

## OSTEOLOGICAL NOTE OF A SPERM WHALE

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Material used in this report is a skeleton of male sperm whale measuring 46 feet in body length, which was collected in request of Staatl. Museum für Naturkunde, Stuttgart, West Germany. The measurements were made soon after cleaning of the skeleton in order to obtain the measurements which do not differ greatly from fresh condition as far as possible. We believe that these measurements may be useful in mounting the skeleton at the Museum. Further we think that it is of some value to publish them, since measurements of the whole skeleton of sperm whale from the coast of Japan have never been reported before.

This sperm whale was caught on 29 August 1960 at  $37^{\circ}17'N$ ,  $145^{\circ}04'E$  by one of the whaling vessel of Nippon Kinkai Hogeï Co. Ltd. and was dissected on the following day. It is very regrettable that no external body proportions were measured owing to some difficulties during the dissecting process. Soon after dissection the skeleton was buried in the sand of Kugunari Beach, Ojika Town, and in the case of small bones they were enveloped in a net of chemical fibres in order to prevent from any missing.

The purpose of the present report is only to supply these data and any discussions comparing with others presented by various authors are not included.

The longitudinal section of an upper tooth was made for the age determination and in it 32 laminae were observed.

While measuring this specimen, some interesting or important facts were noted, which are written below.

The skull of sperm whale differs from that of other toothed whales in having a large space which contains spermaceti. We measured it according to the usual way of measurement applied to other species, though it was thought that other items of measurements should be applied to this species. Among the measurements concerning nasal bones some were omitted, because it was rather difficult to distinguish them from other. It is regrettable that nearly all of the maxillary teeth, vestigial teeth, which usually present ten to twenty have been lost during the course of dissection, though they could have been collected without any difficulty and only one has been saved for age determination. All of the mandibular teeth and vertebral bones were collected, and

chevron bones were nearly complete. Damage of skeleton caused by grenade and harpoon is very little.

The body length of male sperm whale at the attainment of physical maturity is thought to be between 52 and 53 ft. Several years, during which growth of several feet is attained, might be necessary for this specimen before the attainment of physical maturity, for the epiphyses of vertebrae are not completely ankylosed to their centra. The epiphyses are so thin that they were easily warped in various degree by drying after digging them out from sand and washing, and do not fit *in situ* to their centra, which caused some discrepancies in values of the vertebral measurement No. 1 (length of body at center). The ankylosis of vertebral epiphysis to its centrum is only observed in those posterior to the 14th caudal and in the cervical vertebrae.



Fig. 1. Chevron bone.

Though all the ribs have been collected, 9th and 10th of left rib were broken by the harpoon. The 11th ribs are so small compared with 10th that one may apprehend that the preceding one was lost in the process of dissection.

The right lamina of the 1st chevron bone has not been collected. We think that possibly it was lost, though a probability that the ossification had not completed yet cannot finally be erased. The shape of the first chevron bone is subject to a considerable sexual difference. In this specimen 13 pairs of chevron bone were collected. But usually there present several more pairs of cartilage in the posterior region.

The hyoid bone is very large and resembles in shape to that of other toothed whales. The dimensions of the hyoid bone are shown in Table 1.

The sternum is very irregular in shape. It may be of some interest to note that the 2nd and 3rd bones seem to show wide individual variation. Sternum is combined with vertebral ribs by means of cartilage. The first rib is connected to sternum at the most anterior joint, 2nd and 3rd at 2nd, and 4th and 5th at 3rd respectively.

