	6	6	6	6	6	6	6	8	5	6
	155	64		-	8	7	6	8	7	9	8	7	7	-	7	7	-	-	7
	156	64		7	7	6	4	5	5	6	7	6	6	-	7	6	8	-	6

Table B. (continued)

Area	Spec. No.	Len. (cm)	Sex. mat.	Readers 1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	Age mode
3L	157	64		8	8	6	-	9	5	8	7	6	7	8	7	7	10	-	-
(cont'd)	169	67		7	9	6	5	7	6	6	6	6	6	8	6	7	8	9	6
	170	67		9	9	9	8	10	8	10	9	9	9	9	9	9	10	8	9
	171	67		8	7	8	-	9	6	9	10	9	8	-	10	8	-	11	8
	177	70		6	7	7	6	6	6	9	6	6	6	-	8	6	8	11	6
	178	70		7	8	8	6	8	7	8	8	9	8	-	9	7	8	-	8
	179	70		6	7	7	6	6	6	7	6	8	7	-	6	6	8	7	6
	183	73		8	8	8	6	9	6	8	7	8	8	-	7	8	9	8	8
	184	73		8	7	8	7	7	-	8	8	7	8	-	7	8	11	-	8
	185	73		10	9	8	7	10	9	9	9	7	8	-	10	11	11	12	9
	188	76		7	-	7	6	8	7	9	8	7	7	-	8	9	11	9	7
	189	76		10	9	10	8	-	-	11	11	10	10	-	11	8	11	13	-
	191	79		6	7	6	7	6	6	9	6	9	6	-	6	6	10	10	6
	192	79		8	9	8	8	8	8	9	8	8	8	-	9	8	9	-	8
	193	79		7	8	7	7	9	9	9	9	7	7	-	9	10	10	14	-
	258	82		-	7	7	8	7	7	9	7	8	7	-	9	7	11	12	7
	268	82		10	10	11	9	-	8	11	11	11	11	-	11	11	12	10	11
	269	82		-	11	11	9	11	10	12	12	12	12	-	12	11	12	14	12
3NO	1	37		4	6	4	4	-	4	4	4	4	4	4	4	4	5	6	4
	2	40		4	6	4	3	4	4	4	4	3	4	4	4	4	5	6	4
	5	40		4	7	5	4	4	4	4	4	4	4	4	4	4	4	7	4
	8	40		4	6	5	4	4	4	4	4	4	4	4	4	4	5	5	4
	9	43		-	6	4	4	5	4	4	4	5	5	4	4	4	7	4	4
	11	43		4	7	5	4	4	4	4	4	4	5	4	4	4	6	7	4
	13	43		4	5	4	4	4	4	4	4	4	4	4	4	4	4	5	4
	15	46		4	5	4	4	4	4	4	4	4	4	4	4	4	5	5	4
	16	46		4	5	4	3	-	4	3	4	4	4	4	3	3	5	5	4
	17	46		-	7	5	-	4	-	5	5	-	5	-	4	5	8	6	5
	26	49		4	-	5	4	-	5	5	5	4	5	4	5	4	7	-	5
	27	49		4	6	5	4	4	4	4	4	4	5	5	4	4	7	5	4
	28	49		5	-	6	5	6	5	4	5	5	5	5	5	5	9	5	5
	38	52		-	8	6	5	6	5	6	6	6	6	6	5	5	7	8	6
	40	52		5	-	5	4	4	4	5	5	5	5	5	4	5	8	5	5
	41	52		-	8	6	5	7	5	6	6	6	6	6	7	6	9	8	6
	43	55		5	5	6	3	6	4	5	7	4	5	5	6	4	-	5	5
	45	55		6	5	6	4	7	4	5	7	4	-	6	5	4	6	-	
	46	58		7	7	8	6	7	6	7	7	8	7	8	7	6	8	6	7
	47	58		-	7	8	7	7	6	7	7	7	8	7	7	5	8	-	7
	49	61		7	8	7	6	8	5	7	7	7	7	7	7	7	7	7	7
	50	61		7	7	7	7	7	6	7	7	7	7	7	7	6	7	7	7
	51	61		9	6	6	6	6	6	6	7	6	6	6	6	6	7	-	6
	54	64		-	-	6	-	-	6	6	6	6	6	5	5	6	-	-	6
	57	64		8	7	6	6	6	6	6	6	6	7	6	6	6	7	-	6
	59	64		10	8	8	6	8	7	7	7	6	9	8	8	8	9	8	8
	60	67		9	7	8	6	7	7	7	9	6	7	7	7	6	12	-	7
	61	67		9	-	6	5	6	5	7	7	5	6	-	7	6	-	-	6
	64	67		8	8	7	6	7	7	7	8	7	7	7	7	8	7	8	7
	66	70		-	6	7	5	8	6	7	7	6	7	7	7	6	8	-	7
	67	70		7	7	7	6	7	7	7	7	7	7	7	7	7	7	6	7
	68	70		8	6	6	6	6	6	7	7	7	6	6	7	7	9	-	6
	70	73		7	5	6	5	7	6	6	7	6	6	7	7	7	7	8	7
	71	73		7	7	7	7	-	6	9	9	7	-	-	7	5	8	-	7
	72	73		8	8	8	9	-	7	10	8	8	8	-	8	8	10	7	8
	74	76		8	8	8	7	-	7	8	8	7	8	-	8	7	-	7	8
	75	76		8	9	8	8	-	7	8	8	8	9	-	9	7	10	8	8
	76	76		7	7	7	7	-	6	7	7	6	6	-	7	6	7	7	7
	77	79		7	8	8	6	-	6	7	7	6	7	-	7	7	8	7	7
	78	79		7	7	7	6	-	7	7	7	7	-	-	8	7	7	7	7
	79	79		11	12	11	8	-	9	11	11	8	9	-	10	8	11	-	11
	82	82		10	10	11	10	-	8	11	11	11	9	-	10	9	11	10	-
	83	82		-	11	9	11	-	8	11	10	7	8	-	10	7	11	10	11
	84	82		8	7	7	6	-	7	7	8	6	8	-	8	7	8	-	-
	85	85		9	8	9	8	-	8	10	9	9	8	-	10	9	10	-	9

Table B. (continued)

Area	Spec. No.	Len. (cm)	Sex. mat.	Readers 1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	Age mode
3NO	86	85		-	-	9	-	-	9	9	9	9	9	-	11	9	-	8	9
(cont'd)	87	88		-	8	8	7	-	7	8	7	9	7	-	8	7	-	-	7
	88	88		7	7	8	8	-	6	8	7	9	7	-	8	7	10	-	7
	89	91		7	8	8	8	-	7	8	8	8	8	-	8	7	-	6	8
30	1	34		4	4	5	4	5	5	4	4	5	5	4	5	5	5	7	5
	2	34		3	3	3	3	3	3	3	3	3	3	3	3	3	3	5	3
	3	34		5	4	5	5	5	5	4	4	5	5	5	5	4	5	5	5
	4	37		4	4	4	3	4	4	4	4	3	4	4	4	4	4	-	4
	5	40		6	4	5	5	6	6	4	5	5	6	6	6	6	6	7	6
	6	40		4	4	5	4	5	5	5	5	4	5	4	4	4	4	5	4
	7	40		5	5	5	4	5	5	5	5	5	5	4	5	4	5	6	5
	15	43		5	5	5	5	5	5	5	5	5	5	5	5	4	5	-	5
	16	43		6	6	5	4	6	5	5	5	5	7	6	5	5	6	7	5
	17	43		-	6	6	4	4	5	4	4	5	5	6	5	4	5	7	-
	25	46		6	6	6	6	6	6	5	6	6	6	6	6	6	6	5	6
	26	46		5	5	5	5	6	5	4	5	5	5	-	5	5	6	-	5
	27	46		5	6	5	4	5	5	5	5	5	6	5	5	6	6	6	5
	35	49		5	6	6	5	6	5	5	6	6	6	5	5	6	6	8	6
	36	49		6	6	6	4	6	5	5	5	6	6	6	6	6	6	7	6
	48	52		8	8	8	8	7	5	6	6	6	8	-	-	5	8	8	8
	55	55		9	9	7	7	9	5	6	6	4	7	-	-	5	8	7	7
	56	55		-	-	7	6	7	5	6	7	5	6	-	-	5	8	-	-
	57	55		-	8	7	6	6	5	6	6	6	6	-	-	6	7	7	6
	65	58		6	6	6	6	6	5	6	7	6	6	-	-	5	6	5	6
	66	58		6	6	6	5	7	6	6	6	5	6	-	-	6	7	5	6
	67	58		7	7	7	6	7	5	6	6	5	7	-	-	6	10	8	7
	76	61		5	5	7	6	6	5	6	7	6	7	-	-	7	7	-	7
	77	61		-	6	6	6	7	5	6	7	5	6	-	-	6	8	6	6
	78	61		6	6	7	4	-	4	5	6	4	6	-	-	5	-	-	6
	86	64		7	6	6	6	7	5	6	7	5	6	-	-	6	7	6	6
	87	64		8	-	7	6	7	-	7	7	-	7	-	-	7	11	9	7
	88	64		7	6	6	6	6	6	7	7	6	6	-	-	6	7	-	6
	102	67		8	7	6	7	6	6	6	7	6	7	-	-	7	8	-	-
	103	67		7	6	6	6	6	6	6	6	6	6	-	-	6	6	5	6
	108	67		7	6	7	6	6	6	6	6	5	6	-	-	6	7	8	6
	113	70		7	7	7	7	7	6	7	8	7	7	-	-	7	9	-	7
	115	70		8	7	7	7	8	5	7	7	7	7	-	-	8	9	7	7
	119	70		-	11	10	10	10	7	9	12	10	8	10	10	10	10	8	10
	120	73		6	7	6	6	6	5	6	7	6	6	6	6	6	6	-	6
	121	73		7	8	7	7	7	6	8	8	7	7	7	7	7	-	8	7
	122	76		7	11	7	8	8	7	8	8	8	7	10	8	7	12	9	8
	123	76		7	10	7	9	10	7	7	7	7	7	9	9	7	10	-	7
	124	76		5	7	6	6	7	6	6	6	6	6	6	6	6	8	5	6
	131	79		6	7	6	6	6	5	6	7	6	6	6	6	6	6	5	6
	132	79		7	7	-	7	8	7	8	8	8	7	7	7	7	8	6	7
	133	79		9	9	-	9	9	7	9	9	8	7	9	9	9	13	-	9
	140	82		10	10	8	8	9	8	9	9	9	8	10	10	9	14	7	9
	141	85		8	9	9	9	7	8	9	10	9	9	8	8	9	10	8	9
	142	85		8	-	-	8	11	7	9	8	8	8	8	8	9	13	-	8
	143	85		8	-	-	-	9	7	9	9	7	7	8	10	9	13	8	9
	146	88		-	-	8	-	8	7	9	10	6	8	-	9	-	-	6	8
	147	88		7	10	8	8	8	7	9	9	8	7	8	8	8	9	5	8
	149	88		7	8	8	7	9	7	9	10	7	8	7	11	11	-	5	7
3Ps	1	31	10	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
	2	34	50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
	3	34	10	4	4	-	3	3	3	3	3	3	4	3	3	3	4	2	3
	4	34	10	3	3	3	3	3	3	3	3	3	3	3	3	3	4	2	3
	5	37	10	3	4	3	3	3	3	3	3	3	3	3	3	3	3	2	3
	6	37	10	4	4	3	3	3	3	3	3	3	4	4	3	3	6	3	3
	7	37	50	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3
	9	40	50	4	4	3	4	3	4	4	4	4	4	4	4	4	7	3	4

Table B. (continued)

Area	Spec. No.	Len. (cm)	Sex. mat.	Readers 1	2	3	4	5	7	8	9	11	12	13	14	15	16	17	Age mode
3Ps	10	40	10	-	-	3	3	3	3	3	3	3	3	3	3	4	4	3	3
(cont'd)	11	40	10	3	4	3	3	3	3	3	3	3	3	3	3	3	3	2	3
	23	43	10	5	5	4	4	4	4	4	4	4	4	4	4	4	7	3	4
	25	43	50	-	4	3	3	3	3	3	3	3	3	4	4	3	5	3	3
	33	43	10	5	5	5	5	5	4	5	5	5	5	5	5	5	6	4	5
	37	46	50	6	6	-	7	7	5	5	5	6	6	7	7	6	7	5	-
	41	46	10	5	5	5	5	5	4	5	5	5	5	5	5	5	5	4	5
	45	46	11	5	5	5	5	5	4	5	5	5	4	5	5	5	5	4	5
	52	49	50	-	-	6	6	6	6	5	5	5	6	-	5	4	10	5	-
	53	49	50	4	5	4	4	4	4	4	4	4	4	4	4	4	4	-	4
	58	49	50	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	67	52	51	5	6	-	5	5	5	5	5	5	5	4	5	5	5	6	5
	73	52	11	6	6	-	6	6	6	6	6	6	5	6	6	6	6	6	6
	77	52	11	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	82	55	10	5	5	4	5	5	4	5	5	5	5	4	5	5	5	5	5
	86	55	11	6	7	6	6	6	6	6	6	6	6	6	6	6	6	8	6
	93	55	50	5	7	5	5	5	5	5	5	5	5	5	5	5	5	7	5
	101	58	11	5	6	4	5	5	5	6	5	5	4	4	5	5	5	5	5
	102	58	50	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	104	58	11	7	8	6	5	7	7	6	6	6	7	6	6	7	7	7	7
	117	61	50	6	7	6	5	7	7	6	6	6	7	5	7	6	7	8	-
	120	61	11	5	6	5	5	5	5	5	5	5	5	5	5	6	5	6	5
	126	61	11	6	7	6	6	6	6	6	6	6	6	5	6	6	6	7	6
	127	64	11	-	6	5	6	6	6	6	6	6	-	5	6	5	6	6	6
	143	64	51	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	148	64	51	9	8	8	7	9	7	8	9	6	9	9	9	9	9	7	9
	155	67	11	5	7	6	6	6	6	6	6	5	6	7	6	6	-	6	6
	163	67	51	6	7	6	6	6	6	6	6	6	6	6	6	6	6	5	6
	170	67	51	6	7	7	6	6	6	7	7	6	6	6	7	6	6	7	6
	173	70	51	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	174	70	51	6	7	6	6	6	6	6	6	6	6	6	6	6	6	8	6
	175	70	11	9	9	8	7	9	8	9	9	9	-	9	9	8	9	9	9
	178	73	11	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8
	179	73	11	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	180	73	51	9	10	9	9	9	9	9	9	9	9	9	9	9	9	8	9
	183	76	11	7	8	7	7	7	6	7	7	7	7	7	7	7	7	6	7
	184	76	11	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	185	76	51	7	7	7	7	7	7	7	7	7	7	7	7	7	8	-	7
	188	79	51	7	8	7	7	8	7	8	8	8	8	7	8	8	8	7	8
	189	79	11	7	8	-	8	8	7	9	8	8	8	8	8	8	8	8	8
	190	82	51	9	9	8	8	10	8	9	10	8	8	13	10	9	9	8	8

APPENDIX III

Selected Otoliths and Their Interpretations

Otolith 2J-1 (modal age 4)

Nine of the 14 readers aged this otolith as 4, 4 recorded age 3 and one reader gave age 5. Those suggesting age 3 (o) consider the third annulus of the age 4 reading (●) to be a check. The age 5 interpretation was withdrawn after examination of the photograph.

Otolith 2J-2 (modal age 4)

Six of the 13 readers agreed to age 4 and 3 recorded age 3, with other interpretations being withdrawn following discussion of the photograph. The second annulus of the age 4 reading (o) was considered as a check by those recording age 3.

Otolith 2J-12 (modal age 5)

Six of the 13 readers recorded age 5 and 3 indicated age 6, the other interpretations being withdrawn after studying the photograph. Those suggesting age 5 (o) considered the second annulus of the age 6 reading (●) to be a check.

Otolith 2J-13 (modal age 5)

Out of 14 readers, 3 recorded age 4, 5 readers indicated age 5 and 4 gave age 6. Those who suggested age 4 (●) considered the second annulus of the other readings (o and x) to be a check, and those readers who preferred age 5 (o) treated the third annulus of the age 6 reading (x) as a check or split.

Otolith 2J-14 (modal age 6)

Seven of the 14 readers indicated age 6, 2 readers suggested age 4 and 3 favoured age 5. Those recording age 4 (o) considered the third and fifth annuli of the age 6 reading (x) to be checks, whereas the age 5 reading (●) treats the third annulus of the age 6 reading (x) as a check.

Otolith 2J-58 (modal age 4)

Eleven of the 14 readers agreed to age 4, with one suggesting age 3 and 2 favouring age 5. These latter interpretations were withdrawn after studying the photograph.

Otolith 2J-63 (modal age 6)

Seven of the 14 readers recorded age 6 and 4 readers indicated age 7, with the others suggesting ages 4 and 5. The only discrepancy between those recording ages 6 and 7 relates to the interpretation of the innermost ring as a check or an annulus.

Otolith 2J-74 (modal age 7)

Seven of the 14 readers agreed to age 7 and 6 readers favoured age 6, the difference being in the interpretation of the innermost ring (●). The agreed interpretation as age 7 from the photograph (—) includes an annulus not considered by any of those previously recording the age as 6 or 7.

Otolith 2J-85 (modal age 7)

Twelve of the 14 readers recorded age 7, with one suggesting age 8 and another age 6, the last being withdrawn following a study of the photograph. The only discrepancy was in the interpretation of the innermost ring.

Otolith 2J-122 (modal age 9)

Interpretation of this otolith ranged from ages 7 to 11, with 3 of the 14 readers recording age 8, 4 readers favoured age 9, 2 indicated age 10 and 3 preferred age 11. A major problem was in the interpretation of the innermost ring (o and ●). Other discrepancies include the consideration of additional annuli at the edge by some readers and the interpretation of certain rings as checks by some and as annuli by others.

Otolith 2J-300 (modal age 9?)

Out of 12 readers, 4 recorded age 8, 4 indicated age 9 and 3 suggested age 10. The main difference between those recording age 8 on the one hand (o) and ages 9 and 10 on the other (● and x) is the inclusion of an additional annuli at the edge by the latter. The other difference is that the seventh annulus of the age 10 reading (x) is considered as a split by the other groups.

Otolith 3K-317 (modal age 3)

Six of the 14 readers agreed to age 3 and 5 readers indicated age 4, with the others suggesting ages 2 and 5. The third annulus of the age 4 reading (●) was considered as a check in the age 3 reading.

Otolith 3K-318 (modal age 4)

Eleven of the 15 readers recorded age 4, with 2 readers giving age 3 by interpreting the second annulus of the age 4 reading (o) as a check.

Otolith 3K-321 (modal age 4)

Six of the 14 readers agreed to age 4, with 4 readers indicating age 5 and 3 suggesting age 7. The fourth annulus of the age 5 reading (o) is considered as a check in that of age 4 (●). Relative to the age 4 reading, those recording age 7 (x) included three additional annuli in the zone between the third and fourth annuli of the age 4 reading.

Otolith 3K-328 (modal age 5)

Out of 14 readers, 4 recorded the age as 4, 5 readers indicated age 5 and 2 suggested age 6. The remaining readers recorded the age as low as 2 and as high as 8. The third annulus of the age 5 reading (●) was considered as a check in the age 4 reading (o), and the second annulus of the age 6 reading (x) was interpreted as a check by the others.

