# ADDITIONAL INFORMATION ON SKELETON OF THE MINKE WHALE FROM THE ANTARCTIC

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ABSTRACT

A skull and postcranial bones of the minke whale from the Antarctic, kept at the Irako Natural History Museum, were studied comparing with two other specimens reported previously by one of the present authors. In general the present specimen supported the observations made earlier, but the form of the pelvic bone is different and more study is needed in future in this respect.

## INTRODUCTION

Omura (1975) studied two skulls and postcranial bones of the minke whale from the Antarctic and found several characters which differ from the minke whale in the northern hemisphere. Since then we were informed that an another sample of bones is being kept at the Irako Natural History Museum in Aichi prefecture. These bones were taken by a request of the museum for display on 4 December 1973 on the Kyokusei Maru, a minke whaling factory ship which operated in the 1973-74 Antarctic season. Noon position of the ship of this day is 63°33′S and 120°16′E. A total of 36 minke whales were processed on this day, and from which a complete set of skeleton was collected, but there is no assurance that all of the bones were taken from single animal.

These bones were transported to Japan in April the following year and had been burried in sand nearby the museum for extraction of oil until January 1976. We were permited by the museum to investigate these bones after dug out from sand and prior to mounting for display. In this paper bones of this whale or the Irako specimen are compared with the two specimens (71J2793 and 71J2883) reported by Omura (1975).

## SKULL

The skull is comparatively large and its length is 2,266 mm. Size of this skull is compared with other two specimens in Table 1. As seen in this Table the skull of the Irako specimen is larger than that of 71J2793 but smaller than in

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TABLE 1. COMPARISON OF SKULL OF THREE SPECIMENS OF THE MINKE WHALE FROM THE ANTARCTIC

| | Irako | 71J2793* | 71J2883* |
|---|---|---|---|
| Condylo-premaxillary length (mm) | 2,266 | 2,115 | 2,350 |
| Breadth of skull, squamosal (mm) | 1,177 | 1,075 | 1,256 |
| Sex, Body length (m) | ? | M. 8.5 | F. 9.8 |
| Age | ? | Ad. 25 years | Ad. 39 years |

* Cited from Omura (1975).

71J2883, suggesting that this skull was obtained from a whale of about 9 m in length.

Omura (1975) found several distinctions which separate minke whales from the Antarctic from those in the northern hemisphere. In the form of the skull these are: 1. the rostrum is more rounded in dorsal view and flat in profile, 2. anterior margin of nasals is concave and no groove is present on inferior surface, 3. no triangle region is formed by frontal and parietal (or interparietal) at vertex, 4. hamular process of pterygoid is short and broad, and 5. lachrymal is large and rectangular. The present specimen of Irako agrees in general in all characters listed above. In Figs. 1 and 2 are shown the profile of the skull and form of pterygoid separetely, on which no further explanation would be needed.

In the region of vertex (Fig. 3), however, the shape of the frontal is somewhat different from the other two specimens. In the Irako specimen there are two thin projections of frontal towards nasals and they cover partly posterior ends of nasals and premaxillaries. At a glance the photograph shown in Fig. 3 resembles in some extent to that of the Matsushima specimen from the North Pacific (Fig. 4 of Omura, 1975), but the most important point is that in the Irako specimen no trace of parietal is appearing on the upper surface of the vertex and the nasals are situated very close to the supraoccipital bone, whereas in the Matsushima specimen the parietal present at the center of the vertex and nasals are at more anterior position. The form of nasals of the Irako specimen is quite similar to the other two specimens and their anterior margin is concave.

The shape of the lachrymal is similar in general, but shorter and broader than in the two specimens. Measurements of malar and lachrymal are given in Table 2.