The rudimental pelvic bones are slender and in this specimen there is

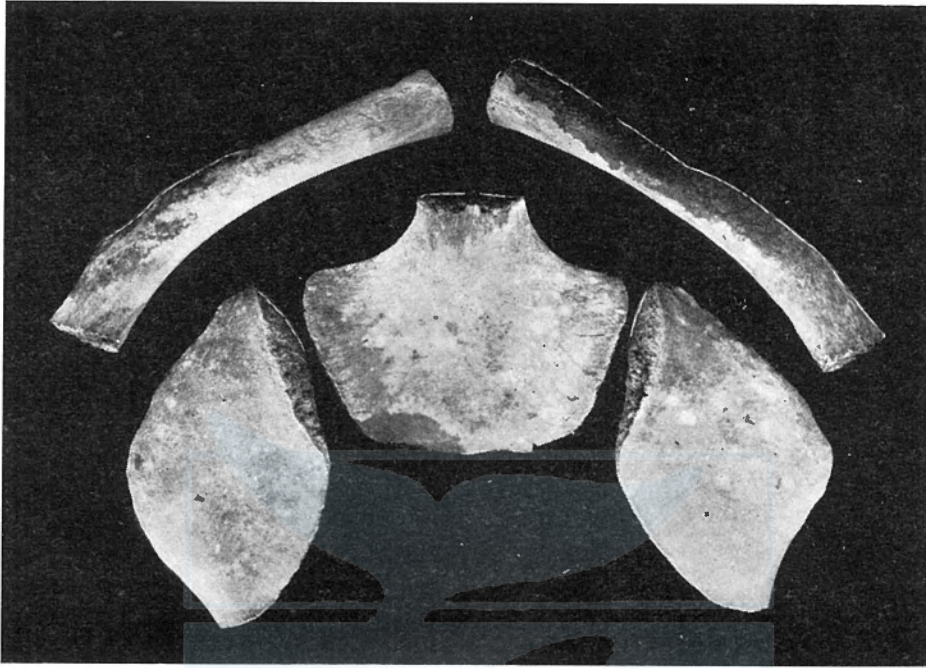
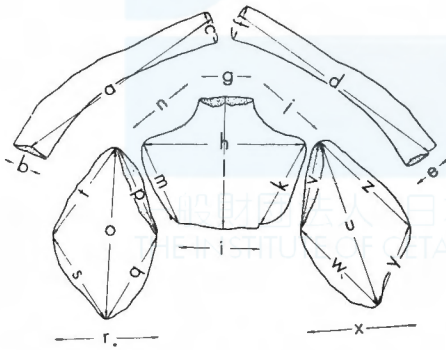


Fig. 2. Hyoid bone.

TABLE 1. DIMENSIONS OF HYOID BONE (cm)

| Stylohyals | L    | R    |
|------------|------|------|
| a          | 60   | d 60 |
| b          | 12   | e 11 |
| c          | 8    | f 8  |
| Basihyals  | g 13 |      |
|            | h 43 |      |
|            | i 20 |      |
|            | j 22 |      |
|            | k 25 |      |
|            | l 35 |      |
|            | m 25 |      |
|            | n 20 |      |
| Thylohyals | L    | R    |
|            | o 45 | u 45 |
|            | p 26 | v 27 |
|            | q 29 | w 26 |
|            | r 28 | x 27 |
|            | s 23 | y 27 |
|            | t 30 | z 28 |



no bone which represent femur. But in other specimens femur-like bones were found, which ankylosed to pelvic bone or connected to it with joint.



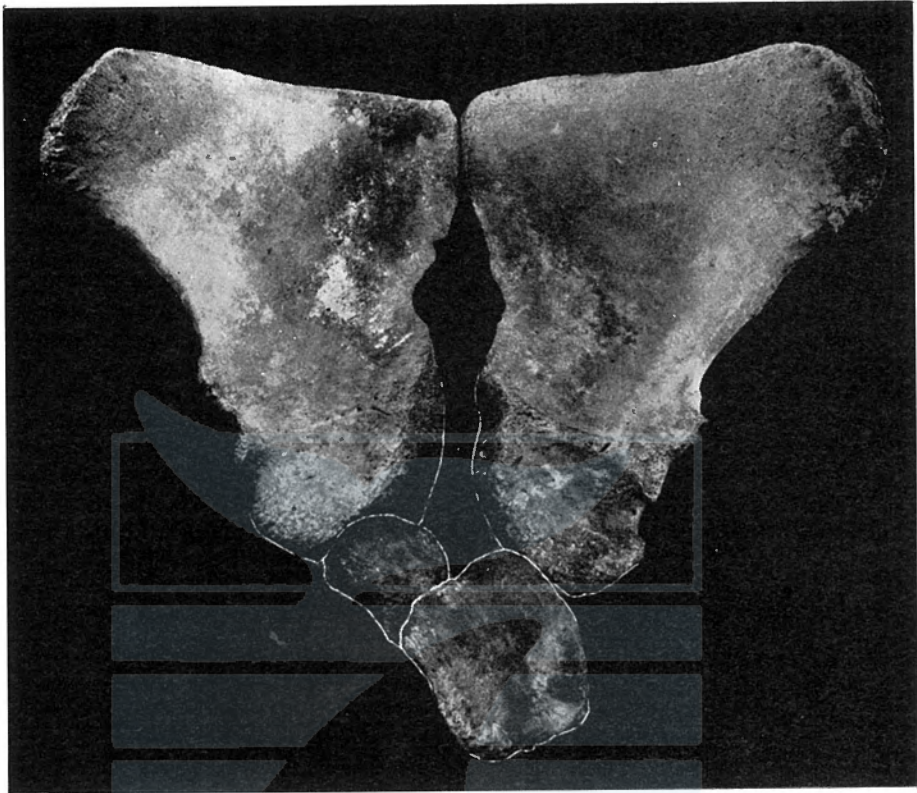
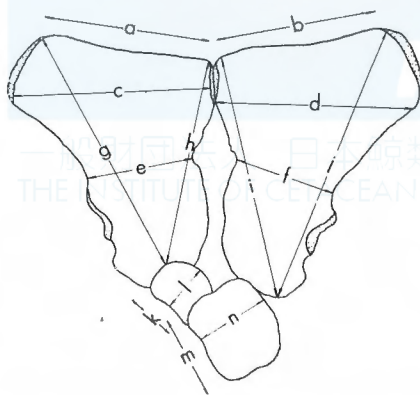