Otolith 3K-337 (modal age 6)

Out of 15 readers, 5 recorded age 5, 6 readers indicated age 6 and 3 suggested age 7. Of the ages indicated in the photograph, the third annulus of the age 6 reading (●) was considered as a check by those favouring age 5 (o).

Otolith 3K-339 (modal age 5)

Out of 15 readers, 2 indicated age 4, 5 readers recorded age 5, 4 favoured age 7, 2 readers preferred age 8 and the others gave ages 3 and 9. Relative to the modal age (x), variation in interpretation was great. This otolith is a typical example of the problem of interpreting annuli and checks.

Otolith 3K-352 (modal age 6 or 7)

The ageing of this otolith ranged from ages 4 to 10, with ages 5, 6 and 7 being recorded by 3, 4 and 4 readers respectively. The two readers recording age 4 (—) considered the first annulus of the other readers to be a check. The second and fifth annuli of the age 8 reading (x) were treated as checks by the other groups. The major difference between those recording ages 6 and 7 (o and ●) was in the interpretation of the fourth ring as a check on the one hand and as an annulus on the other.

Otolith 3K-366 (modal age 4)

Out of 15 readers, 7 recorded the age as 4, with 3 readers indicating age 3, 2 giving age 5 and 3 recording age 6. The third and fifth annuli of the age 6 readings (●) were considered as checks by those recording age 4 (—) and the third annulus (●) as a check or split by those giving age 5 (o).

Otolith 3K-404 (modal age 8)

Out of 14 readers, 2 recorded age 7, 7 indicated age 8 and 3 suggested age 9. Following a discussion of the photograph, two interpretations were held (ages 7 and 8). The second annulus of the age 8 reading (o) was considered to be a check by those recording the age as 7.

Otolith 3K-429 (modal age 6 or 7)

Out of the 12 readers, 6 indicated age 6 and 7 recorded age 7, the difference in all cases being the interpretation of the fifth annuli of the age 7 reading (o) as a check by the others.

Otolith 3K-548 (modal age 7)

Out of 15 readers, 4 recorded the age as 6, 7 recorded age 7, 2 suggested age 8 and 1 gave age 9. Following a study of the photograph, discussion centred on interpretation as ages 7, 8 and 9. The main discrepancies were: designation of the innermost ring as an annulus in the age 9 reading (●); the second and third annuli in the age 8 reading (o) were treated as checks by the other groups; the fourth annulus in the age 7 reading (–) was considered a check by the others; and the sixth and eighth annuli in the age 9 reading (●) were read as checks by readers recording ages 7 and 8.

Otolith 3L-6 (modal age 4)

This specimen was read as age 4 by 7 readers and age 5 by 6 readers, with one reader suggesting age 3 and another age 8. Discussion of the photograph centred on interpretation as age 4 or age 5. Those indicating age 4 arrived at that age by considering as the second annulus (– and x) rings which are not coincident, whereas the age 5 reading (●) treated both of these rings as annuli.

Otolith 3L-24 (modal age 5)

Out of 15 readers, 9 recorded the age as 5 and 5 readers indicated age 6. Among the readers recording age 5, one group (o) considered the second annulus of the other group (–) as a check but included an annulus at the edge. Those who recorded the age as 6 (x) included both of these rings as annuli.

Otolith 3L-55 (modal age 4)

Following discussion of the photograph all readers agreed unanimously on age 4, although 3 out of the 14 readers recorded the age as 3, 5 or 7 previously.

Otolith 3L-68 (modal age 7)

Out of 14 readers, 8 recorded the age as 7, 3 readers indicated age 5 and 2 readers gave age 8. Those suggesting age 5 (x) considered as checks the second and third annuli (–) of the age 8 reading and omitted the annulus at the edge. The majority, however, in deciding on age 7 (o), considered the second annulus of the age 8 reading as a check.

Otolith 3L-102 (modal age 6)

This specimen was interpreted as age 6 by 12 of the 15 readers, with the remainder suggesting age 7. The only difference in interpretation involved the innermost ring which was considered as a check by most of the readers.

Otolith 3L-134 (modal age 6)

Nine of the 15 readers recorded age 6, 3 readers indicated age 5 and the remaining 3 suggested ages 7 or 8. The age 7 reading (–) agrees with that of age 6 (x), except that the innermost ring is considered as a check in the latter interpretation. Those recording age 5, however, considered the second annulus of the age 6 reading (x) as a check.

Otolith 3L-170 (modal age 9)

This specimen was recorded as age 9 by 9 of the 15 readers, with 3 suggesting age 8 and 3 indicating age 10. The main differences were that the ninth annulus of the age 10 reading (–) was considered a check by the other groups and that the second annulus of the age 9 reading (●) was treated as a check by the readers recording the age as 8 (x).

Otolith 3L-183 (modal age 8)

Eight of 14 readers recorded the age as 8, with 2 readers indicating age 7, 2 others age 8 and one suggesting age 6. The readers who recorded age 7 (x) considered the second annulus of the age 8 reading (o) as a check, and those suggesting age 9 (●) interpreted the rings in the same way as the age 8 reading but added an additional annulus at the edge.

Otolith 3L-189 (modal age 10 or 11)

Out of 12 readers, 4 agreed on age 10 and 4 indicated age 11, with the others variously suggesting 8, 9 or 13. Two interpretations of the otolith as age 10 are indicated (● and x), the first including the innermost ring as an annulus, and the third annulus (x) is considered as a check by the other group (●). In the age 11 reading (o), the tenth annulus is considered to be a check by those giving age 10 (●).

Otolith 3L-268 (modal age 11)

Seven of 13 readers initially recorded age 11 for this specimen, with 3 indicating age 10 and the others variously suggesting 8, 9 or 12. Following a discussion of the photograph, age 11 was agreed to by all readers.

Otolith 30-1 (modal age 5)

Eight of the 15 readers indicated age 5 and 6 readers suggested age 4. The difference in interpretation was due to one group (–) including the second ring as an annulus and the other group (●) treating the ring as a check.

Otolith 30-16 (modal age 5)

Seven of the 15 readers recorded age 5 but arrived at the result in different ways (x and o), whereas 5 readers indicated age 6 and one gave age 4. For both groups giving age 5, the sole difference was in the location of the first annulus. Those readers who suggested age 6 included both of the first two rings as annuli.

Otolith 30-17 (modal age ?)

Out of 14 readers, 5 indicated age 4, 5 recorded age 5 and 3 suggested age 6. The difference between the age 4 and age 5 readings is in the interpretation of the third annulus of the latter age (o) as a check in the case of the age 4 reading (–). The last 4 annuli of the age 5 reading (o) are the same as those of age 6 (●), but the first annulus of the former does not coincide with either of the first 2 annuli of the latter reading.

Otolith 30-48 (modal age 8)

Seven of the 13 readers interpreted this otolith as age 8, 1 as age 7, 3 as age 6 and 2 as age 5. Only ages 6 and 8 warranted consideration in the subsequent study of the photograph, the major difference being the consideration of the fourth and sixth annuli of the age 8 reading (o) as checks in the age 6 reading (–).

Otolith 30-55 (modal age 7)

The 13 readers recorded ages ranging from 4 to 9, with 2 readers favouring age 5, 2 for age 6, 4 for age 7 and 3 for age 9. Relative to the modal age (o), the age 9 reading (–) includes two annuli (fourth and fifth) which were considered to be checks in the age 7 reading. The difference between the age 6 and age 7 reading is that the second annulus of the latter (o) is treated as a check in the former (●). Regarding the age 5 reading (x), the fifth and sixth annuli of the age 7 reading (o) are considered to be checks.

Otolith 30-65 (modal age 6)

The modal age of 6 was recorded by 9 of the 13 readers, with 3 indicating age 5 and one suggesting age 7. The fifth annulus of the age 7 reading (●) was considered to be a check by those who recorded age 6 (–), and the fifth annulus of the age 6 reading (–) was treated as a check in the age 5 reading (o).

Otolith 30-115 (modal age 7)

Eight of the 13 readers interpreted the age of this otolith as 7 but they arrived at the result in different ways (– and x), the location of the second and third annulus being different for the two groups. The 3 readers who suggested age 8 arrived at their results in somewhat different ways (● and o).

Otolith 30-119 (modal age 10)

The ageing of this otolith ranged from 7 to 12, with 8 of the 14 readers recording

age 10 (x). Other interpretations were suggested, but most agreed, following discussion of the photograph, that the differences were due to considering some checks as annuli and *vice versa*.

Otolith 30-121 (modal age 7)

Nine of the 14 readers recorded age 7, with 4 suggesting age 8 and one favouring age 6. The seventh annulus of the age 8 reading (x) is considered to be a check by those who preferred age 7 (o).

Otolith 30-132 (modal age 7)

Eight of the 14 readers aged this otolith as 7, with 5 readers suggesting age 8 and one favouring age 6. The seventh annulus of the age 8 reading (x) is considered to be a check by those preferring age 7 (o).

Otolith 30-140 (modal age 9)

The ageing of this otolith ranged generally from 7 to 10 but one reader suggested age 14. Out of 15 readers, 4 indicated age 8, 5 gave age 9 and 4 were for age 10. Those suggesting age 9 arrived at the result in two different ways (o and x), the third annulus in each case not being coincident. Relative to the age 9 reading, those suggesting age 8 (•) considered the fifth annulus (x) to be a check. In the age 10 reading (—), the fifth annulus is treated as a check by the others.

Otolith 3NO-11 (modal age 4)

Ten of the 15 readers aged this otolith as 4 years, 2 readers recorded age 5 and the others suggested 6 or 7. The age 5 reading was arrived at in different ways (o and x), the innermost ring being treated as an annulus in one case (o) and the second ring from the edge (x) considered as an annulus in the other. All readers who indicated age 4 (—) considered the innermost ring (o) and the fourth ring near the edge (x) as checks or splits.

Otolith 3NO-27 (modal age 4)

Nine of the 15 readers recorded age 4, with 4 readers indicating age 5 and the others suggesting 6 or 7. In the age 5 reading (x), the fourth annulus is considered to be a split by those recording age 4 (—). The single age 6 reading (o) includes, as the second annulus, a ring which was treated as a check by the others.

Otolith 3NO-38 (modal age 6)

Seven of the 14 readers agreed on age 6, with 4 favouring age 5 and the others suggesting 7 or 8. The only difference between the age 5 and the age 6 readings is whether the innermost ring is a check on the one hand (x) or an annulus on the other (—). The age 7 reading includes as the second annulus (o) a ring which was considered a check by the other groups.

Otolith 3NO-46 (modal age 7)

Seven of the 15 readers recorded age 7, with 4 readers indicating age 6 and 4 others suggesting age 8. The only difference between the age 7 and age 8 readings is whether the innermost ring is a check in the first case (x) or an annulus in the other (o). Those suggesting age 6 (—) considered as checks both the innermost ring and one near the edge of the otolith.

Otolith 3NO-51 (modal age 6)

Eleven of the 14 readers agreed on age 6 with 2 readers favouring age 7 and one suggesting age 9. The third annulus of the age 7 reading (x) is considered to be a check by those recording age 6 (—).

Otolith 3NO-60 (modal age 7)

Seven of the 14 readers recorded age 7, with 3 readers suggesting age 6, one indicating age 8 and the remainder giving age 9 or 12. The fourth annulus of the age 8 reading (o) is considered as a check in the age 7 reading (—), and those recording age 6 (x) considered both the fourth and sixth annuli of the age 8 reading (o) as checks.

Otolith 3NO-68 (modal age 6)

Seven of the 14 readers agreed to age 6, with 5 readers indicating age 7 and the remaining 2 readers suggesting 8 or 9. Relative to the age 6 reading (x), the second and third annuli of the age 8 reading (●) are considered as checks. The age 7 reading was arrived at in three different ways (–, x and o), with particular rings being treated as checks by some readers and as annuli by others.

Otolith 3NO-71 (modal age 7)

Of the 11 readers who aged this otolith, 6 recorded age 7 and the others variously indicated the age as low as 5 and as high as 9. The innermost ring was included as an annulus by those recording age 8 (+) and age 9 (●) but not by the other groups. The other major difficulty in interpretation relates to consideration of certain rings as checks or annuli.

Otolith 3NO-72 (modal age 8)

Eight of the 13 readers agreed on age 8, with others suggesting age 7, 9 or 10. There was no problem with the first 5 annuli but the sixth annulus of the age 10 reading (●) was considered to be a check by the others, as was also one or two other annuli near the edge. The seventh annulus of the age 8 reading (–) is considered as a check in the age 7 reading (x).

Otolith 3NO-75 (modal age 8)

Seven of the 13 readers recorded age 8, with 2 readers favouring age 7, 3 suggesting age 9 and one for age 10. The two ways of arriving at age 8 (x and –) are different only to the extent that the first annulus is split and its location may vary from reader to reader. Relative to the age 8 reading (–), both the age 9 reading (●) and the age 10 reading (o) include an additional annulus at the edge, and the fourth annulus of the latter (o) is considered as a check by all others.

Otolith 3Ps-10 (modal age 3)

Eleven of the 13 readers indicated age 3 and 2 readers suggested age 4. The third annulus of the age 4 reading (o) is considered to be a split of the third growth zone by all others.

Otolith 3Ps-25 (modal age 3)

Ten of the 14 readers agreed on age 3, with 3 readers recording age 4 and one favoured age 5. Those suggesting age 4 arrived at their result in two different ways (o and x), the innermost ring being considered as an annulus in one case (o) and a split being considered as an annulus in the other (x). Those who recorded age 3 (–) were consistent in their interpretation.

Otolith 3Ps-37 (modal age ?)

Out of 14 readers, ages 6 and 7 were each favoured by 5 readers, with 4 recording age 5. The first 5 annuli (o and x) presented no difficulty for those who read the ages as 6 or 7, but the sixth annulus of the latter (x) was considered as a check in the age 6 reading. The age 5 reading (–) treated the second annulus of the age 6 reading (o) as a check.

Otolith 3Ps-45 (modal age 5)

Twelve of the 15 readers agreed on age 5, with 3 readers suggesting age 4. The third annulus of the age 5 reading (–) is considered as a check by the others.

Otolith 3Ps-82 (modal age 5)

As for the previous otolith, 12 readers recorded age 5 and 3 indicated age 4. The third annulus of the age 5 reading (–) is considered as a check by those favouring age 4.

Otolith 3Ps-101 (modal age 5)

Ten of the 15 readers recorded age 5, with 3 readers suggesting age 4 and 2 favour-

ing age 6. The sole difference between the age 5 (—) and the age 6 (o) readings is that the innermost ring was considered as an annulus by the latter group. The fourth annulus of the age 5 reading (—) was treated as a check by those favouring age 4 (x).

Otolith 3Ps-104 (modal age 7)

Seven of the 15 readers agreed on age 7 and 6 readers indicated age 6, with one suggesting age 5 and another age 8. The third annulus of the age 7 reading (x) was considered as a check in the age 6 reading (o). This annulus as well as the fifth were treated as checks by the reader favouring age 5 (—).

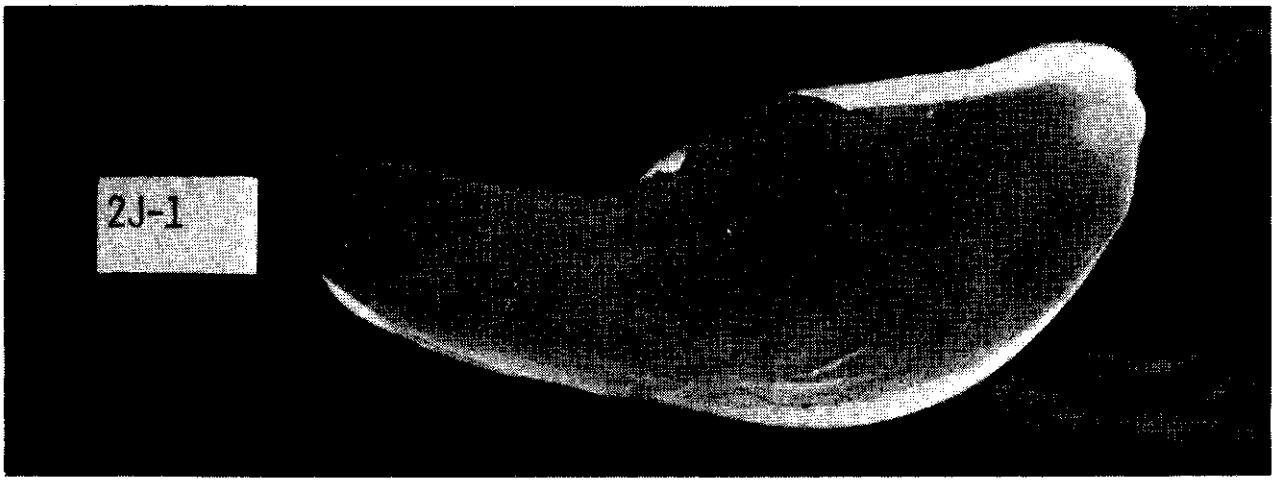
Otolith 3Ps-127 (modal age 6)

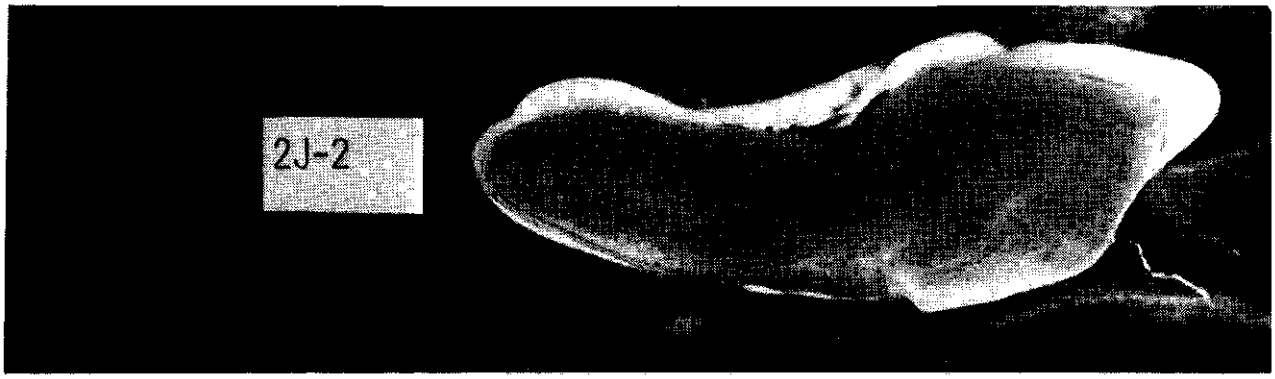
Ten of the 13 readers indicated age 6 and 3 readers favoured age 5, with the fourth annulus of the age 6 reading (o) being considered as a check in the age 5 reading.