Measurements of the skull are shown in Table 3. The percentage figures of measurements against skull length are also compared with two other specimens in the table. All measurements for the Irako specimen are very close to those of the two other specimens, excepting the measuremet no. 28 (tip of premaxillary to anterior end of vomer) in which the Irako specimen shows somewhat greater value. This means, however, a comparatively shorter vomer and which is thought to be subject to individual or age difference. In any case the specimens other than the Irako specimen are full grown animal of high

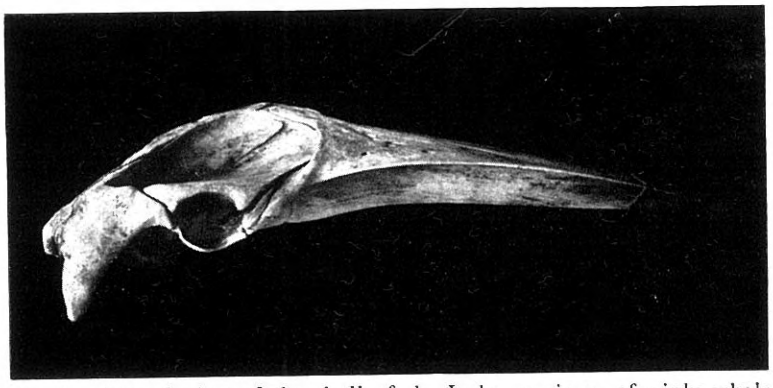

Fig. 1. Lateral view of the skull of the Irako specimen of minke whale from the Antarctic.

Fig. 2. Inferior view of the skull of the Irako specimen of minke whale from the Antarctic, showing the form of the pterygoid.

Fig. 3. Superior view of the skull of the Irako specimen of minke whale from the Antarctic, showing the vertex.

TABLE 2. MEASUREMENTS OF MALARS AND LACHRYMALS OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| | Length, greatest | | Breadth at middle | |
|---|---|---|---|---|
| | Right | Left | Right | Left |
| Malar | 246 | 250 | 38 | 38 |
| Lachrymal | 348 | 229 | 105 | 106 |

age, but the age of this specimen is not known.

In the skull measurements Omura (1975) noted several distinctions among minke whale populations from the Antarctic, North Atlantic, and North Pacific. These are in the Antarctic specimen: 1. breadth of skull is narrower than in those from the other two oceans, 2. rostrum is longer than those from the North Pacific, 3. breadth of rostrum at base is narrower than those from the other two oceans, and 4, breadth at middle of rostrum is narrower than those from the North Atlantic. In these characters the figures for the Irako specimen (measurements nos. 10, 11, 12, and 16) are all within the ranges of the other two specimens as seen in Table 3, and no change of observation is needed. In conclusion the skull of the Irako specimen agrees well in general with the other two specimens from the Antarctic.

## VERTEBRAE

The character which separates minke whales from the Antarctic from those in the northern hemisphere in vertebrae is in the 7th cervical (Omura, 1975). In minke whales in the northern hemisphere the 7th cervical has parapophysis though it reduced to a tubercle, whereas the two specimens from the Antarctic were lacking parapophyses and no sign of tubercle was noted. Also in the Irako specimen parapophysis is lacking as seen in Fig. 4, but in this specimen there is very low elevation of bone on the surface of body or a sign of tubercle, though it is not clearly shown in the photograph. In this specimen the 2nd and 3rd cervicals are united at lateral margins of the spinous processes.

In total 48 vertebrae were preserved in the Irako specimen. These are 7 cervicals, 11 dorsals, 12 lumbars, and 18 caudals (Fig. 5), but the size of the 18th caudal is much larger than the expected size of the last, comparing with those of the other two specimens. It is possible, therefore, that the last caudal was missed when sampled and the vertebral formula of the Irako specimen should be C 7, D 11, L 12, Ca 19, total 49. This total number of 49 is in close agreement with the other two specimens which numbered 49 and 50 respectively.