Fig. 3. Sternum.

TABLE 2. DIMENSIONS OF STERUM (cm)



|   |    |   |    |
|---|----|---|----|
| a | 45 | h | 61 |
| b | 38 | i | 65 |
| c | 52 | j | 73 |
| d | 52 | k | 15 |
| e | 28 | l | 12 |
| f | 27 | m | 22 |
| g | 68 | n | 18 |

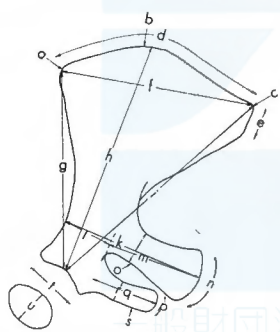
Bones in flipper were collected nearly completely. But ulna, radius and some digits of left flipper were broken by the clashing with the side of the catcher boat during the time of towing the whale to the landstation.



Fig. 4. Pelvic bone.

TABLE 3. DIMENSIONS OF SCAPULA (cm)

|                 | L   | R   | L               | R   |
|-----------------|-----|-----|-----------------|-----|
| a <sup>1)</sup> | 25  | 28  | l               | 93  |
| b <sup>1)</sup> | 23  | 23  | m               | 282 |
| c <sup>1)</sup> | 26  | 27  | n               | 170 |
| d               | 610 | 650 | o <sup>1)</sup> | 20  |
| e               | 100 | 120 | p               | 82  |
| f               | 570 | 580 | q               | 198 |
| g               | 600 | 600 | r               | 51  |
| h               | 705 | 718 | s               | 27  |
| i               | 715 | 738 | t               | 188 |
| j               | 143 | 152 | u               | 137 |
| k               | 428 | 440 |                 |     |



1) thickness

We are grateful to Mr. Yoshinori Kimura who kindly helped us in various works, e. g. securing of the fresh skeleton, preparation for sample, and in measuring the skeleton. Sincere thanks are due to the staffs of Nippon Kinkai Hogeï Co. Ltd., especially to those who worked at Ayukawa whaling landstation. The sperm whale was caught by the catcher of this company and dissected at the landstation.

TABLE 4. DIMENSIONS OF SKULL (cm)