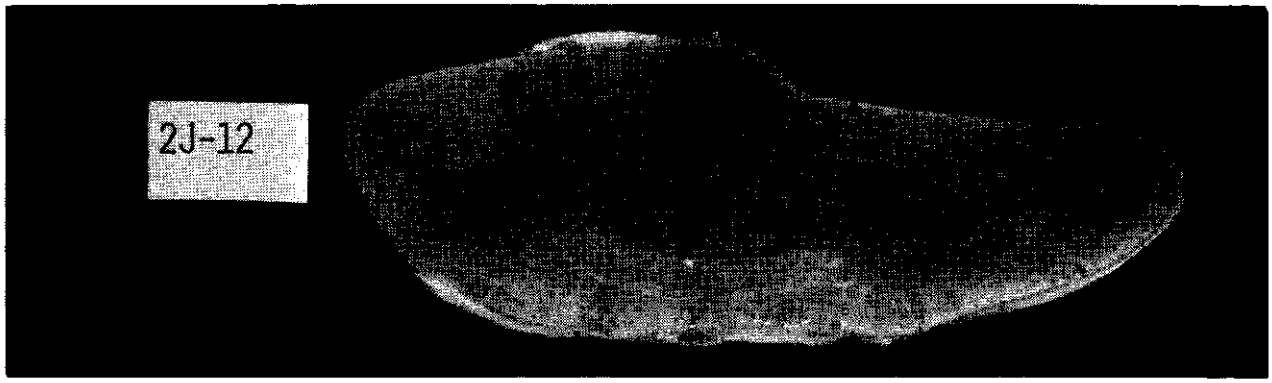
Otolith 3Ps-155 (modal age 6)

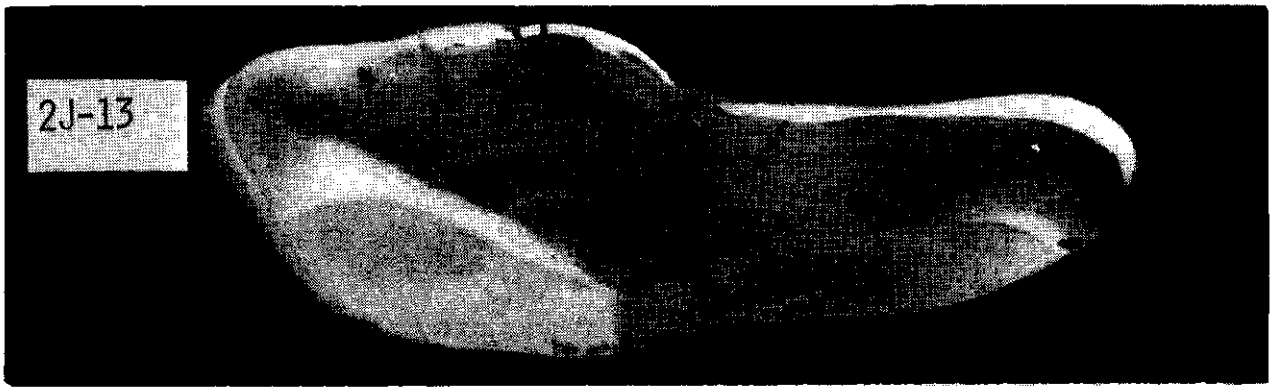
Ten of the 14 readers agreed to age 6, with 2 readers each suggesting age 5 and age 7. The fifth annulus of the age 6 reading (x) is considered as a check by those favouring age 5 (—). The age 7 reading (o) includes an additional annulus (fourth) which was considered a check by the other readers.

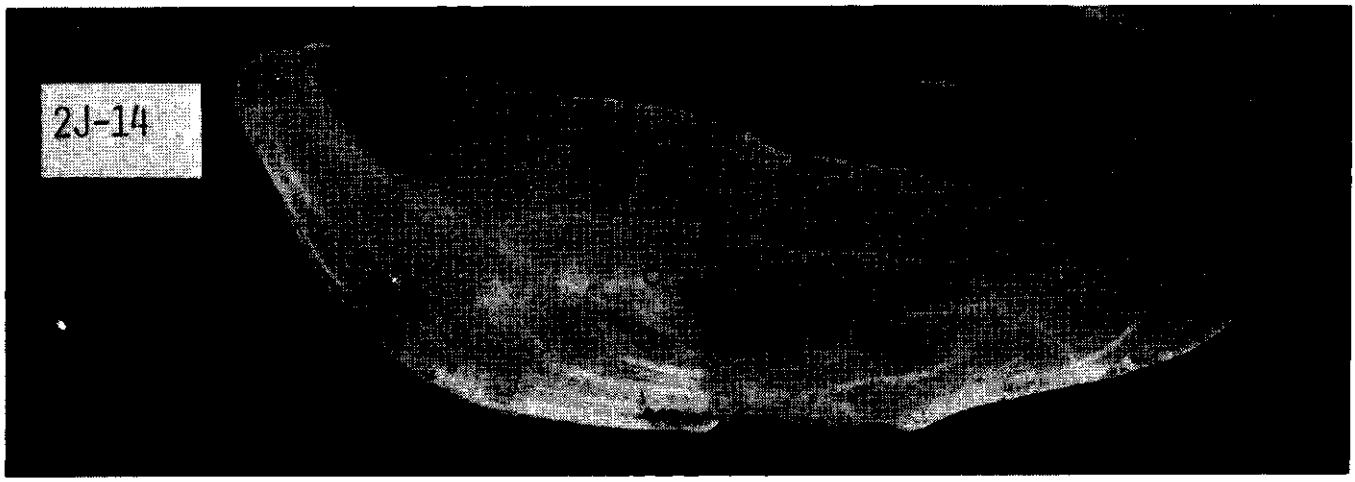
DIVISION 2J







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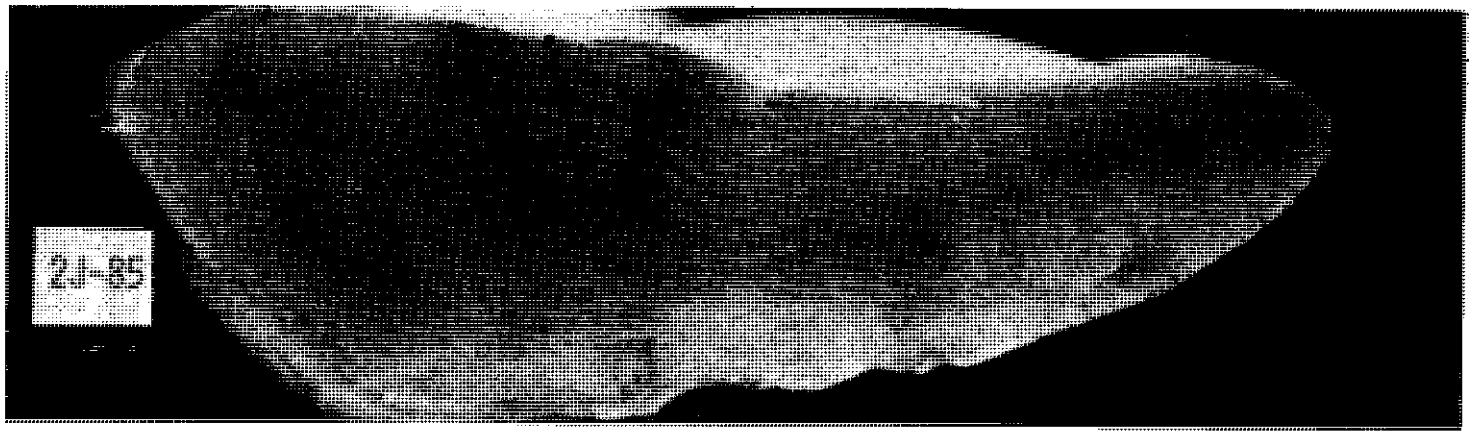
2J-58


2J-63


2J-74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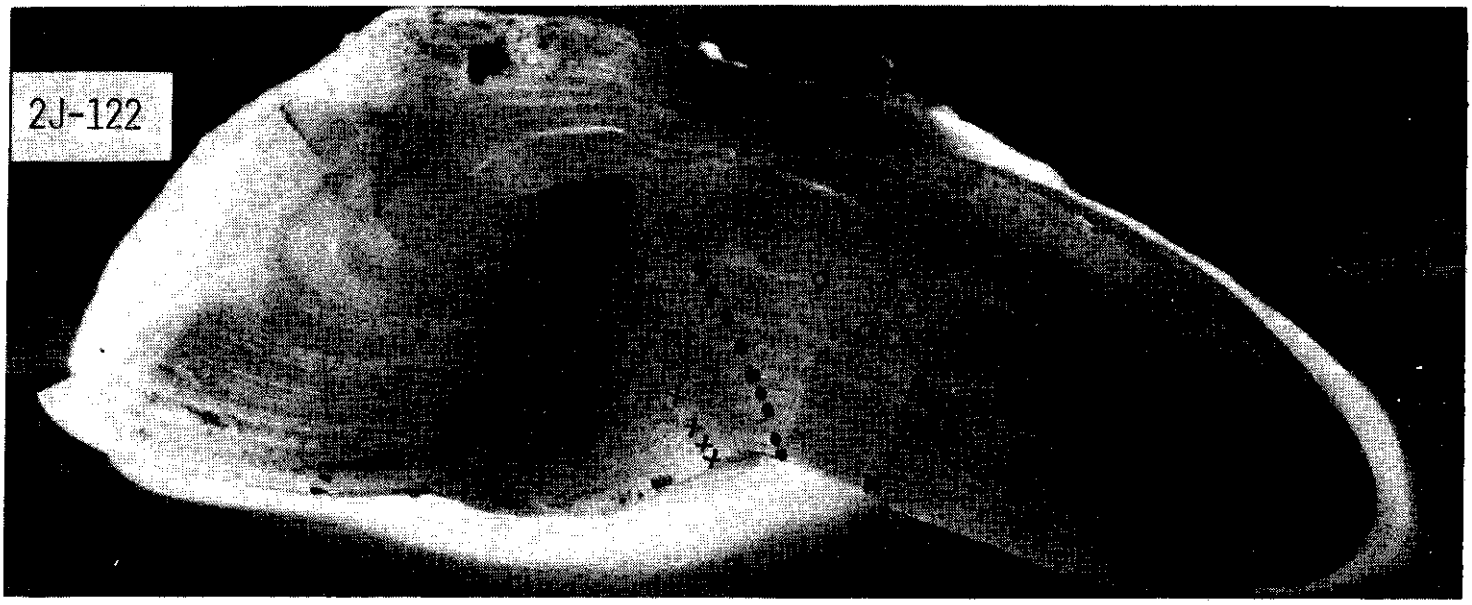
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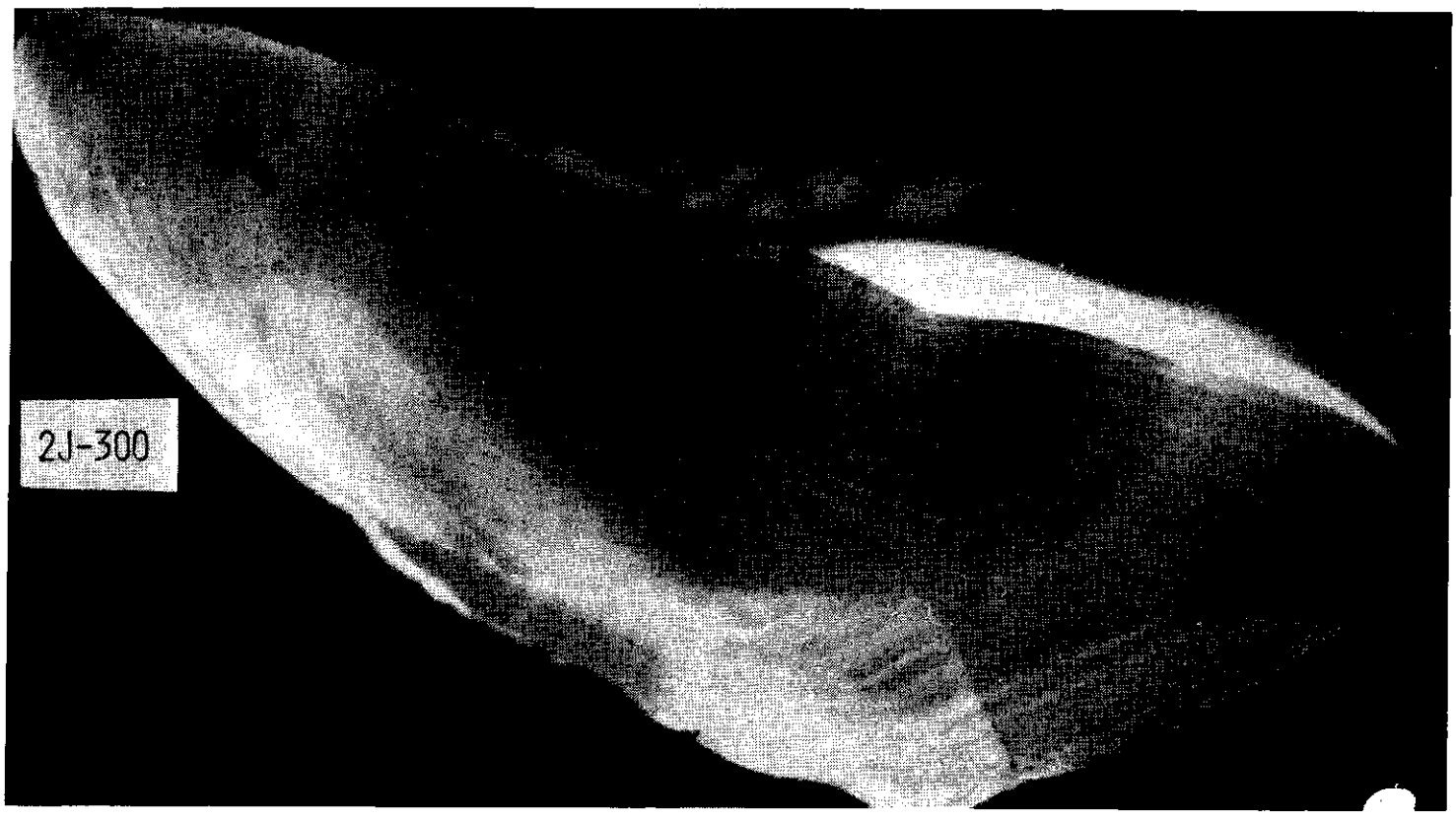
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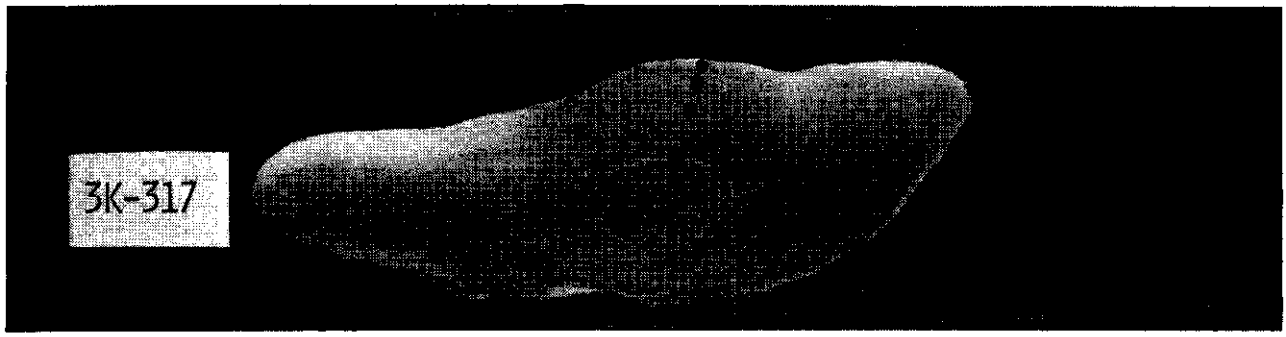
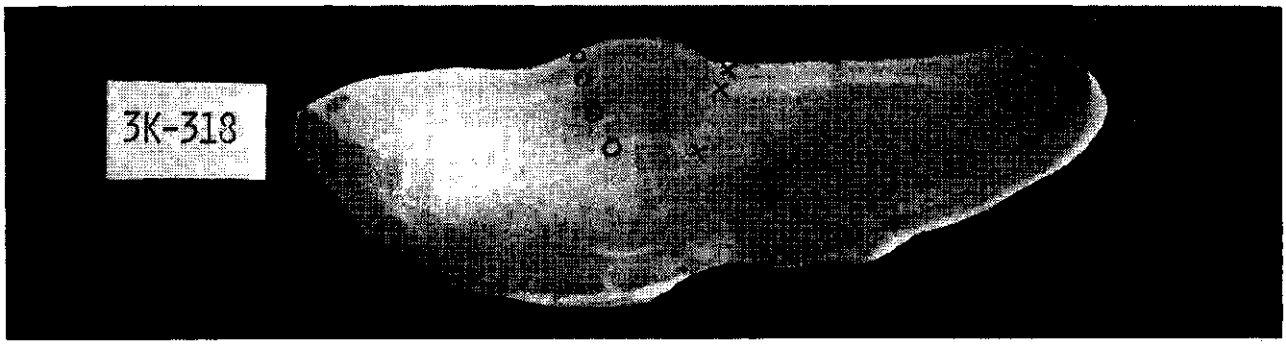
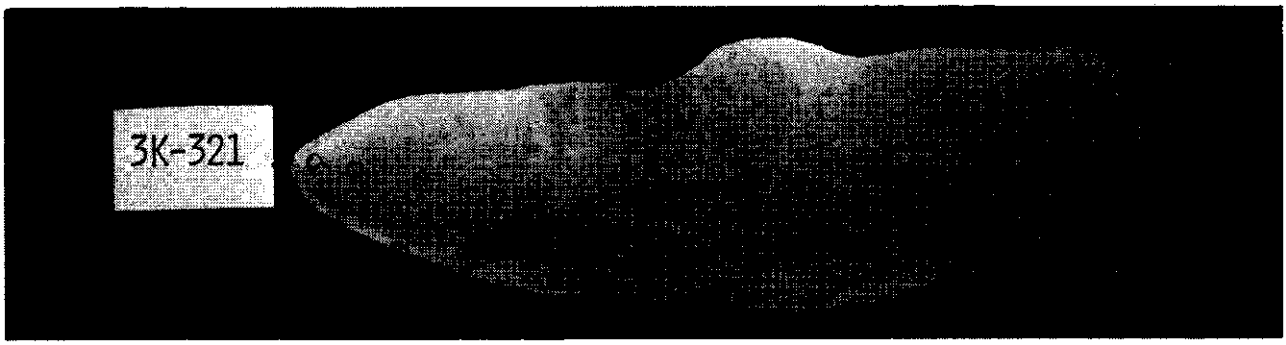
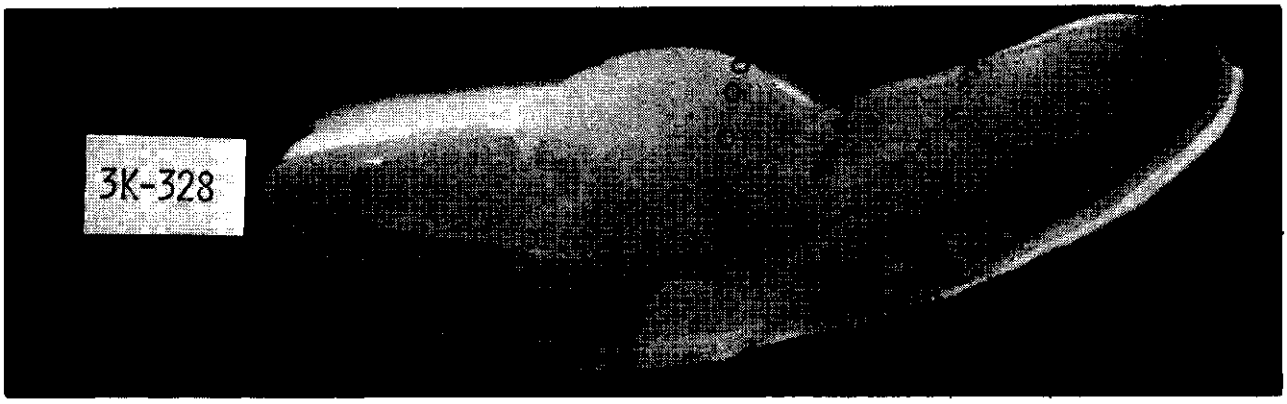
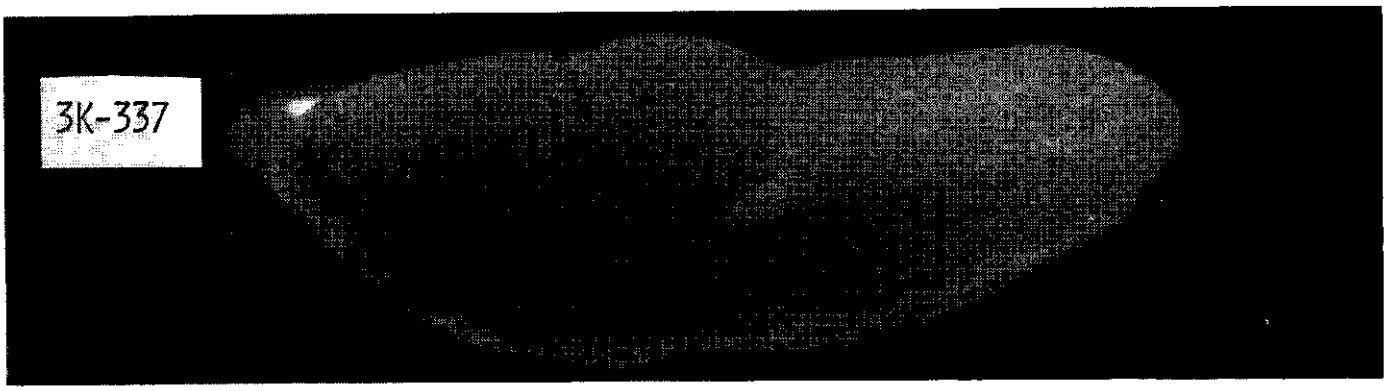
DIVISION 3K