In the Irako specimen the vertebral epiphyses are not all fused to their centra. Posterior epiphyses of the vertebrae from 3rd dorsal to and inclusive 2nd lumbar are not fused and in the 6th dorsal also anterior one is not fused. In all of the above vertebrae linea epiphysialis is quite visible even in those

TABLE 3. SKULL MEASUREMENTS OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC, COMPARED WITH OTHER SPECIMENS

| | Measurements | Irako specimen in mm | Irako specimen in % | 71J2793 and 71J2883 (%) |
|---|---|---|---|---|
| 1. | Condylo-premaxillary length | 2,266 | 100 | 100* |
| 2. | Length of premaxillary, right | 1,600 | 70.6 | 70.4 - 72.8 |
| 3. | „ „ „ , left | 1,633 | 72.1 | 71.4 - 72.6 |
| 4. | „ „ maxillary, superior, right | 1,566 | 69.1 | 68.6 - 70.0 |
| 5. | „ „ „ „ , left | 1,586 | 70.0 | 70.0 |
| 6. | Tip of premaxillary to vertex | 1,668 | 73.6 | 71.9 - 72.8 |
| 7. | „ „ „ „ nasals | 1.445 | 63.8 | 64.5 - 66.0 |
| 8. | Length of nasals, median | 183 | 8.1 | 6.3 - 7.2 |
| 9. | Breadth of nasals, anterior | 118 | 5.2 | 4.6 - 5.8 |
| 10. | Length of rostrum | 1,502 | 66.3 | 64.0 - 69.4 |
| 11. | Breadth of rostrum at middle | 462 | 20.4 | 18.9 - 22.7 |
| 12. | Breadth of rostrum at base | 727 | 32.1 | 29.8 - 32.8 |
| 13. | Breadth across maxillaries at vertex | 236 | 10.4 | 8.8 - 10.1 |
| 14. | Breadth of frontal across nasals | 250 | 11.0 | 10.9 - 11.1 |
| 16. | Breadth of skull, squamosal | 1,177 | 51.9 | 50.8 - 53.4 |
| 17. | „ „ „ , frontal | 1,149 | 50.7 | 49.5 - 51.9 |
| 18. | „ „ „ , maxillaries | 1,113 | 49.1 | 46.9 - 48.7 |
| 19. | Length of orbit, frontal, right | 191 | 8.4 | 8.9 - 8.8 |
| 20. | „ „ „ „ , left | 192 | 8.5 | 8.8 - 9.0 |
| 21. | Breadth of occipital bone | 906 | 40.0 | 35.9 - 37.7 |
| 22. | Breadth across occipital condyles | 209 | 9.2 | 9.6 - 9.7 |
| 23. | Height of occipital condyle, right | 126 | 5.6 | 6.2 |
| 24. | „ „ „ „ , left | 123 | 5.4 | 5.9 - 6.0 |
| 25. | Breadth of foramen magnum | 72 | 3.2 | 3.3 - 3.4 |
| 26. | Height of foramen magnum | 100 | 4.4 | 4.6 - 5.4 |
| 27. | Length from foramen magnum to vertex | 628 | 27.7 | 27.7 - 28.6 |
| 28. | Tip of premax. to anterior end of vomer, median | 422 | 18.6 | 12.2 - 12.3 |
| 29. | „ „ „ „ „ „ „ palatine, median | 1,591 | 70.2 | 69.9 - 71.2 |
| 30. | „ „ „ „ posterior „ „ „ „ | 1,966 | 86.8 | 84.3 - 87.4 |
| 31. | „ „ „ „ „ „ „ pterygoid | 2,087 | 92.1 | 91.5 |
| 32. | Breadth across hamular processes of pterygoid | 234 | 10.3 | 9.9 - 10.0 |
| 33. | Length of mandible, straight, right | 2,186 | 96.5 | 97.2 - 97.5 |
| 34. | „ „ „ „ , left | 2,185 | 96.4 | 96.4 - 98.1 |
| 35. | „ „ „ , curved, right | 2,340 | 103.3 | 104.4-106.2 |
| 36. | „ „ „ „ , left | 2,330 | 102.8 | 104.0-106.9 |
| 37. | Height of mandible at coronoid, right | 267 | 11.8 | 13.2 - 14.3 |
| 38. | „ „ „ „ „ , left | 283 | 12.5 | 13.4 - 14.3 |
| 39. | „ „ „ „ condyle, right | 200 | 8.8 | 9.4 - 9.5 |
| 40. | „ „ „ „ „ , left | 208 | 9.2 | 9.6 - 9.9 |

* Actual length of skull is shown in Table 1.