|  | cm   | percentage<br>to<br>the length | percentage<br>to<br>the breadth |
|--|--|--------------------------------|---------------------------------|
| 1. Total (condylo-basal) length  | 359  | 100                            | 221.8                           |
| 2. Length of rostrum (median)  | 251  | 69.9                           | 151.3                           |
| 3. Breadth of rostrum at base  | 123  | 34.3                           | 74.2                            |
| 4. Breadth of rostrum at middle  | 83   | 23.1                           | 50.0                            |
| 5. Breadth of rostrum between antorbital notches                                   | 124  | 34.6                           | 74.7                            |
| 6. Depth of rostrum at middle  | 21   | 5.9                            | 12.6                            |
| 7. Breadth of premaxillae at middle of rostrum                                     | 37   | 10.3                           | 22.3                            |
| 8. Breadth of premaxillae in front of anterior nares                               | 51   | 14.2                           | 30.7                            |
| 9. Greatest breadth of premaxillae <i>opposit</i> anterior nares                   | 64   | 17.9                           | 38.6                            |
| 10. Least distance between the postero-dorsal margins of the maxillary foramina    | 89   | 24.8                           | 53.6                            |
| 11. Least distance between the postero-dorsal margins of the premaxillary foramina | 29   | 8.1                            | 17.5                            |
| 12. Least distance between the maxillary foramina and premaxillary foramina        | L: 37<br>R: 25                               | 10.3<br>7.0                    | 22.3<br>15.0                    |
| 13. Greatest breadth of superior nares   | 33   | 9.2                            | 19.9                            |
| 14. Distance from tip of rostrum to anterior end of vomer                          | 52   | 14.5                           | 31.3                            |
| 15. From the same to anterior margin of superior nares                             | L: 289<br>R: 309                             | 83.4<br>86.2                   | 174.1<br>180.1                  |
| 16. From the same to medial suture line of posterior end of pterygoid              | 277  | 77.2                           | 166.9                           |
| 17. From the same to occipito-frontal vertex                                       | 298  | 83.0                           | 173.5                           |
| 18. From the same to posterior median end of maxillae on palate                    | 231  | 64.4                           | 139.2                           |
| 19. From the same to most anterior point of the palatines                          | 231  | 64.4                           | 139.2                           |
| 20. Length of vomer visible on palate  | 151  | 42.1                           | 91.0                            |
| 21. Breadth across middle of orbits  | 166  | 46.3                           | 100                             |
| 22. Diameter of orbit (antero-posterior)   | L: 16<br>R: 16                               | 4.5<br>4.5                     | 9.6<br>9.6                      |
| 23. Greatest breadth across supra-orbital plates of maxillae                       | 153  | 42.6                           | 92.2                            |
| 24. Greatest breadth across post-orbital processes                                 | 166  | 46.3                           | 100                             |
| 25. Greatest breadth of cranium at parietal region in temporal fossae              | 120  | 33.4                           | 72.3                            |
| 26. Length of temporal fossae  | L: 26<br>R: 27                               | 7.3<br>7.5                     | 15.7<br>16.3                    |
| 27. Depth of temporal fossae   | L: 25<br>R: 30                               | 7.2<br>8.4                     | 15.1<br>18.1                    |
| 28. Breadth of occipital condyles  | 51   | 14.2                           | 30.7                            |
| 29. Breadth of foramen magnum  | 18   | 5.0                            | 10.7                            |
| 30. Length of occipital condyle  | L: 31<br>R: 30                               | 8.6<br>8.4                     | 18.7<br>18.1                    |
| 31. Height, vertex to <i>inferior border of pterygoids</i>                         | 126  | 35.1                           | 75.7                            |
| 32. Depth of orbit   | L: 16<br>R: 16                               | 4.5<br>4.5                     | 9.6<br>9.6                      |
| 33. Length of mandible (median)  | 300 <sup>1)</sup>                            | 83.6                           | 180.7                           |
| 34. Length of mandibular ramus   | L: 301 <sup>1)</sup><br>R: 305 <sup>1)</sup> | 83.8<br>85.0                   | 181.3<br>183.7                  |
| 35. Distance from anterior end of mandible to coronoid process                     | L: 269 <sup>1)</sup><br>R: 275 <sup>1)</sup> | 75.0<br>76.6                   | 162.0<br>165.6                  |
| 36. Length of symphysis  | L: 171<br>R: 161                             | 47.8<br>44.8                   | 103.0<br>97.0                   |