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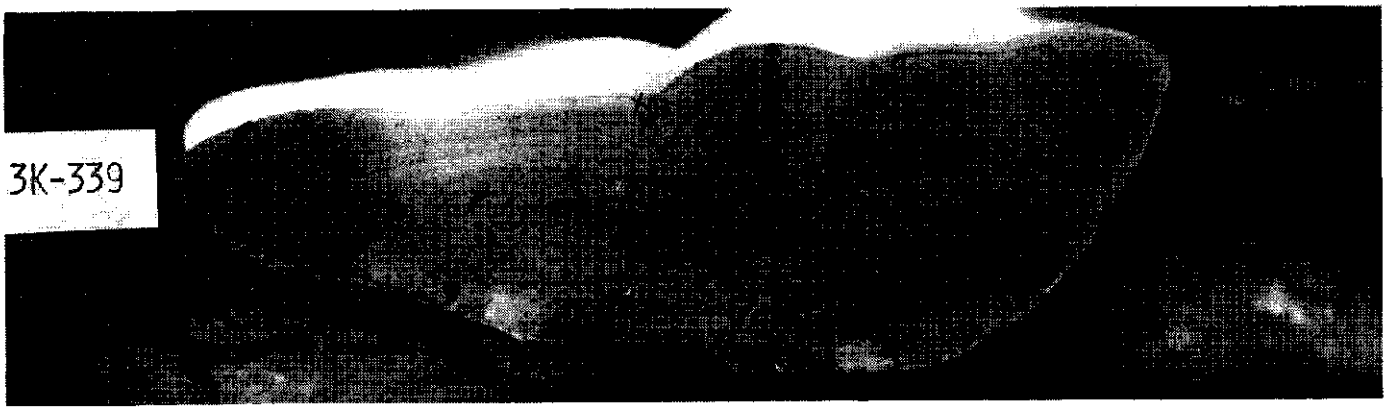
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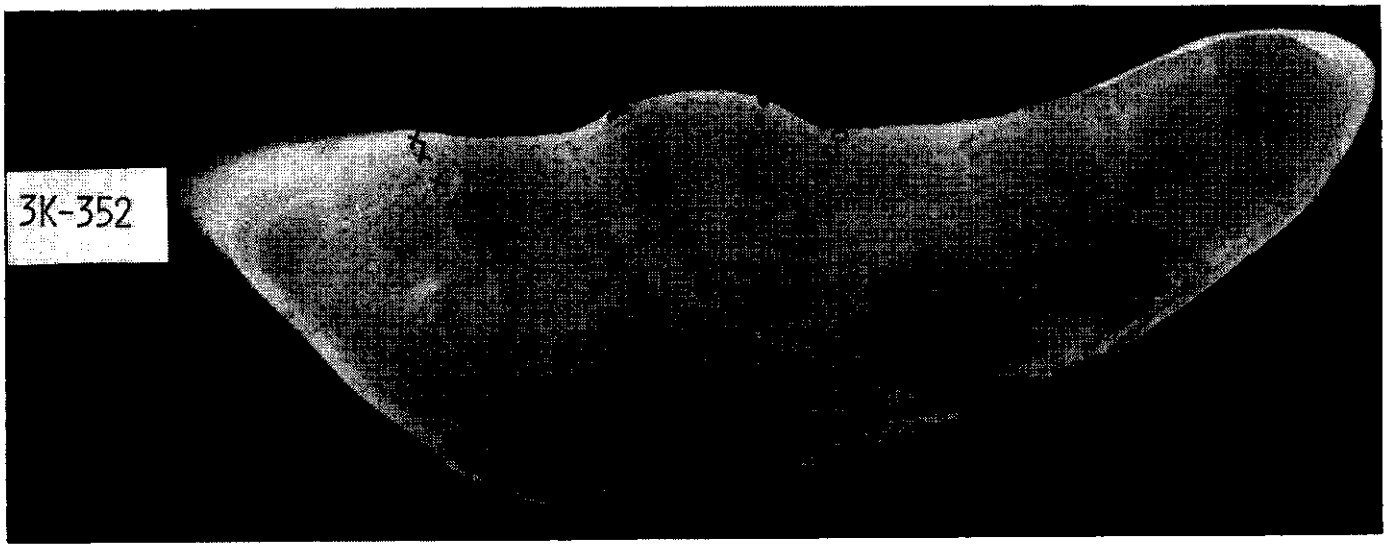
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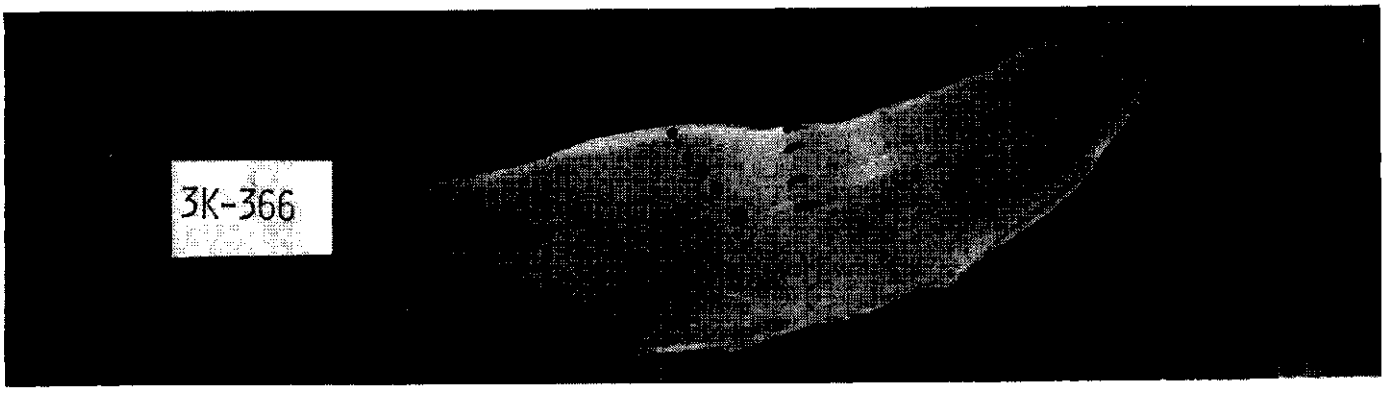
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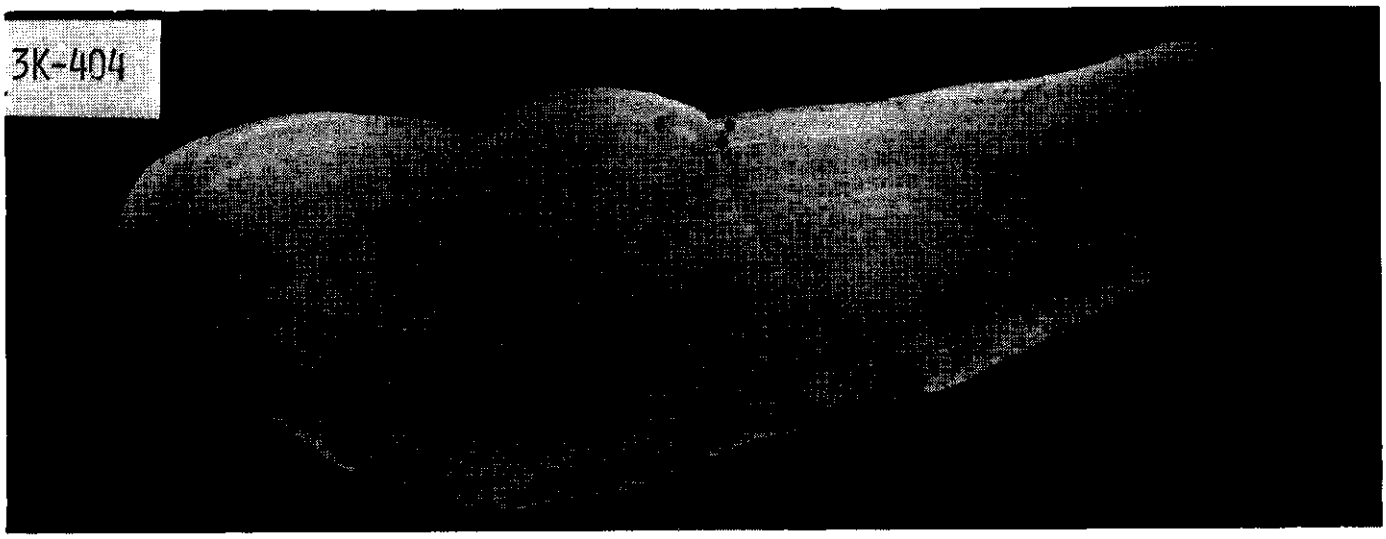
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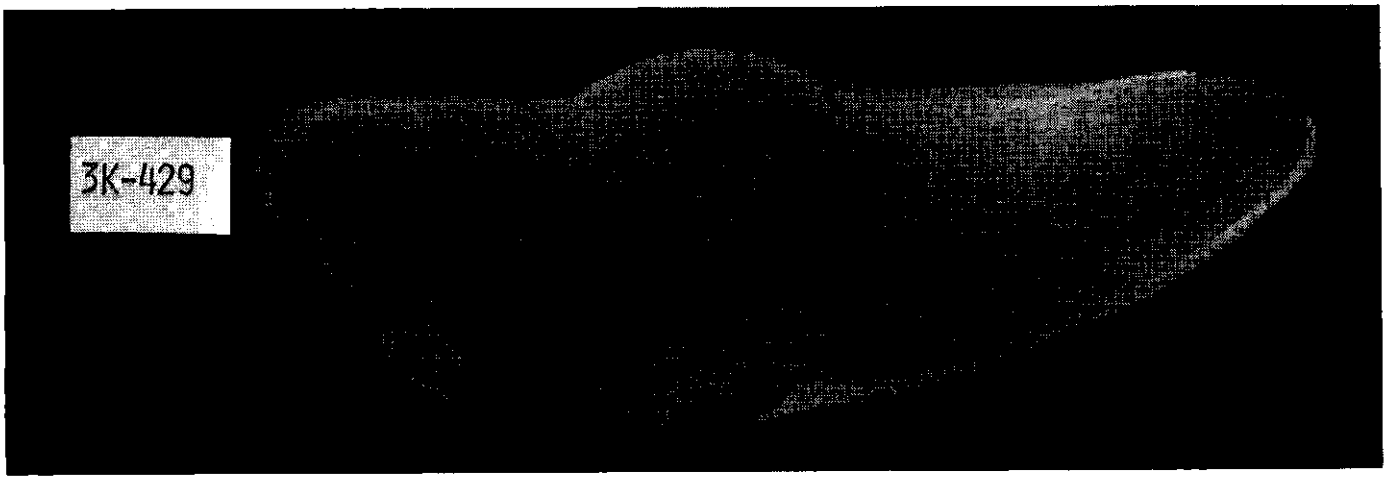
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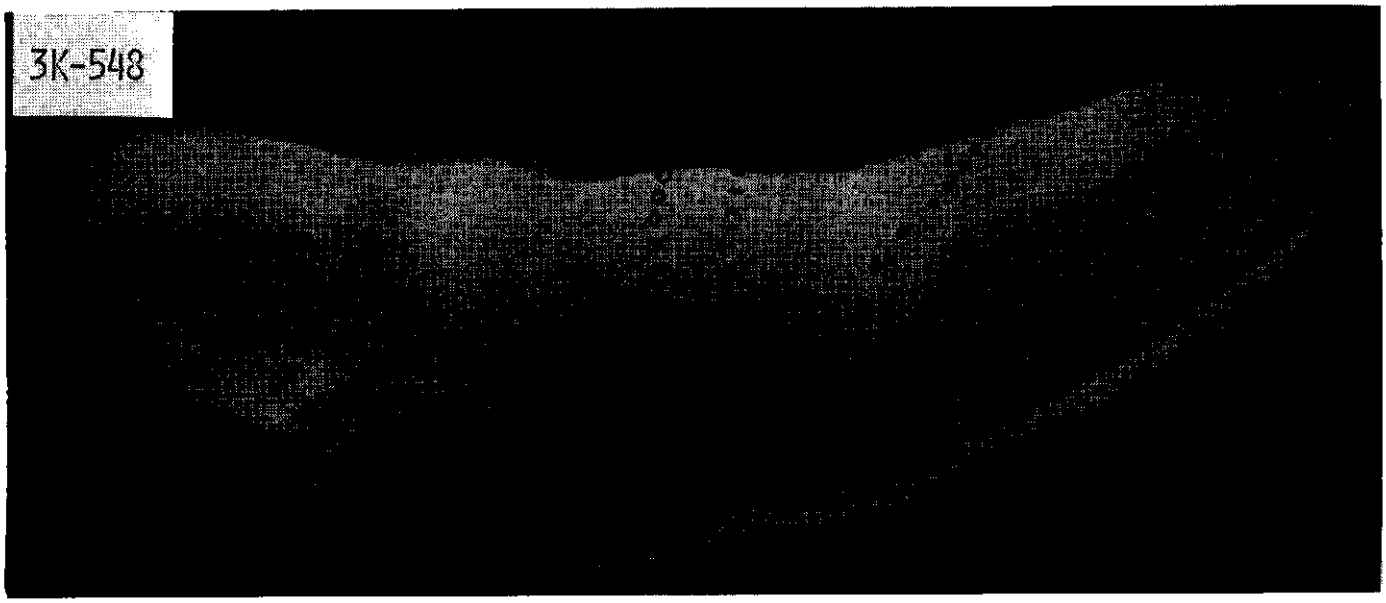
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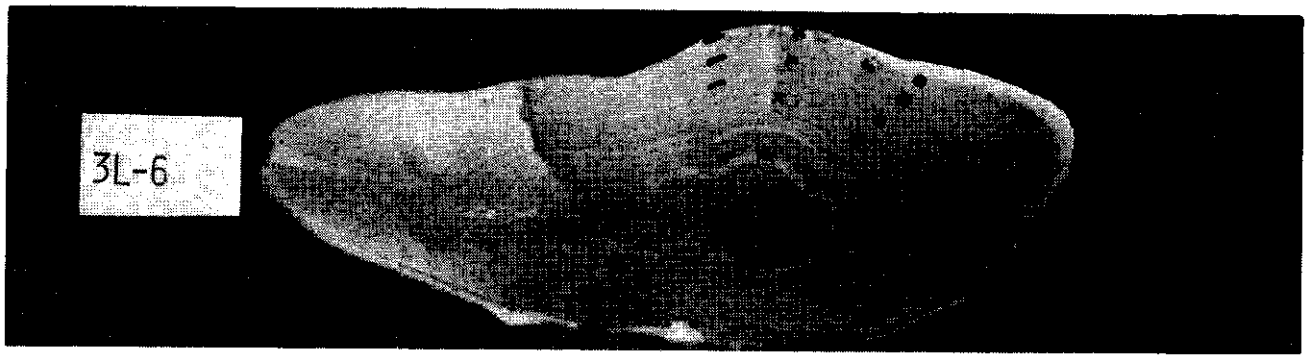
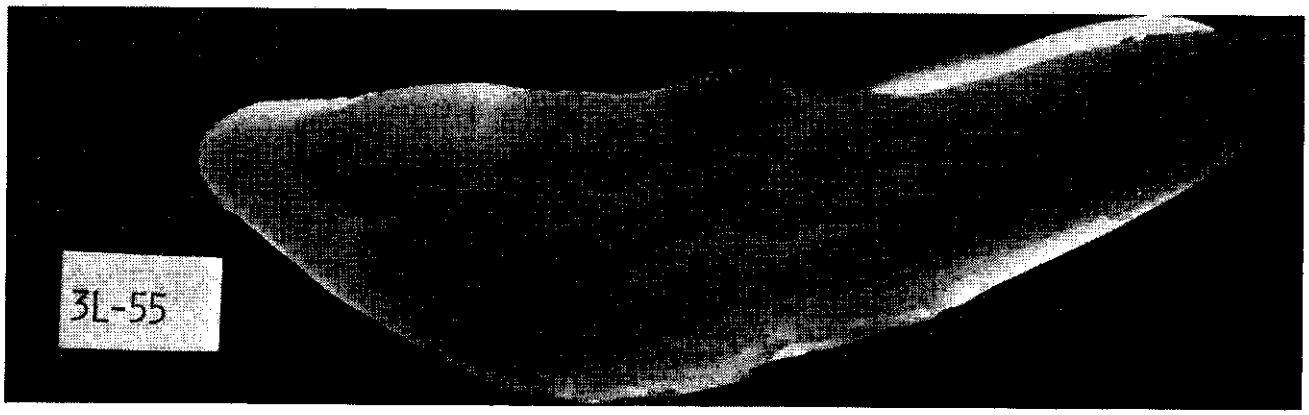
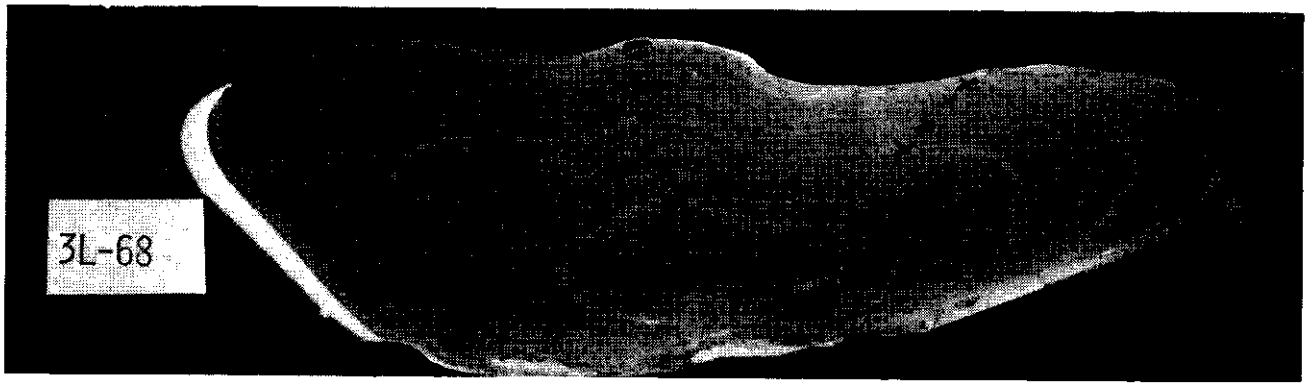
DIVISION 3L