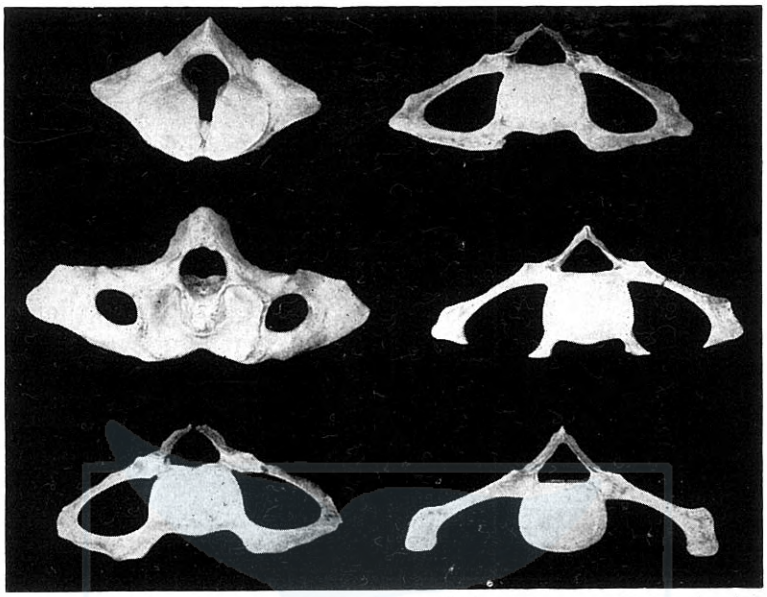

Fig. 4. Anterior view of the cervical vertebrae of the Irako specimen of minke whale from the Antarctic. Left side: 1st, 2-3 combined, and 4th; Right side: 5th, 6th, and 7th from top to bottom.

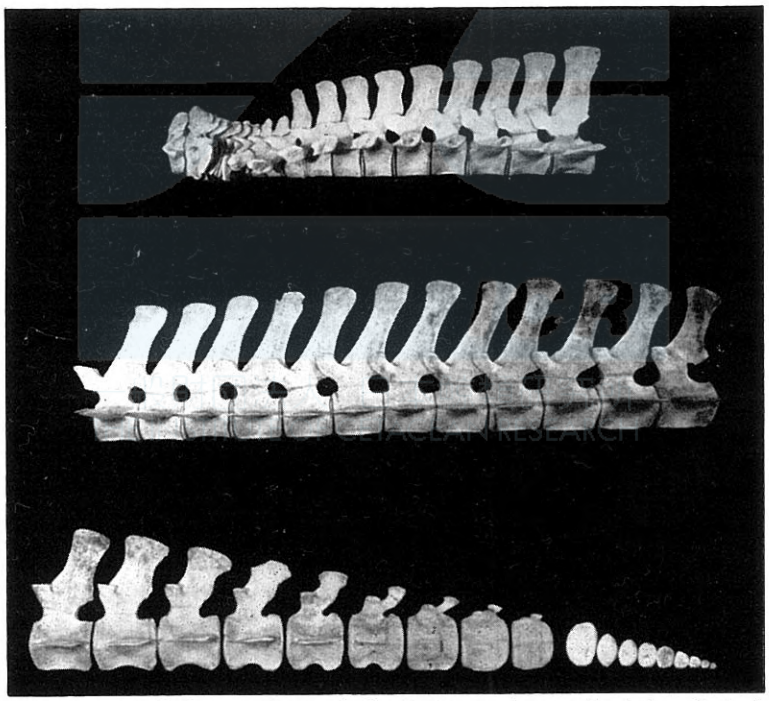

Fig. 5. Lateral view of the vertebrae of the Irako specimen of minke whale from the Antarctic. Upper: Cervical and dorsal vertebrae. Center: Lumbar vertebrae. Lower: Caudal vertebrae.

already fused. The posterior epiphyses of the 4th and 5th dorsals were not recovered when dug out of the sands.