TABLE 4. DIMENSIONS OF SKULL (cm) (continued)

|  | cm   | percentage<br>to<br>the length | percentage<br>to<br>the breadth |
|--|--|--------------------------------|---------------------------------|
| 37. Distance from anterior end of mandible to anterior end of alveoli  | L: 0<br>R: 0                                 | 0<br>0                         | 0<br>0                          |
| 38. Distance from anterior end of mandible to posterior end of alveoli | L: 185 <sup>1)</sup><br>R: 189 <sup>1)</sup> | 51.6<br>52.7                   | 111.4<br>119.9                  |
| 39. Depth of mandible at posterior margin of teeth                     | L: 17<br>R: 17                               | 4.7<br>4.7                     | 10.2<br>10.2                    |
| 40. Depth of mandible at anterior margin of teeth                      | L: 7<br>R: 7                                 | 2.0<br>2.0                     | 4.2<br>4.2                      |
| 41. Depth between angle and coronoid process                           | L: 50<br>R: 52                               | 13.9<br>14.9                   | 30.1<br>31.3                    |
| 42. Breadth across mandibular condyles                                 | L: 13<br>R: 13                               | 3.6<br>3.6                     | 7.8<br>7.8                      |
| 43. Greatest height of mandible at coronoid process                    | L: 55<br>R: 56                               | 15.3<br>16.2                   | 33.1<br>33.7                    |
| 44. Distance between mandibular condyles                               | 148  | 41.2                           | 89.2                            |
| 45. Distance between ear bones   | 70   | 19.5                           | 42.2                            |
| 46. Breadth of posterior end of pterygoids                             | 25   | 7.0                            | 15.0                            |
| 47. Breadth of anterior end of pterygoids                              | 46   | 12.8                           | 27.7                            |
| 48. Length of malar bone   | L: 54<br>R: 54                               | 15.0<br>15.0                   | 32.5<br>32.5                    |

1) 2 cm added for deficit

TABLE 5. DIMENSIONS OF MANDIBULAR TEETH (mm)

| Number of<br>teeth <sup>1)</sup> | Length           |                  | Diameter of<br>cavum dentis<br>(antero-posterior) |                  | Diameter of<br>cavum dentis<br>(transverse) |    |
|----------------------------------|------------------|------------------|---|------------------|---|----|
|                                  | L                | R                | L   | R                | L   | R  |
| 1st                              | 82               | 80               | 21  | 20               | 19  | 17 |
| 2nd                              | 92               | 93               | 29  | 28               | 27  | 26 |
| 3rd                              | 100              | 94               | 29  | 29               | 27  | 27 |
| 4th                              | 98               | 97               | 30  | 29               | 28  | 28 |
| 5th                              | 94               | 98               | 31  | 32               | 25  | 27 |
| 6th                              | 92               | 93               | 33  | 35               | 25  | 25 |
| 7th                              | 91               | 96               | 36  | 38               | 24  | 26 |
| 8th                              | 90               | 89               | 38  | 37               | 24  | 24 |
| 9th                              | 93               | 92               | 37  | 41               | 24  | 26 |
| 10th                             | 97               | 93               | 37  | 41               | 25  | 27 |
| 11th                             | 99               | 97               | 39  | 40               | 26  | 27 |
| 12th                             | 95               | 99               | 38  | 41               | 28  | 28 |
| 13th                             | 100              | 94               | 39  | 38               | 27  | 28 |
| 14th                             | 100              | 94               | 36  | 38 <sup>3)</sup> | 28  | 28 |
| 15th                             | 102              | 88               | 34  | 37               | 27  | 28 |
| 16th                             | 99               | 92               | 31  | 33               | 24  | 26 |
| 17th                             | 89               | 88               | 33  | 30               | 27  | 24 |
| 18th                             | 81 <sup>2)</sup> | 84               | 25  | 26               | 21  | 21 |
| 19th                             | 78 <sup>2)</sup> | 83               | 23  | 25               | 18  | 19 |
| 20th                             | 83               | 82 <sup>2)</sup> | 23  | 21               | 18  | 15 |
| 21th                             | 60 <sup>2)</sup> | 75               | 20  | 17               | 14  | 16 |
| 22th                             | 73               | 62               | 22  | 23               | 9   | 8  |
| 23th                             | 67               | 55               | 21  | 19               | 12  | 8  |
| 24th                             | 60               | —                | 19  | —                | 8   | —  |