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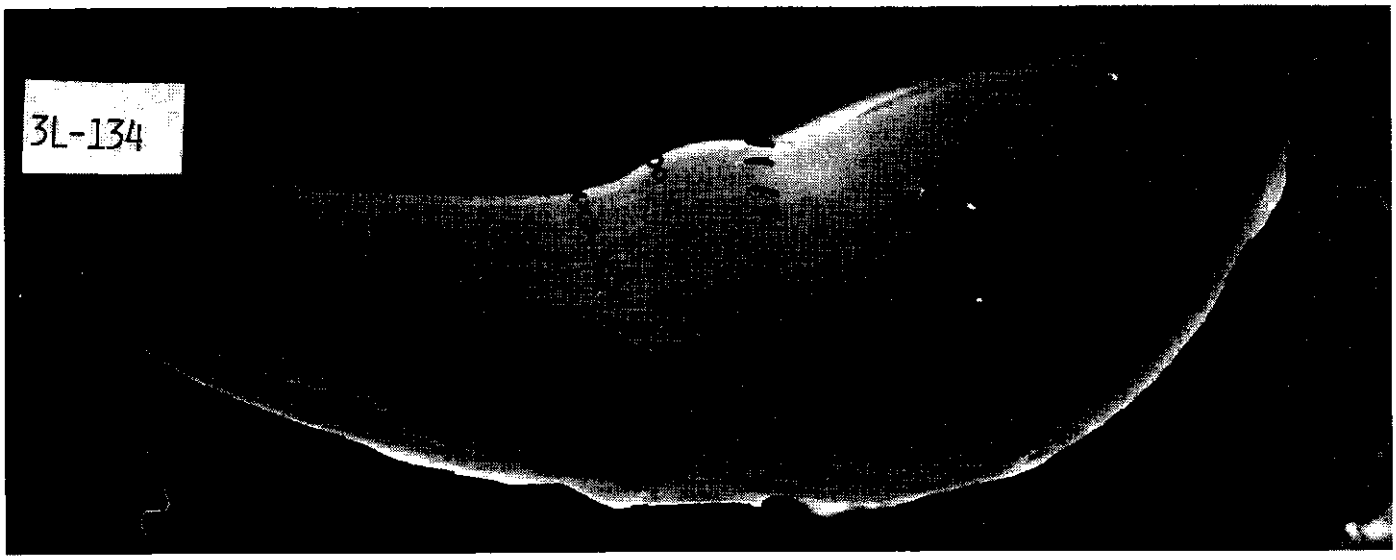
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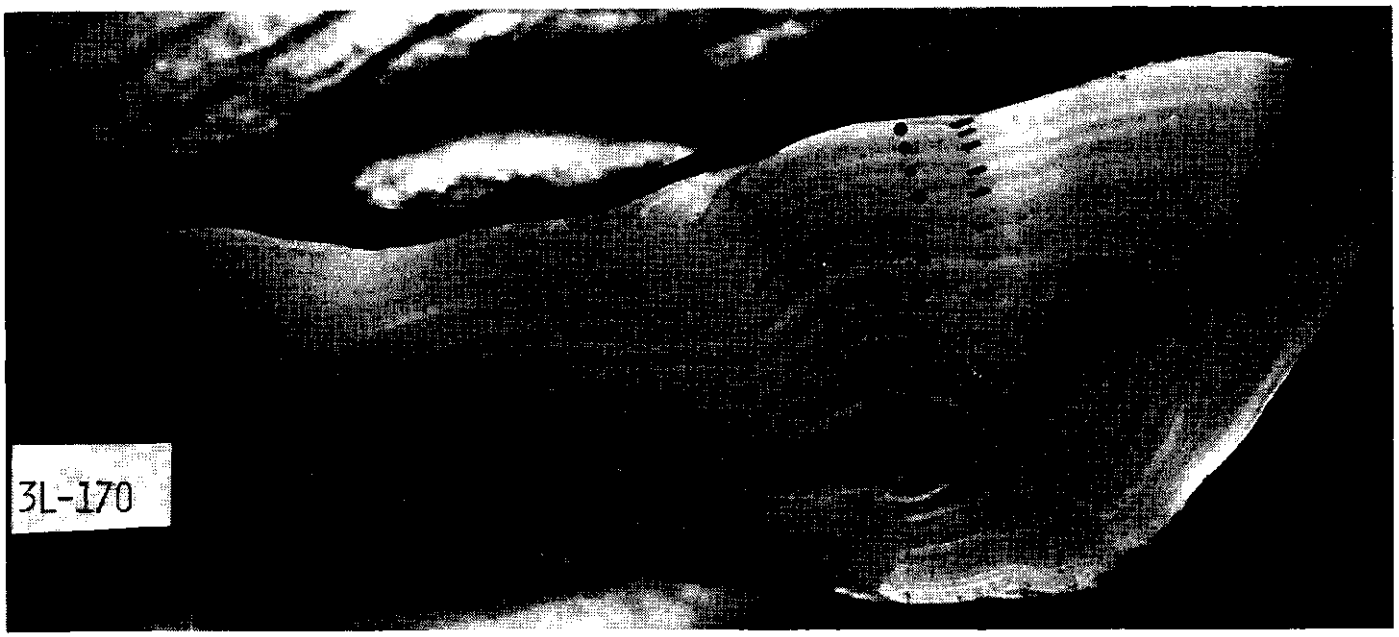
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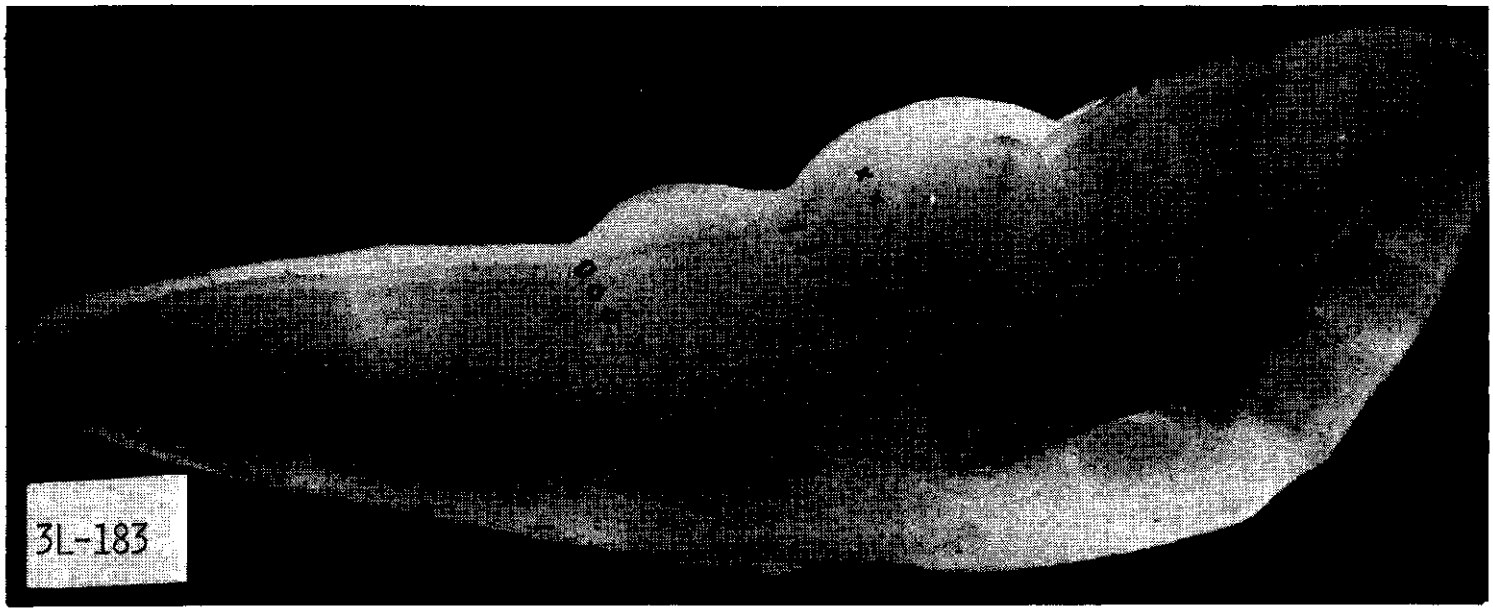
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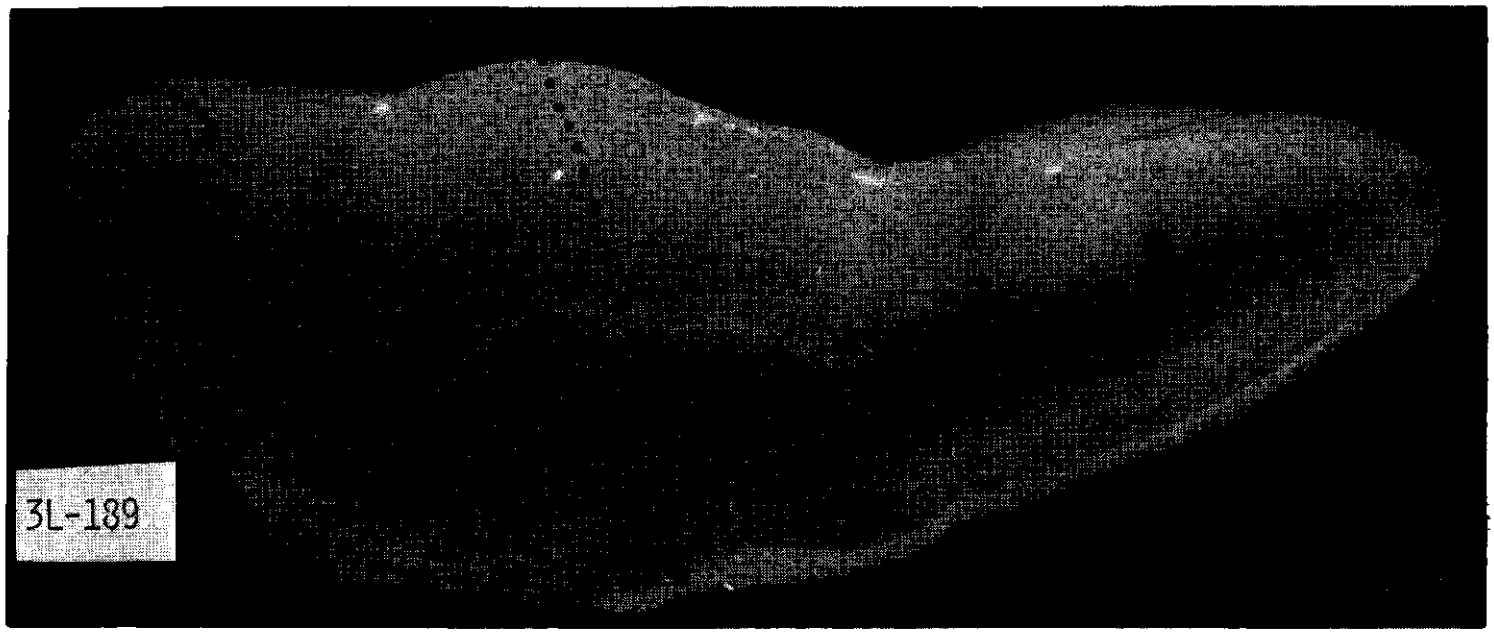
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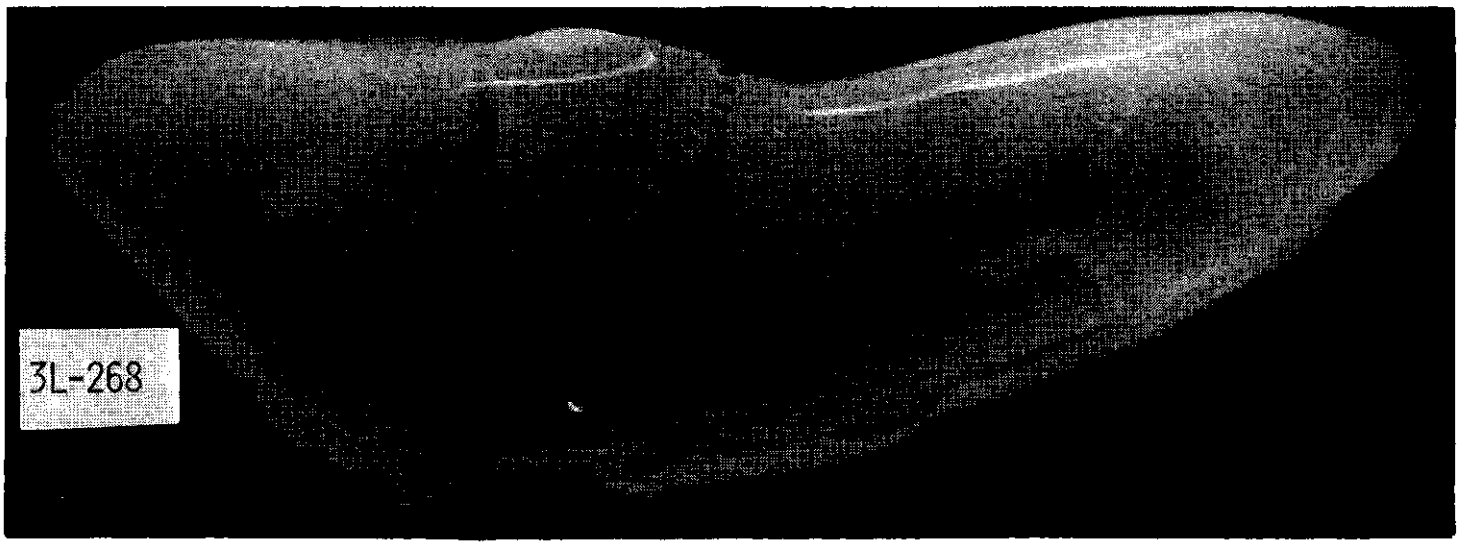
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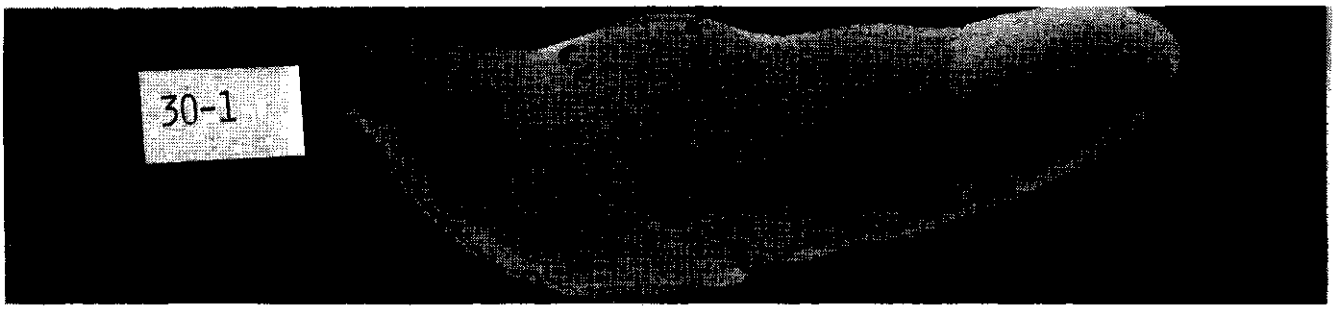
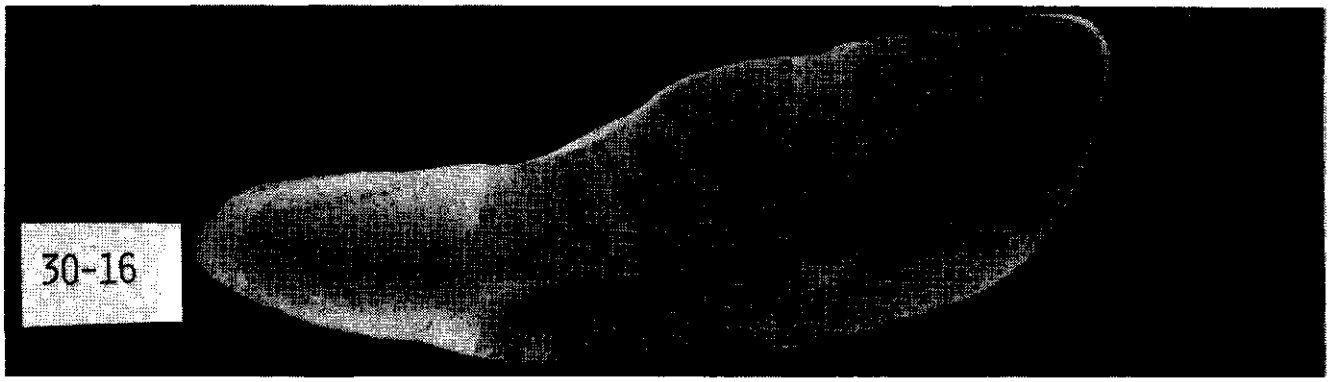
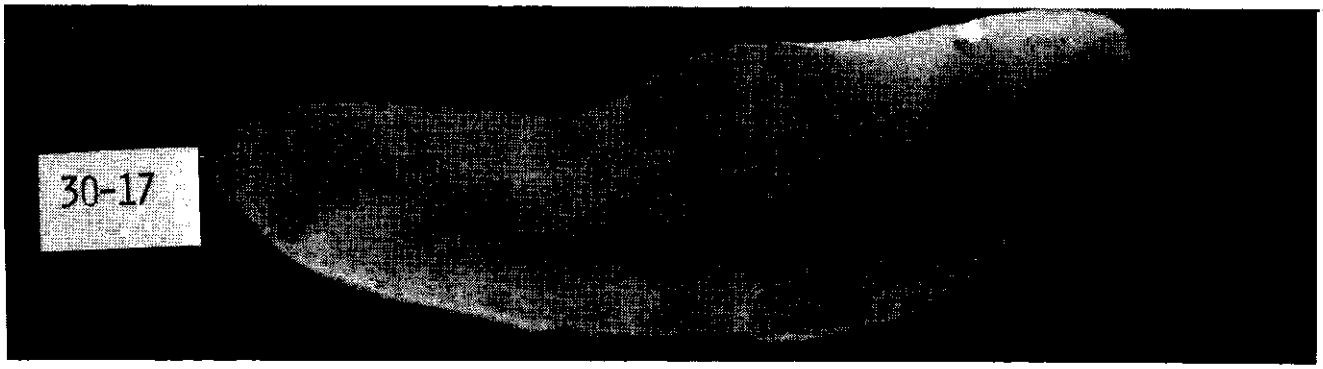
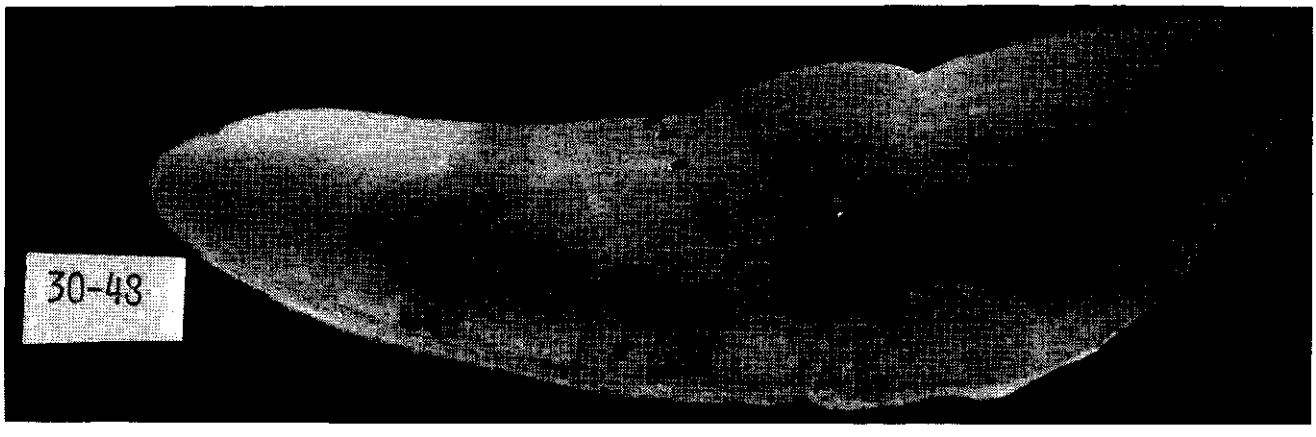
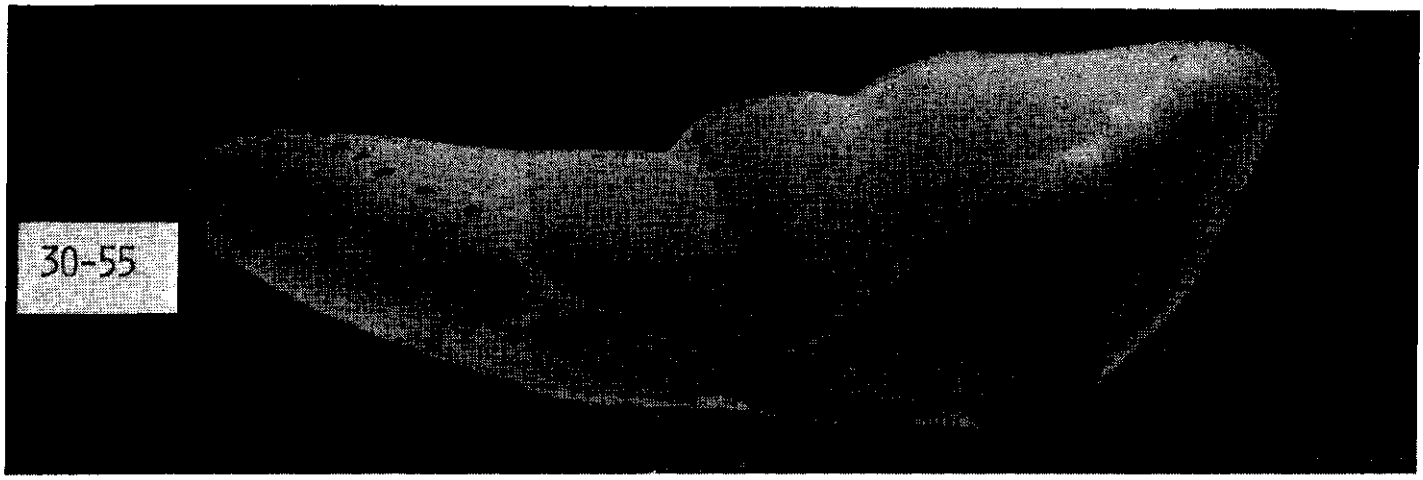
DIVISION 30