All of the vertebrae of the Irako specimen are thought to have been collected from single whale, but it is not certain whether or not the skull and vertebrae were collected from the same individual. Measurements of vertebrae are appended this report, but these are of limited value. The aggregated length of vertebrae is 6,305 mm. The corresponding figures of the full grown specimens (71J2793 and 71J2883) are 5,872 and 6,741 mm respectively. The body length of the Irako specimen would, therefore, be between those of the two adult specimens or about 9 m, though it has not attained physical maturity.

The chevron bones (Fig. 6) are 9 in number, but possibly the first and the last were missed when sampling. In general they resemble in form and size to those of the specimen 71J2773. In the second chevron of the present specimen, right and left laminae are not fused together as in the case of the other specimen. Measurements of chevron bones are shown in Table 4.

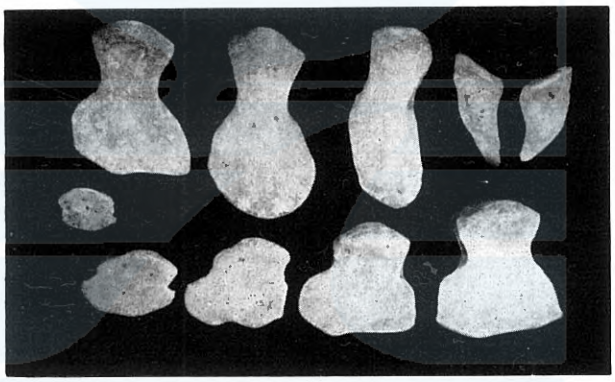

Fig. 6. Chevron bones of the Irako specimen of minke whale from the Antarctic. From right to left. Upper: 2nd (separated), 3rd, 4th, and 5th. Lower: 6th, 7th, 8th, 9th, and 10th.

TABLE 4. MEASUREMENTS OF CHEVRON BONES OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| No. | | Length | Height | No. | Length | Height |
|---|---|---|---|---|---|---|
| 2* | R. | 80 | 138 | 6 | 168 | 178 |
| | L. | 79 | 160 | 7 | 154 | 141 |
| 3 | | 93 | 233 | 8 | 133+ | 116 |
| 4 | | 145 | 247 | 9 | 124 | 87 |
| 5 | | 159 | 198 | 10 | 73 | 51 |

* Not united.

## RIBS AND STERNUM

There are 11 pairs of ribs, but possibly the left 3rd and the right 9th bones were substituted by bones of other individual, presumably due to breakage. Heads of these two ribs are not coincide with others. All bones, except right 7th whose head was broken partly, are all perfect. In Fig. 7 are shown proximal parts of ribs, excluding those of dubious origin. Measurements of ribs

Fig. 7. Proximal parts of ribs of the Irako specimen of minke whale from the Antarctic.

TABLE 5. STRAIGHT LENGTH OF RIBS OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| No. | Length | | No. | Length | |
|---|---|---|---|---|---|
| | Right | Left | | Right | Left |
| 1 | 744 | 714 | 7 | 1,197+ | 1,215 |
| 2 | 1,078 | 1,177 | 8 | 1,157 | 1,154 |
| 3 | 1,272 | ? | 9 | ? | 1,098 |
| 4 | 1,310 | 1,302 | 10 | 1,012 | 1,042 |
| 5 | 1,300 | 1,289 | 11 | 1,125 | 1,099 |
| 6 | 1,243 | 1,262 | | | |

are shown in Table 5. In general they are larger than those of the 71J2793, but smaller than in the 71J2883.

The sternum is roughly T shaped rather than cruciform (Fig. 8), and its breadth is 379 mm and the height is 411mm. This sizs is greater than in the other two specimens from the Antarctic.

Fig. 8. Sternum of the Irako specimen of minke whale from the Antarctic.