1) from anterior to posterior

2) tip broken

3) has some deficit, estimated

TABLE 6. DIMENSIONS OF VERTVRAL COLUMN (mm)

| Number of vertebrae | (1) | (2)               | (3) | (4) | (5) | (6)                                      | (7)                                       |
|---------------------|-----|-------------------|-----|-----|-----|--|---|
| C 1st               | 105 | 125               | 158 | 420 | 730 | 241                                      | 224                                       |
| 2nd                 | 169 | 336 <sup>2)</sup> | 253 | 413 | 750 | {126 <sup>3)</sup><br>98 <sup>4)</sup> } | {192 <sup>3)</sup><br>212 <sup>4)</sup> } |
| 3rd                 |     |                   |     |     |     |  |   |
| 4th                 |     |                   |     |     |     |  |   |
| 5th                 |     |                   |     |     |     |  |   |
| 6th                 |     |                   |     |     |     |  |   |
| 7th                 |     |                   |     |     |     |  |   |
| D 1st               | 104 | 248               | 349 | 425 | 548 | 94                                       | 215                                       |
| 2nd                 | 113 | 236               | 294 | 446 | 525 | 111                                      | 202                                       |
| 3rd                 | 113 | 224               | 257 | 482 | 478 | 122                                      | 184                                       |
| 4th                 | 122 | 222               | 234 | 502 | 450 | 130                                      | 170                                       |
| 5th                 | 127 | 226               | 235 | 516 | 442 | 122                                      | 189                                       |
| 6th                 | 122 | 228               | 230 | 526 | 429 | 132                                      | 149                                       |
| 7th                 | 120 | 235               | 232 | 514 | 397 | 104                                      | 137                                       |
| 8th                 | 129 | 240               | 244 | 558 | 375 | 112                                      | 125                                       |
| 9th                 | 138 | 244               | 256 | 567 | 367 | 114                                      | 114                                       |
| 10th                | 140 | 251               | 272 | 588 | 491 | 118                                      | 101                                       |
| 11th                | 144 | 265               | 283 | 613 | 640 | 121                                      | 86  |
| L 1st               | 152 | 251               | 275 | 625 | 616 | 126                                      | 78  |
| 2nd                 | 160 | 288               | 275 | 655 | 618 | 120                                      | 66  |
| 3rd                 | 160 | 313               | 291 | 682 | 622 | 117                                      | 60  |
| 4th <sup>1)</sup>   | 165 | 331               | 280 | 637 | 623 | 119                                      | 60  |
| 5th                 | 172 | 322               | 288 | 632 | 628 | 110                                      | 60  |
| 6th                 | 177 | 315               | 284 | 605 | 625 | 81                                       | 60  |
| 7th                 | 183 | 315               | 278 | 587 | 640 | 88                                       | 60  |
| 8th                 | 195 | 320               | 282 | 574 | 655 | 85                                       | 63  |
| Ca 1st              | 203 | 322               | 310 | 588 | 640 | 74                                       | 58  |
| 2nd                 | 204 | 322               | 320 | 595 | 662 | 72                                       | 58  |
| 3rd                 | 205 | 310               | 332 | 576 | 638 | 76                                       | 44  |
| 4th                 | 210 | 311               | 332 | 562 | 562 | 66                                       | 35  |
| 5th                 | 212 | 315               | 331 | 542 | 535 | 55                                       | 32  |
| 6th                 | 207 | 313               | 327 | 495 | 450 | 45                                       | 38  |
| 7th                 | 193 | 309               | 313 | 446 | 379 | 45                                       | 30  |
| 8th                 | 188 | 306               | 300 | 420 | 323 | 36                                       | 28  |
| 9th                 | 182 | 287               | 268 | 390 | 272 | 29                                       | 25  |
| 10th                | 175 | 276               | 252 | 355 | —   | 26                                       | 18  |
| 11th                | 143 | 260               | 230 | 303 | —   | 26                                       | 20  |
| 12th                | 100 | 232               | 222 | 250 | —   | —  | 13  |
| 13th                | 68  | 173               | 207 | 187 | —   | —  | —   |
| 14th                | 62  | 140               | 176 | 147 | —   | —  | —   |
| 15th                | 56  | 124               | 161 | 128 | —   | —  | —   |
| 16th                | 52  | 105               | 162 | 122 | —   | —  | —   |
| 17th                | 50  | 99                | 140 | 110 | —   | —  | —   |
| 18th                | 50  | 79                | 110 | 88  | —   | —  | —   |
| 19th                | 43  | 74                | 90  | 78  | —   | —  | —   |
| 20th                | 38  | 62                | 84  | 65  | —   | —  | —   |
| 21th                | 40  | 54                | 68  | 55  | —   | —  | —   |
| 22th                | 36  | 44                | 46  | 46  | —   | —  | —   |
| 23th                | 36  | 33                | 35  | 33  | —   | —  | —   |
| 24th                | 20  | 18                | 22  | 18  | —   | —  | —   |