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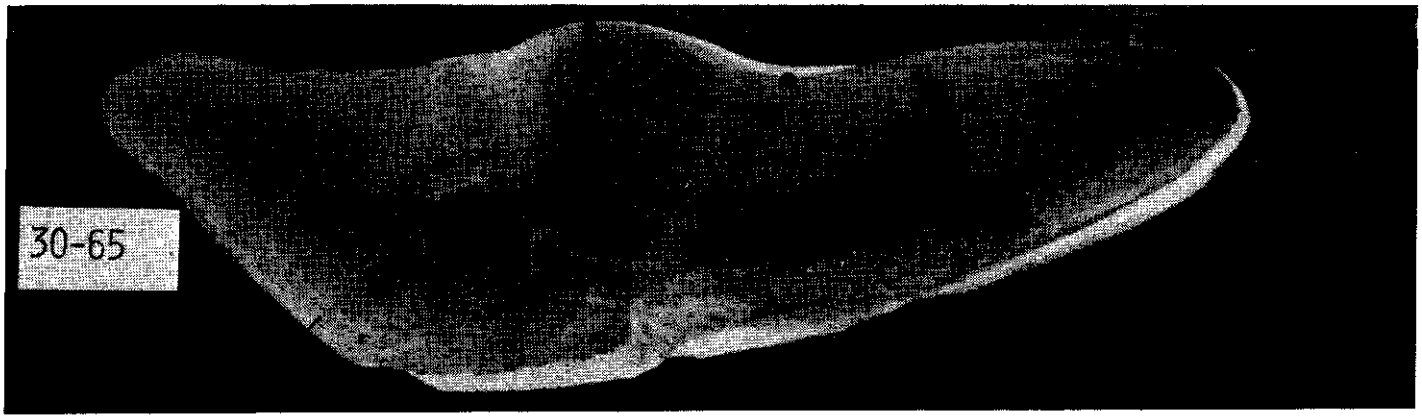
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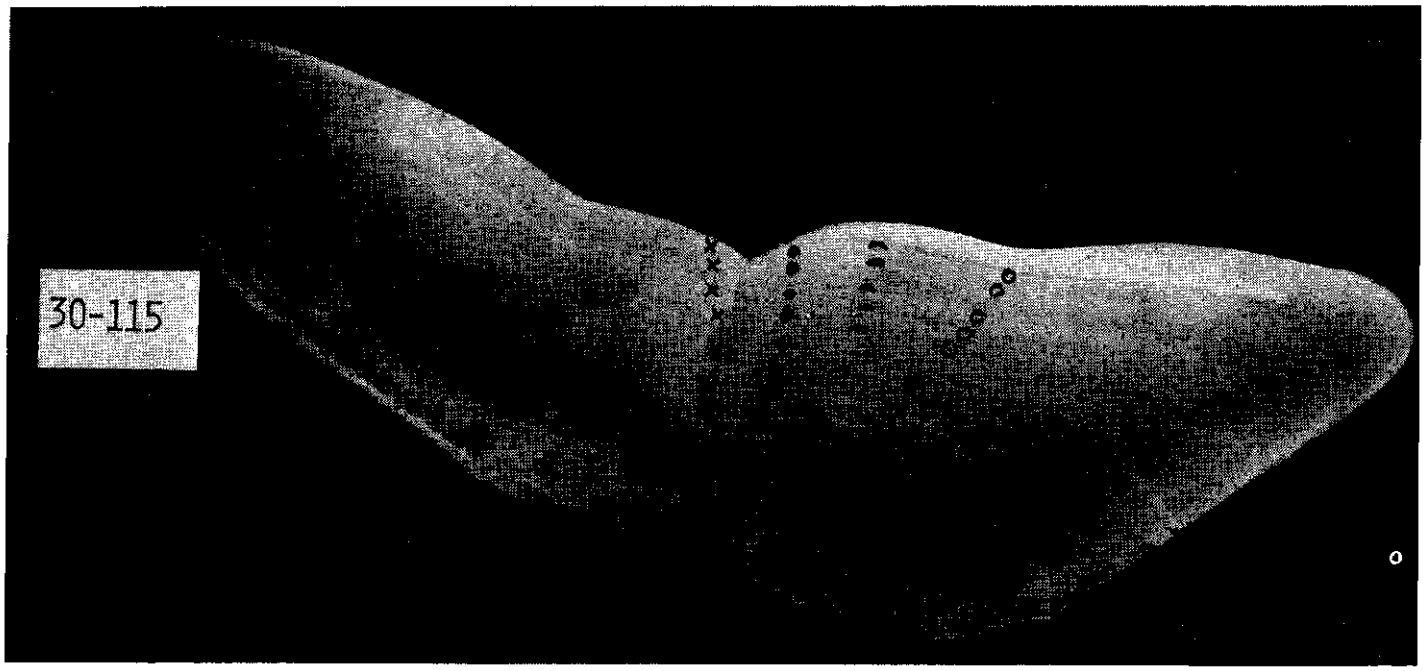
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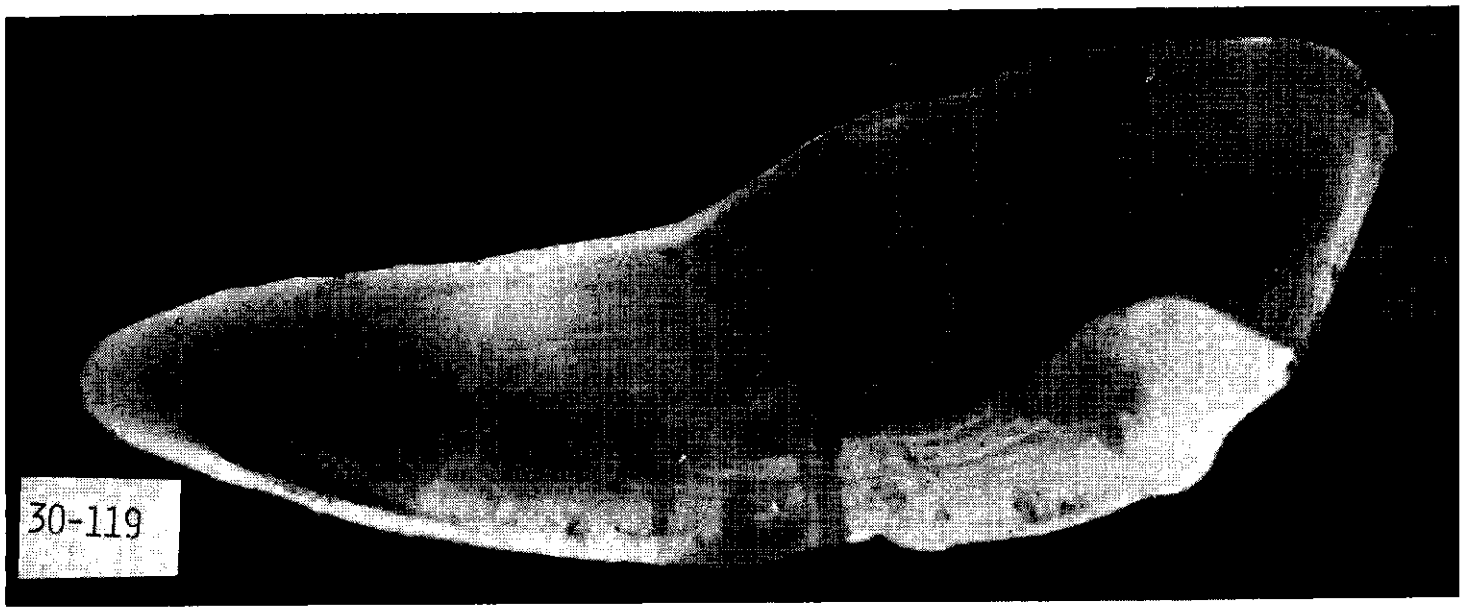
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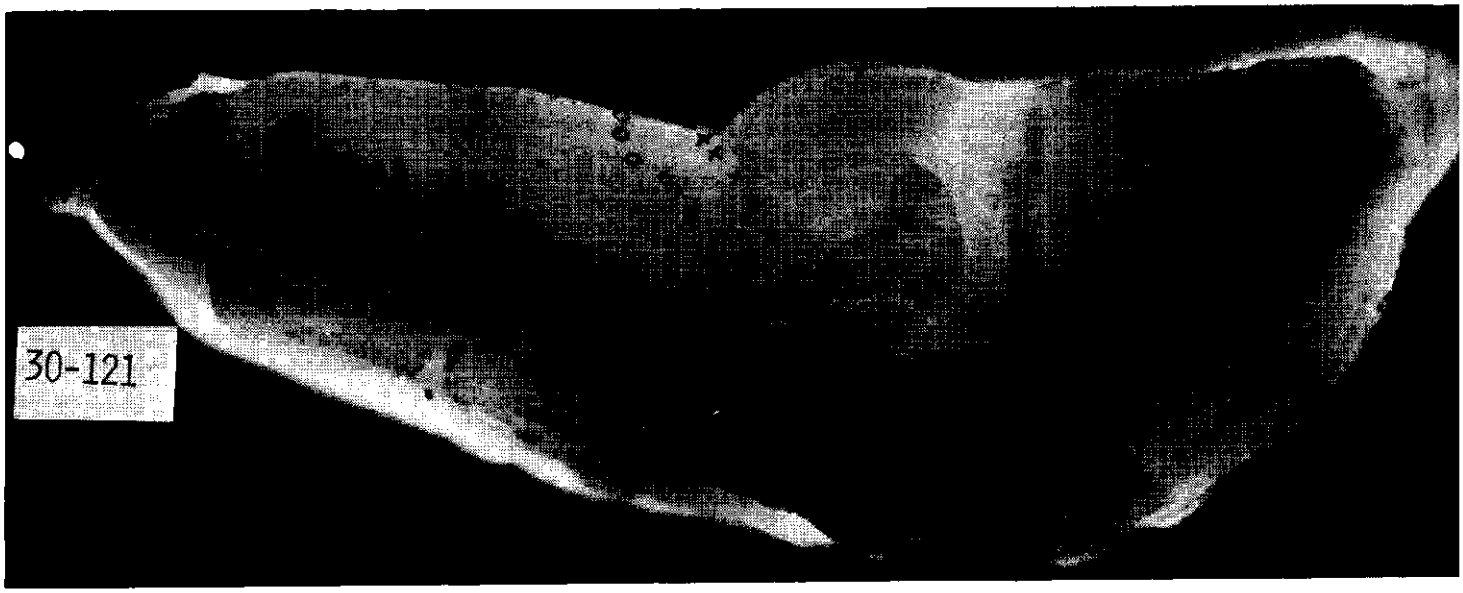
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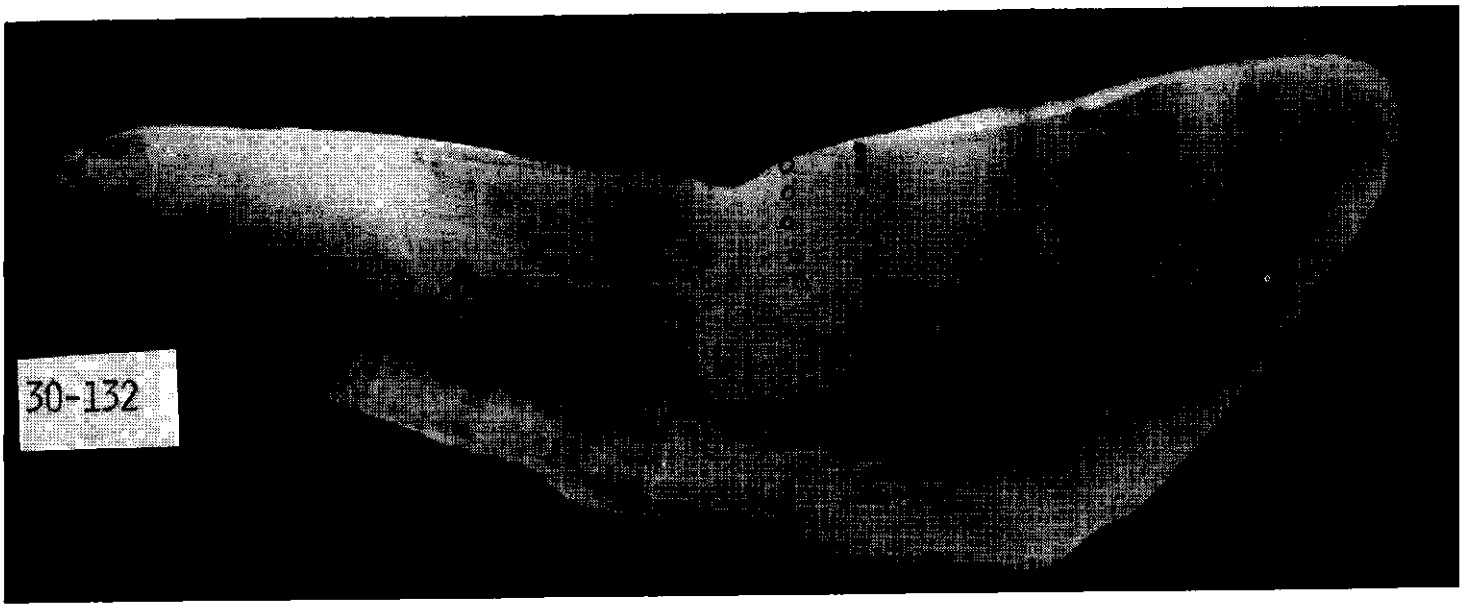
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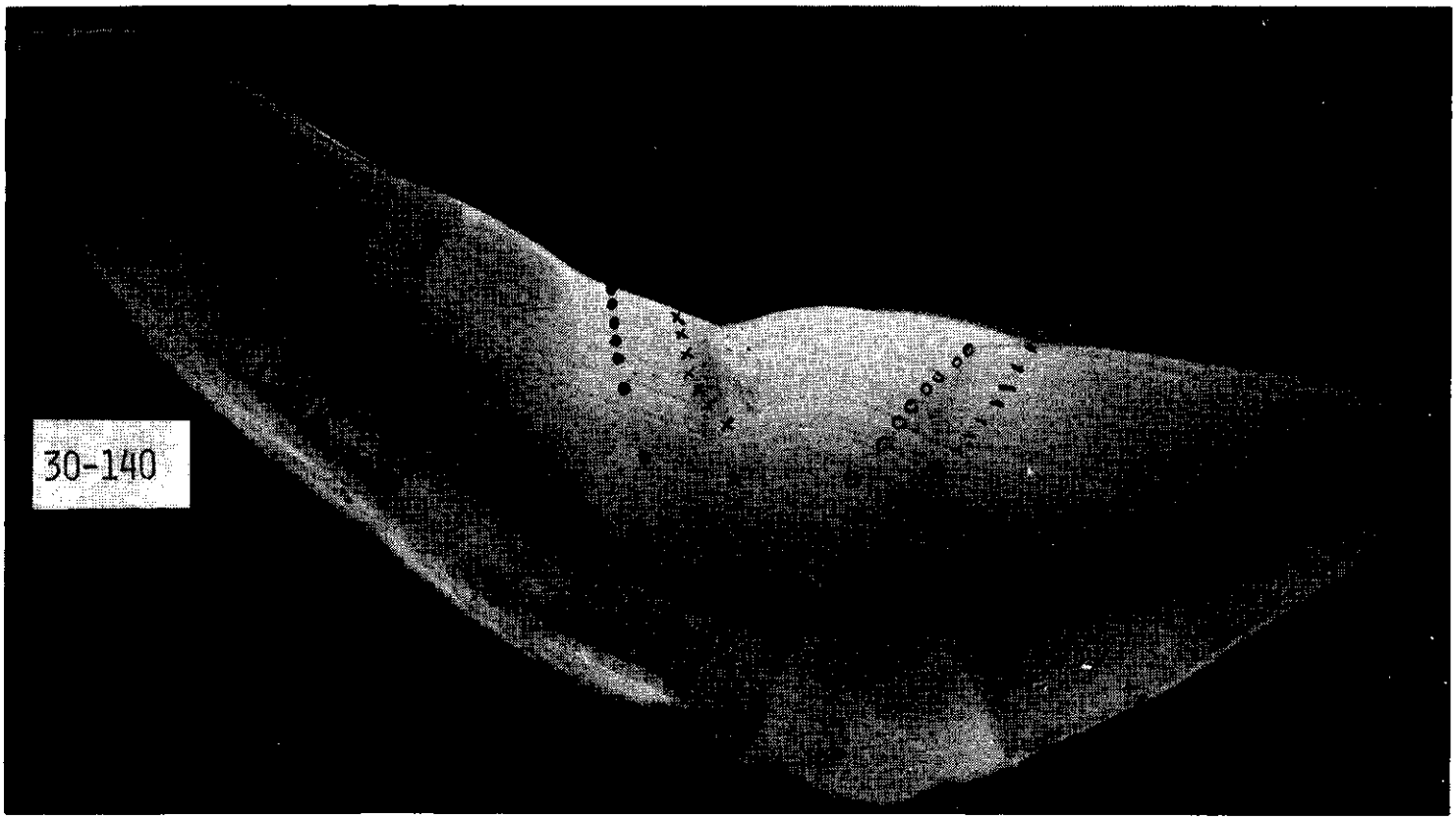
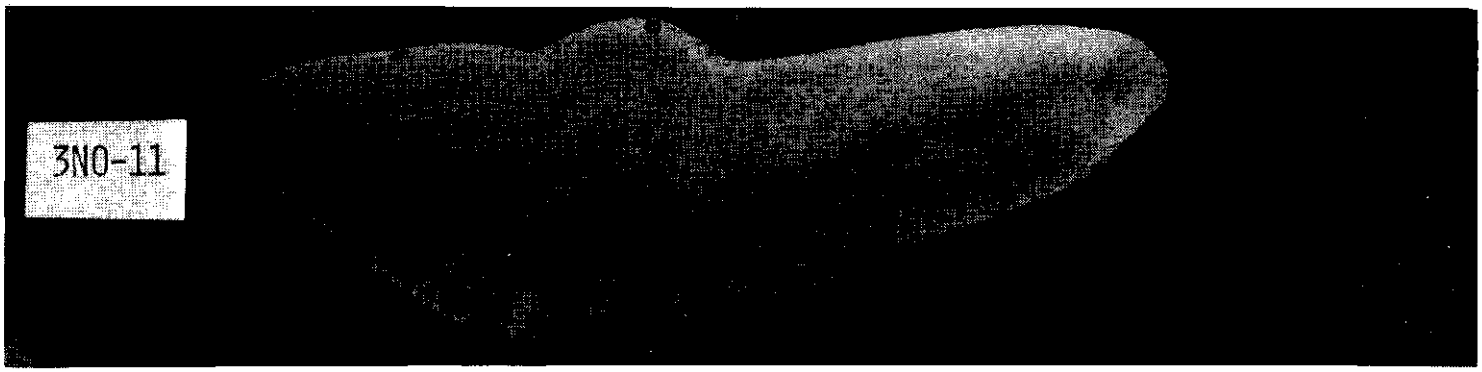
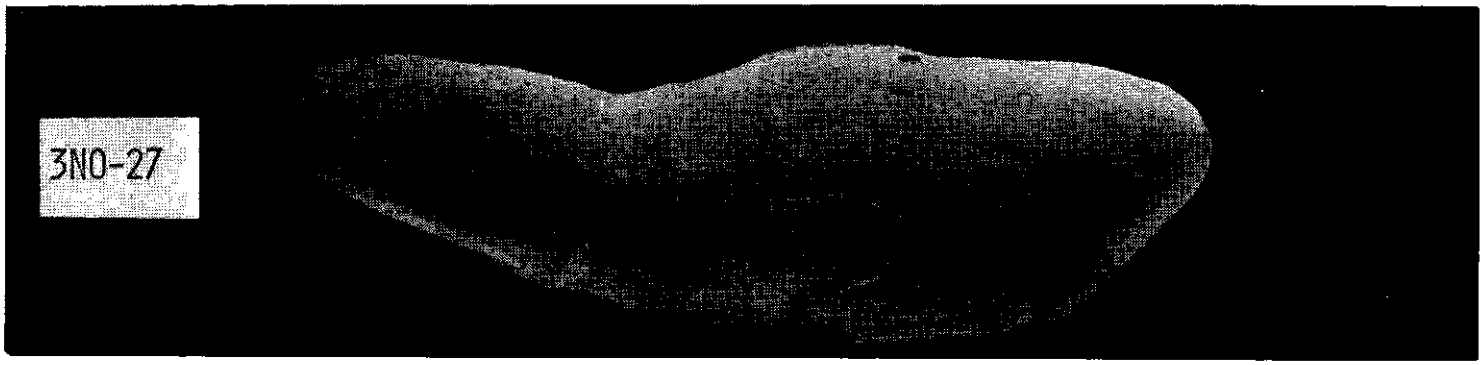
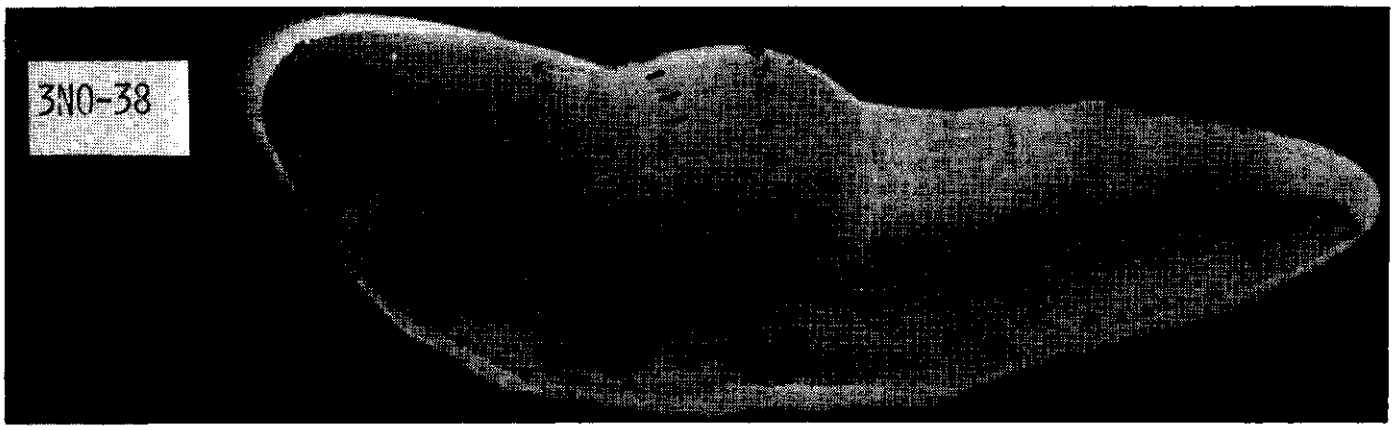