## SCAPULA AND FLIPPER BONES

Scapula (Fig. 9) of the Irako specimen resembles in general to that of the other two specimens, but it is narrower and higher than the latter. The ratio of breadth against its height of the right and left scapullae are 1.65 and 1.63 respectively, whereas this ratio is 1.76-1.81 in the specimens 71J2793 and 71J2883. Measurements of scapullae of the Irako specimen are shown in Table 6.

Measurements of the humerus, radius, and ulna are shown in Table 7. The distal epiphyses of the radius and ulna are not fused in both sides.

Fig. 9. Right scapula of the Irako specimen of minke whale from the Antarctic.

TABLE 6. MEASUREMENTS OF SCAPULA OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| | Right | Left |
|---|---|---|
| Greatest breadth | 789 | 774 |
| Greatest height | 478 | 474 |
| Length of acromion, inferior | 218 | 228 |
| Breadth of acromion, distal end | 61 | 66 |
| Length of coracoid, inferior | 121 | 127 |
| Breadth of coracoid, distal end | 51 | 48 |
| Length of glenoid fossa | 154 | 154 |
| Breadth of glenoid fossa | 117 | 116 |
| Ratio of breadth against height | 1.65 | 1.63 |

TABLE 7. MEASUREMENTS OF HUMERUS, RADIUS, AND ULNA OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| | Humerus | | Radius | | Ulna | |
|---|---|---|---|---|---|---|
| | Right | Left | Right | Left | Right | Left |
| Length* | 305 | 307 | 492 | 489 | 534 | 532 |
| Breadth* | 148 | 150 | 68 | 69 | 105 | 104 |

* Measured at middle.

TABLE 8. LENGTH OF PHALANGES OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| Phalanx | Right | | | | Left | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | I | II | III | IV |
| 1 | 86 | 85 | 95 | 58 | 83 | 97 | 85 | 60 |
| 2 | 85 | 95 | 101 | 62 | 86 | 103 | 94 | 64 |
| 3 | 75 | 77 | 77 | 64 | 74 | 77 | 78 | 64 |
| 4 | 57 | 57 | 55 | 40 | 58 | 53 | 57 | 39 |
| 5 | 21 | 38 | 37 | — | 33 | 35 | 40 | — |
| 6 | — | 25 | 23 | — | — | 24 | 26 | — |
| 7 | — | 14 | — | — | — | 15 | 16 | — |

The phalangeal formula of the Irako specimen is $I_5$, $II_7$, $III_{6-7}$, $IV_4$, but probably some small distal bones were missed at the time of sampling. Measurements of phalanges are shown in Table 8.

## HYOID AND PELVIC BONES

Hyoid bone of the Irako specimen is of no special feature and resembles to those of other specimens reported by Satake and Omura (1974). Its transverse breadth is 445 mm, height at middle is 102 mm, and the depth between two

forward promontories is 34 mm. Length of right and left stylophyals are 310 and 305 mm respectively.

Pelvic bone of the Irako speeimen (Fig. 10) is of some interest. This bone was taken possibly from a male, but it differs in form from that of the specimen 71J2793 from the Antarctic as well as from that of a specimen from the North Pacific (compare with Figs. 12 and 13 of Omura, 1975). Length and width of the pelvic bone of the Irako specimen are 205 and 44 mm in the right bone and 202 and 44 mm in the left bone respectively. These figures are very close to those of the specimen 71J2793, but the form is different. In the Irako specimen bones are a little slender and curving inwards. Further the tubercle or tuberculum laterale is not situated towards the middle of the bone, differing from that of the specimen 71J2793. Omura (1975) listed the pelvic bone in Fig. 14 of his paper as one of the characters which separate the minke whale population from the Antarctic from that from the northern hemisphere, but this needs further examination in the light of the present knowledge. Rather a wide individual variation in the form is expected.

Fig. 10. Pelvic bones of the Irako specimen of minke whale from the Antarctic.

## ACKNOWLEDGMENTS

Our sincere thanks are due to the staff of the Irako Natural History Museum. They not only permited us to investigate the bones, but also helped us greatly during our work at the museum. The photographs shown in Figs. 2 and 3 were taken by the staff.