$$C 7 + D 11 + L 8 + Ca 24 = 50$$

- (1) Length of body at center
- (2) Height of body at front end
- (3) Breadth of body at front end
- (4) Total height from anterior bottom
- (5) Breadth of transverse processes
- (6) Greatest height of neural canal
- (7) Greatest breadth of neural canal

- 1) has some deficit and pathological change at centrum
- 2) measurment at the posterior end of 7th cervical
- 3) height at anterior point of the canal
- 4) height at posterior point of the canal



TABLE 7. DIMENSIONS OF RIB BONE (cm)

| Number of rib     | Straight length   |     | Curvilinear length <sup>1)</sup> |     | Breadth of head |    | Breadth at middle |    |
|-------------------|-------------------|-----|----------------------------------|-----|-----------------|----|-------------------|----|
|                   | L                 | R   | L                                | R   | L               | R  | L                 | R  |
| 1st               | 89                | 89  | 140                              | 130 | 20              | 21 | 11                | 12 |
| 2nd <sup>3)</sup> | 113               | 115 | 192                              | 194 | 20              | 20 | 8                 | 8  |
| 3rd <sup>3)</sup> | 127               | 131 | 211                              | 218 | 21              | 21 | 7                 | 6  |
| 4th <sup>3)</sup> | 129               | 131 | 221                              | 223 | 20              | 20 | 5                 | 5  |
| 5th <sup>3)</sup> | 126               | 128 | 212                              | 214 | 19              | 21 | 4                 | 5  |
| 6th <sup>3)</sup> | 123               | 124 | 200                              | 200 | 19              | 20 | 5                 | 5  |
| 7th <sup>3)</sup> | 119               | 113 | 184                              | 188 | 19              | 19 | 5                 | 5  |
| 8th <sup>3)</sup> | 121               | 123 | 171                              | 171 | 17              | 17 | 4                 | 5  |
| 9th               | 115               | 121 | 145                              | 155 | 10              | 14 | 4                 | 4  |
| 10th              | 101 <sup>2)</sup> | 102 | 121 <sup>2)</sup>                | 122 | 11              | 12 | 4                 | 4  |
| 11th              | 28                | 25  | —                                | —   | —               | —  | —                 | —  |

| Number of rib     | Breadth at distal end |    | Depth at head |   | Depth at middle |   | Depth at distal end |    |
|-------------------|-----------------------|----|---------------|---|-----------------|---|---------------------|----|
|                   | L                     | R  | L             | R | L               | R | L                   | R  |
| 1st               | 28                    | 27 | 6             | 6 | 4               | 5 | 8                   | 8  |
| 2nd <sup>3)</sup> | 16                    | 15 | 5             | 5 | 5               | 4 | 9                   | 9  |
| 3rd <sup>3)</sup> | 15                    | 13 | 5             | 5 | 5               | 5 | 10                  | 10 |
| 4th <sup>3)</sup> | 11                    | 10 | 4             | 5 | 5               | 5 | 9                   | 9  |
| 5th <sup>3)</sup> | 11                    | 12 | 5             | 5 | 5               | 5 | 8                   | 7  |
| 6th <sup>3)</sup> | 10                    | 10 | 5             | 5 | 4               | 4 | 7                   | 7  |
| 7th <sup>3)</sup> | 8                     | 8  | 5             | 5 | 4               | 4 | 6                   | 7  |
| 8th <sup>3)</sup> | 8                     | 8  | 5             | 7 | 4               | 4 | 4                   | 5  |
| 9th               | 7                     | 8  | 6             | 4 | 3               | 4 | 3                   | 3  |
| 10th              | 5 <sup>2)</sup>       | 5  | 6             | 6 | 3               | 3 | 2 <sup>2)</sup>     | 1  |
| 11th              | —                     | —  | —             | — | —               | — | —                   | —  |