DIVISION 3NO



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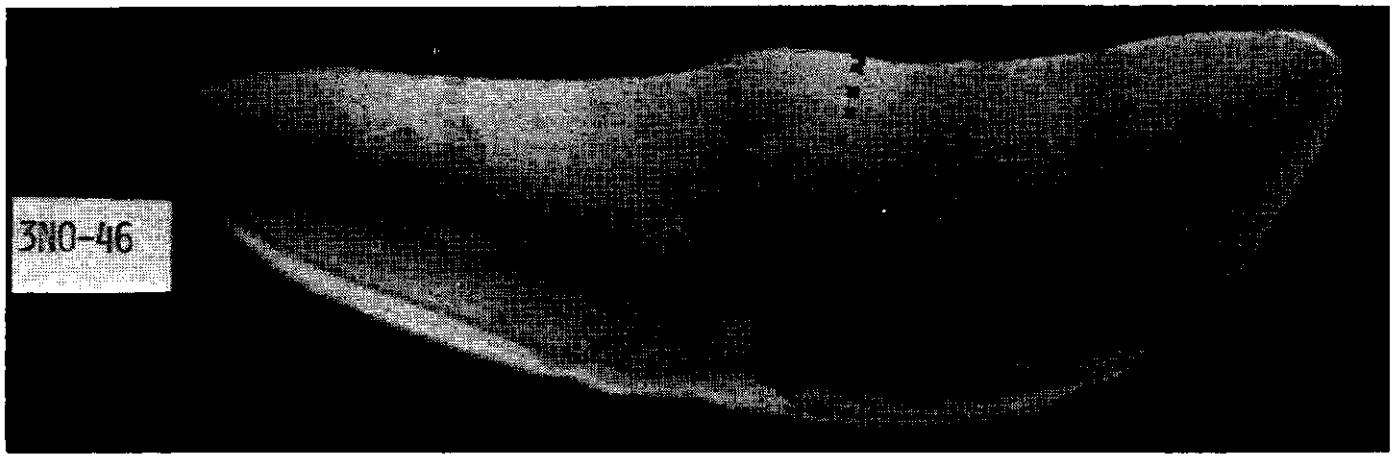
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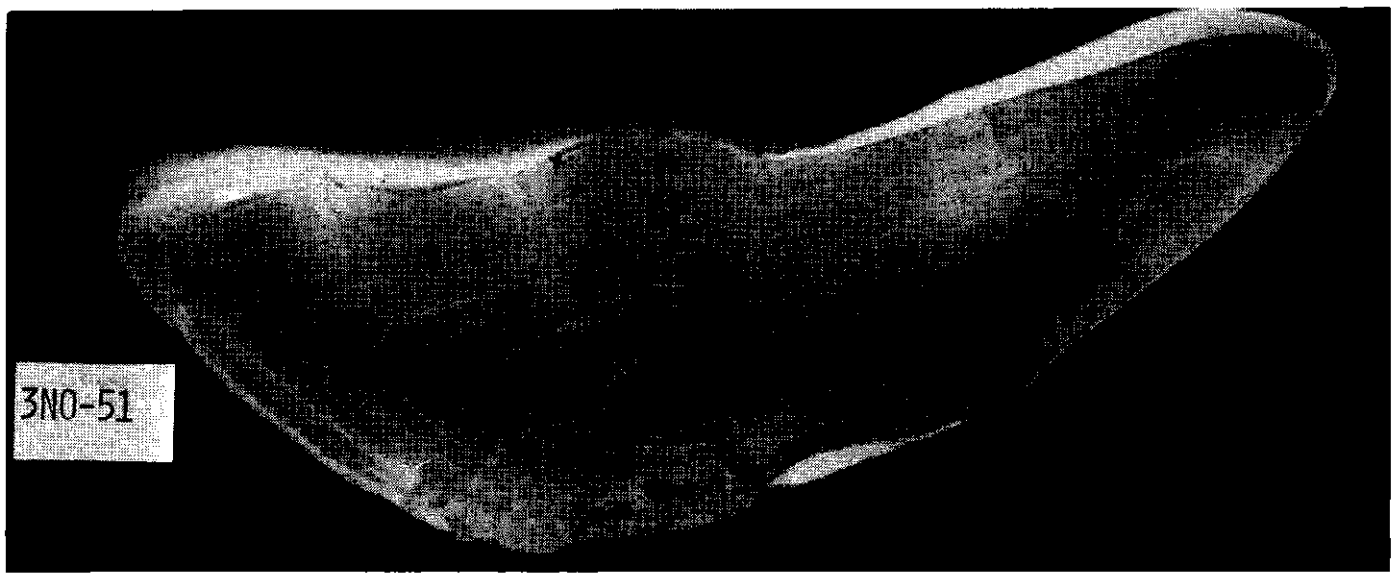
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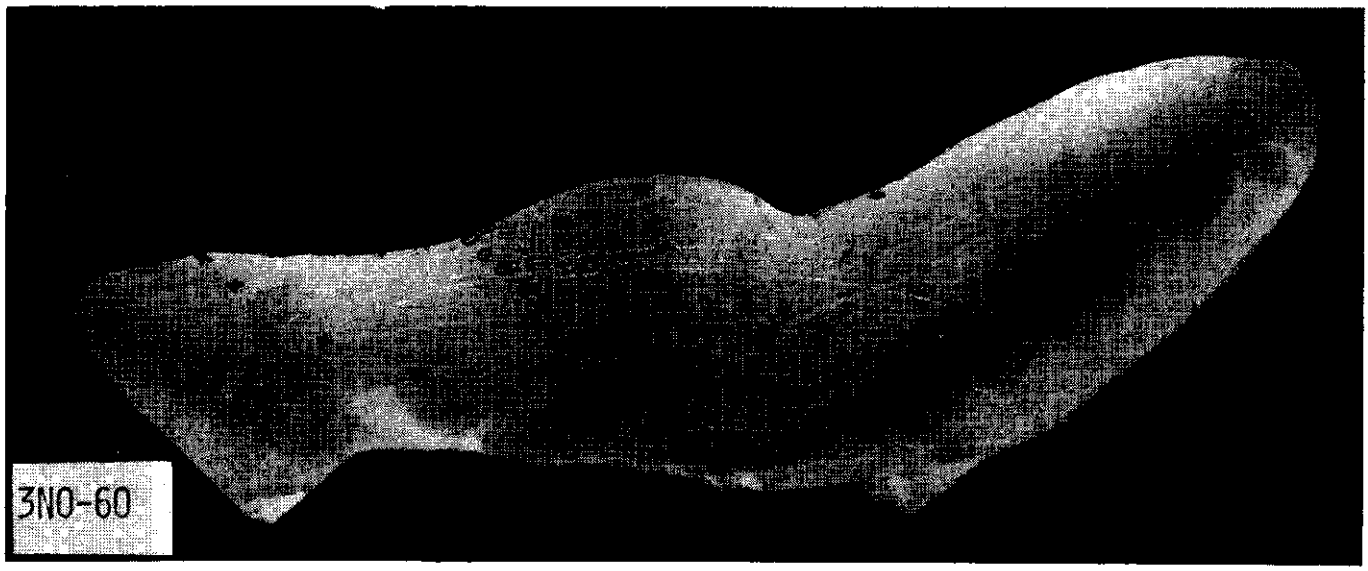
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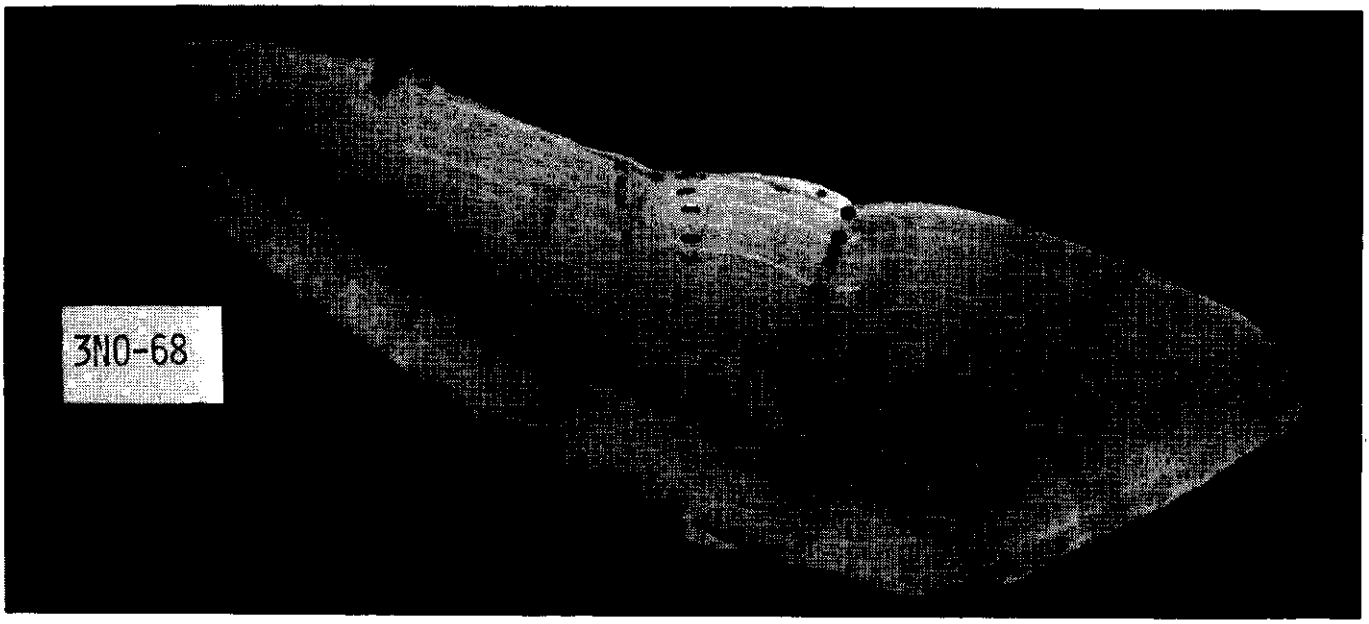
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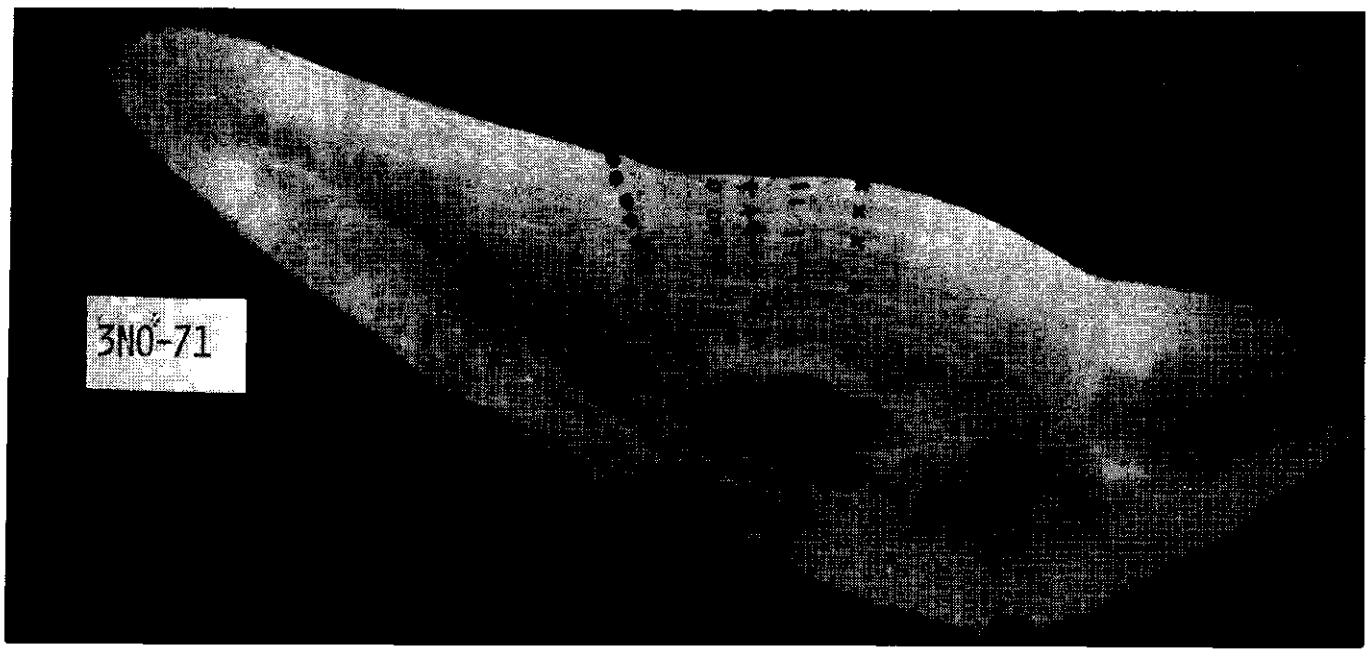
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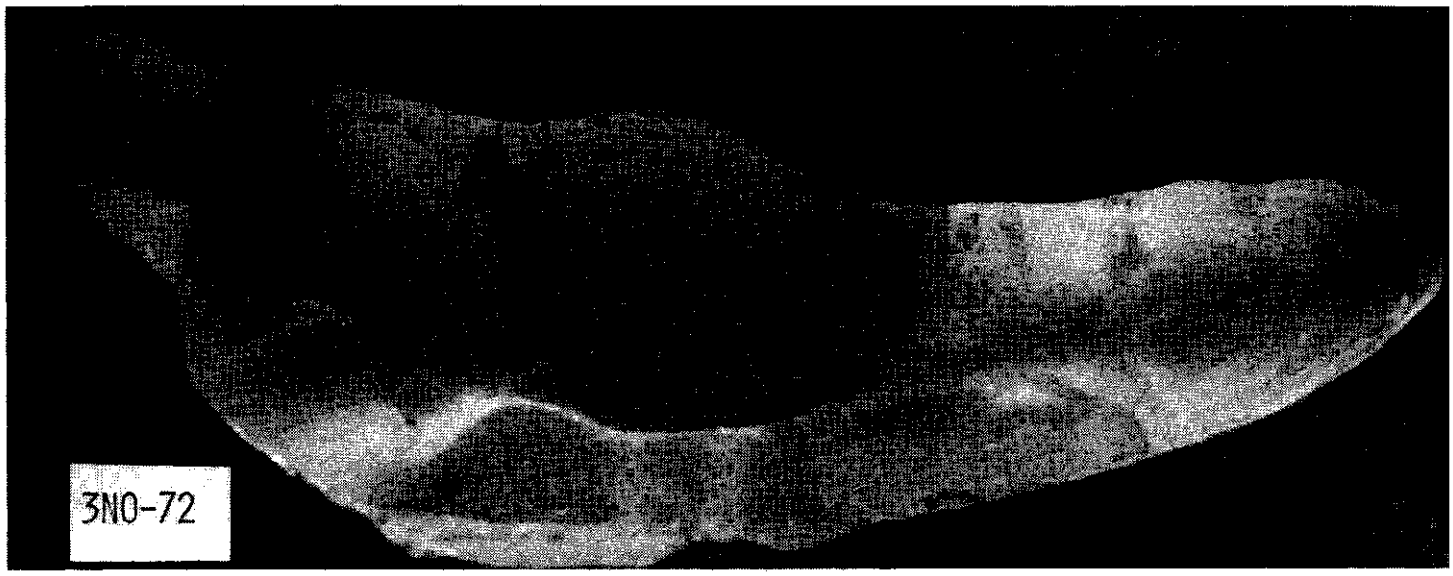
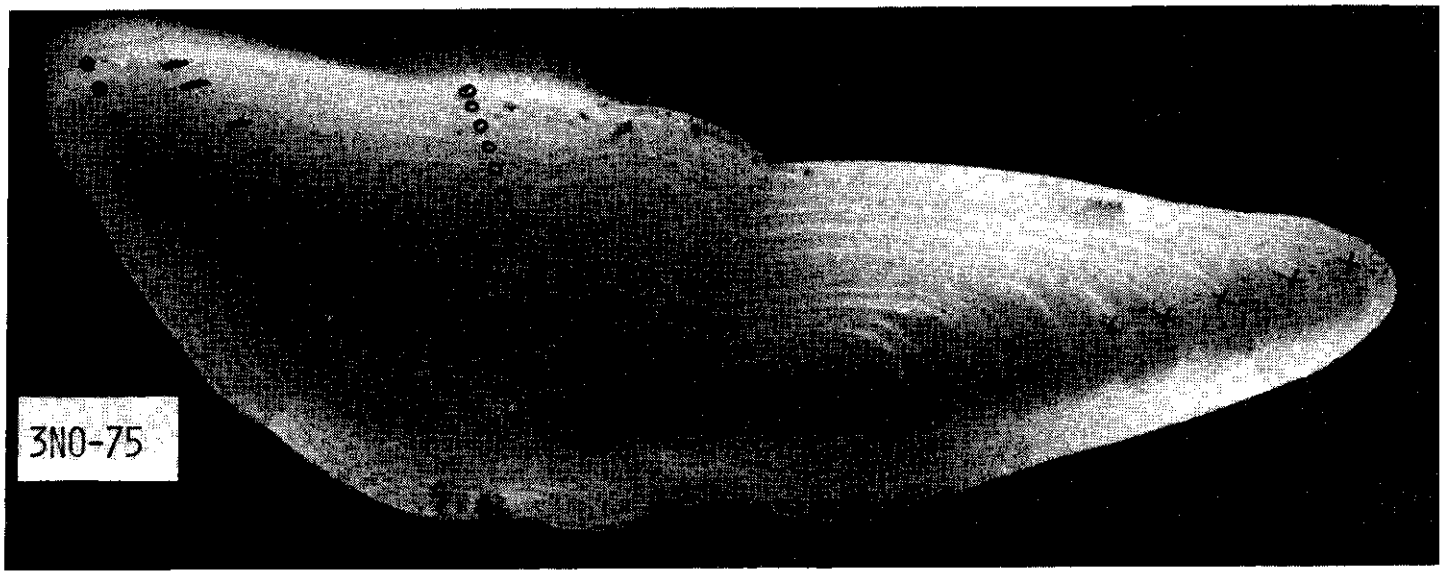
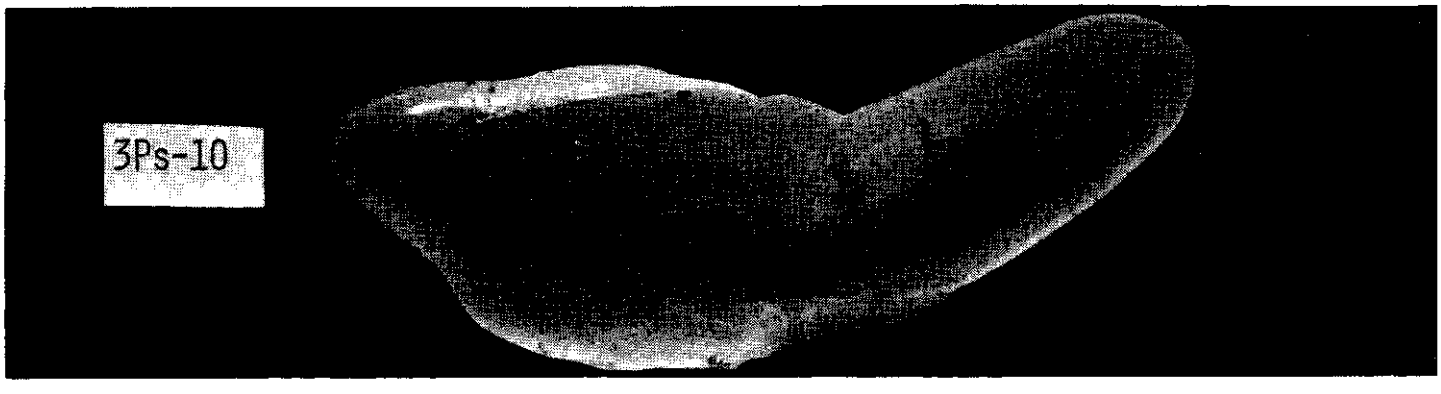