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APPENDIX. MEASUREMENTS OF VERTEBRAE OF THE IRAKO SPECIMEN OF MINKE WHALE FROM THE ANTARCTIC (in mm)

| Serial no. | Vertebral no. | Greatest breadth | Greatest height | Centrum | | |
|---|---|---|---|---|---|---|
| | | | | Breadth | Height | Length |
| 1 | C 1 | 387 | 237 | 211 | R. 128, L. 126 | 66 |
| 2 | 2 | 539 | 246 | 206 | 136 | 35 |
| 3 | 3 | 511 | 197 | 161* | 110* | 26 |
| 4 | 4 | 488 | 190 | 156 | 110 | 30 |
| 5 | 5 | 519 | 194 | 152 | 117 | 34 |
| 6 | 6 | 510 | 205 | 150 | 117 | 37 |
| 7 | 7 | 511 | 210 | 148 | 118 | 42 |
| 8 | D 1 | 522 | 230 | 153 | 119 | 52 |
| 9 | 2 | 523 | 294 | 163 | 121 | 66 |
| 10 | 3 | 492 | 340 | 163 | 121 | 83 |
| 11 | 4 | 520 | 374 | 164 | 123 | 98+ |
| 12 | 5 | 570 | 395 | 163 | 125 | 106+ |
| 13 | 6 | 636 | 412 | 163 | 127 | 119 |
| 14 | 7 | 684 | 432 | 167 | 127 | 131 |
| 15 | 8 | 703 | 453 | 165 | 125 | 144 |
| 16 | 9 | 715 | 452 | 171 | 123 | 147 |
| 17 | 10 | 703 | 476 | 176 | 125 | 151 |
| 18 | 11 | 709 | 493 | 175 | 124 | 156 |
| 19 | L 1 | 667 | 521 | 174 | 137 | 162 |
| 20 | 2 | 665 | 528 | 178 | 141 | 166 |
| 21 | 3 | 674 | 544 | 177 | 144 | 173 |
| 22 | 4 | 669 | 569 | 180 | 145 | 178 |
| 23 | 5 | 659 | 576 | 182 | 148 | 187 |
| 24 | 6 | 650 | 594 | 184 | 156 | 188 |
| 25 | 7 | 629 | 599 | 186 | 156 | 195 |
| 26 | 8 | 636 | 588 | 191 | 155 | 200 |
| 27 | 9 | 625 | 589 | 194 | 154 | 207 |
| 28 | 10 | 598 | 596 | 203 | 161 | 214 |
| 29 | 11 | 594 | 572 | 205 | 171 | 221 |
| 30 | 12 | 504 | 562 | 209 | 169 | 228 |
| 31 | Ca 1 | 458 | 528 | 210 | 171 | 232 |
| 32 | 2 | 419 | 505 | 210 | 178 | 236 |
| 33 | 3 | 366 | 453 | 209 | 189 | 234 |
| 34 | 4 | 303 | 410 | 213 | 196 | 232 |
| 35 | 5 | 237 | 364 | 222 | 201 | 226 |
| 36 | 6 | T.P. disappear | 309 | 217 | 202 | 218 |
| 37 | 7 | — | 271 | 198 | 200 | 206 |
| 38 | 8 | — | 239 | 170 | 190 | 189 |
| 39 | 9 | — | 207 | 153 | 184 | 160 |
| 40 | 10 | — | S.P. disappear | 143 | 151 | 112 |
| 41 | 11 | — | — | 131 | 116 | 82 |
| 42 | 12 | — | — | 112 | 97 | 72 |
| 43 | 13 | — | — | 101 | 89 | 68 |
| 44 | 14 | — | — | 88 | 74 | 58 |
| 45 | 15 | — | — | 71 | 59 | 46 |
| 46 | 16 | — | — | 55 | 43 | 37 |
| 47 | 17 | — | — | 39 | 33 | 31 |
| 48 | 18 | — | — | 38 | 23 | 24 |
| 49 | 19 | — | — | ? | ? | ? |

* Measured from posterior side, since 2nd and 3rd are united together.
In other bones all from anterior side.