DIVISION 3Ps

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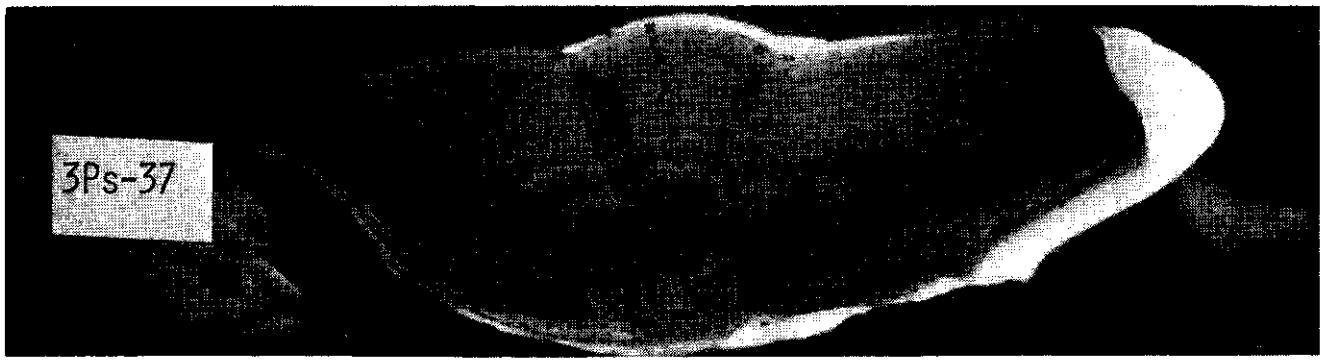
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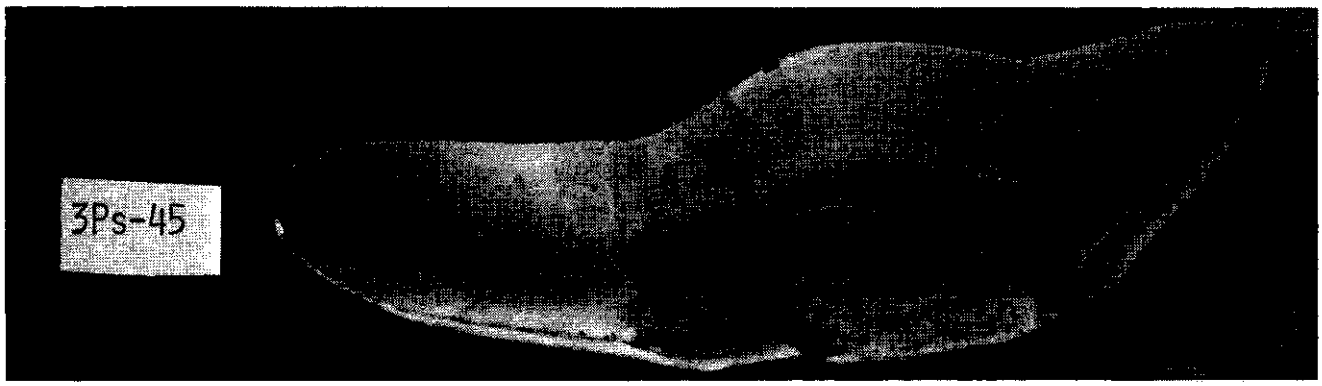
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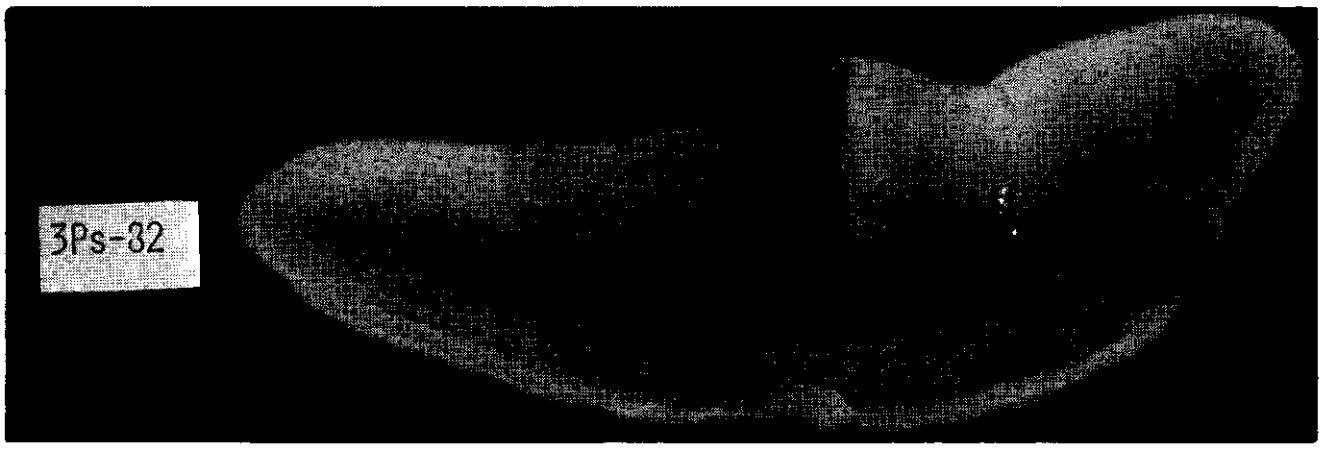
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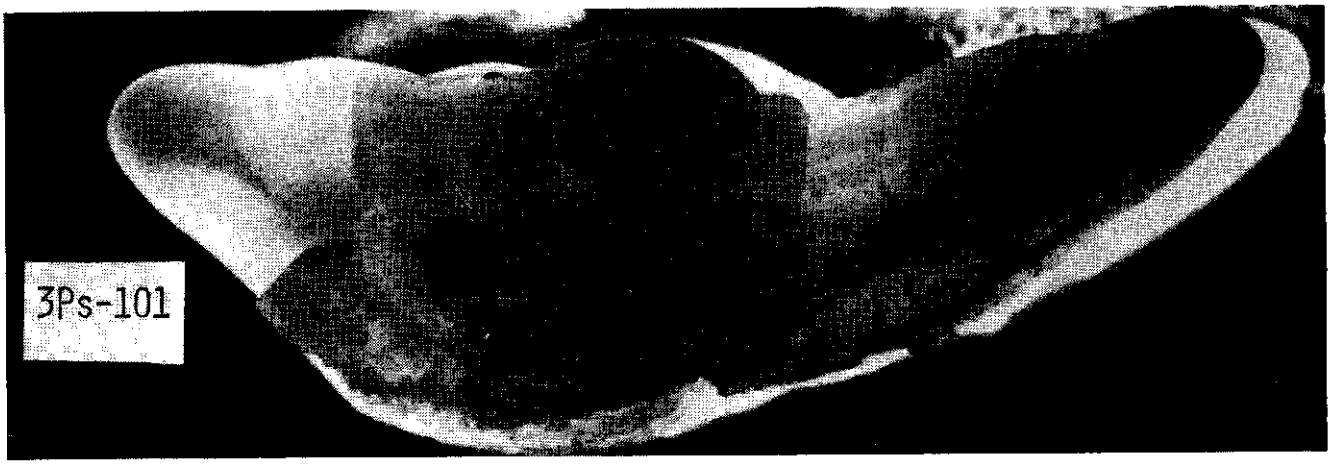
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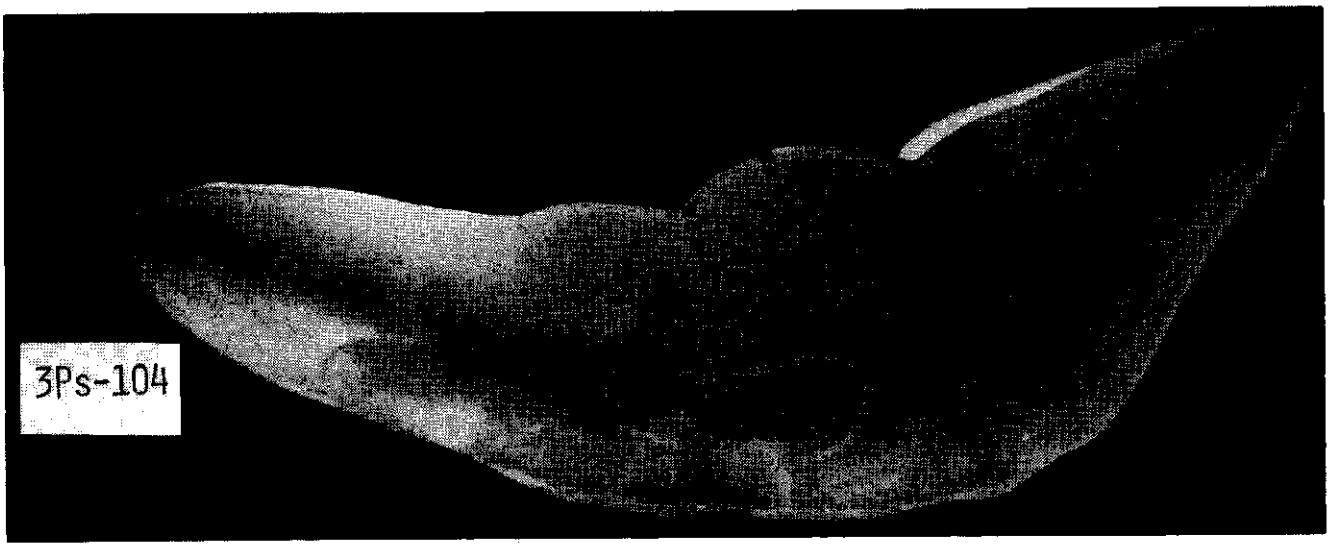
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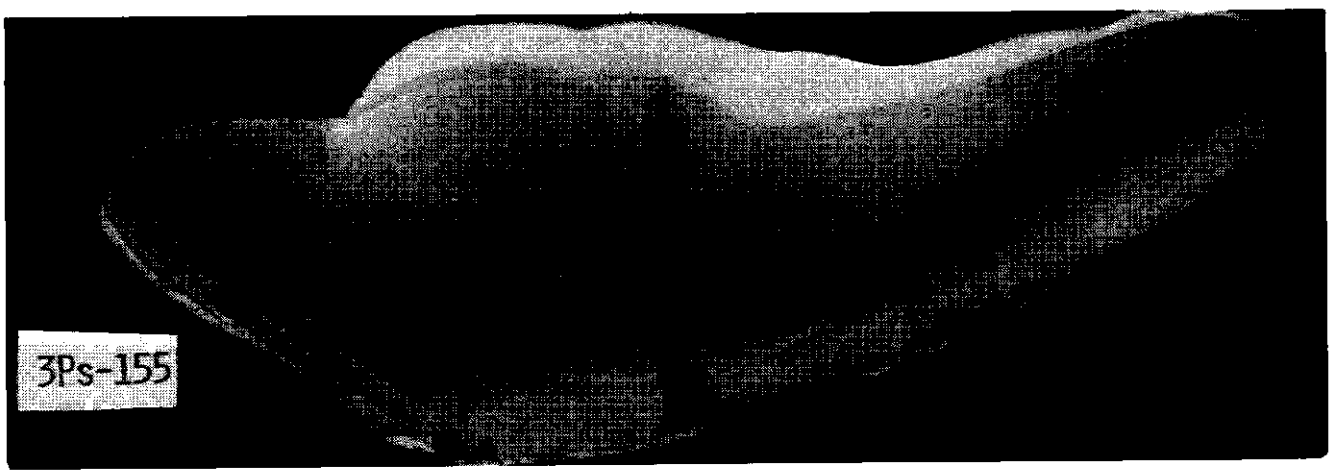
3Ps-127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