- 1) along the lateral border
- 2) has some deficit
- 3) two headed rib

TABLE 8. DIMENSIONS OF CHEVRON BONE (mm)

| Number of chevron |                 | Length (antero-posterior) |        |        | Breadth (transverse) |        |        | Greatest height (supero-inferior) |
|-------------------|-----------------|---------------------------|--------|--------|----------------------|--------|--------|-----------------------------------|
|                   |                 | proximal                  | middle | distal | proximal             | middle | distal |                                   |
| 1.                | L               | 57                        | 65     | —      | 38                   | 18     | 15     | 131                               |
|                   | R <sup>1)</sup> | —                         | —      | —      | —                    | —      | —      | —                                 |
| 2.                |                 | 130                       | 77     | 141    | 74                   | 60     | 43     | 382                               |
| 3.                |                 | 138                       | 101    | 195    | 160                  | 47     | 39     | 423                               |
| 4.                |                 | 139                       | 128    | 182    | 155                  | 30     | 35     | 422                               |
| 5.                |                 | 162                       | 137    | 201    | 152                  | 46     | 53     | 332                               |
| 6.                |                 | 162                       | 197    | 156    | 152                  | 42     | 39     | 311                               |
| 7.                |                 | 178                       | 201    | 168    | 142                  | 34     | 34     | 280                               |
| 8.                |                 | 171                       | 190    | 176    | 145                  | 34     | 31     | 225                               |
| 9.                |                 | 153                       | 189    | 183    | 137                  | 35     | 26     | 183                               |
| 10.               |                 | 133                       | —      | 145    | 122                  | 26     | 16     | 134                               |
| 11.               |                 | 118                       | —      | 104    | 116                  | 27     | 18     | 85                                |
| 12.               | L               | —                         | 78     | —      | 26                   | 9      | 11     | 55                                |
|                   | R               | —                         | 79     | —      | 26                   | 9      | 11     | 56                                |
| 13.               | L               | —                         | 45     | —      | 14                   | 8      | 10     | 26                                |
|                   | R               | —                         | 46     | —      | 15                   | 8      | 10     | 27                                |

- 1) missed

TABLE 9. DIMENSIONS OF PECTORAL LIMB BONE (cm)

|                         | Humerus |    | Radius |    | Ulna             |                  |
|-------------------------|---------|----|--------|----|------------------|------------------|
|                         | L       | R  | L      | R  | L                | R                |
| Length                  | 40      | 40 | 30     | 30 | 30 <sup>1)</sup> | 30 <sup>1)</sup> |
| Breadth at distal end   | 17      | 15 | 19     | 20 | 15               | 15               |
| Breadth at proximal end | 19      | 20 | 16     | 17 | 14               | 15               |
| Depth at distal end     | 15      | 16 | 8      | 10 | 10               | 10               |
| Depth at proximal end   | 12      | 12 | 5      | 5  | 7                | 7                |

1) Epiphysis at distal end is lost.

TABLE 10. DIMENSIONS OF CARPALS (mm)

| Number of Carpals | Length |    | Breadth |    | Depth |    |
|-------------------|--------|----|---------|----|-------|----|
|                   | L      | R  | L       | R  | L     | R  |
| 1.                | 42     | 44 | 51      | 52 | 47    | 41 |
| 2.                | 52     | 60 | 66      | 66 | 44    | 43 |
| 3.                | 44     | 44 | 56      | 54 | 55    | 48 |
| 4.                | 55     | 52 | 62      | 60 | 45    | 43 |
| 5.                | 51     | 51 | 62      | 61 | 41    | 38 |

TABLE 11. DIMENSIONS OF DIGITS (mm)

|            | I        |    | II  |     | III |                   | IV  |                   | V  |    |    |
|------------|----------|----|-----|-----|-----|-------------------|-----|-------------------|----|----|----|
|            | L        | R  | L   | R   | L   | R                 | L   | R                 | L  | R  |    |
| 1st Length | 66       | 61 | 115 | 114 | 121 | 130 <sup>1)</sup> | 109 | 110 <sup>1)</sup> | 94 | 92 |    |
| Breadth    | proximal | 45 | 41  | 65  | 69  | 68                | 68  | 68                | 70 | 50 | 51 |
|            | middle   | 18 | 19  | 35  | 40  | 31                | 31  | 32                | —  | 37 | 38 |
|            | distal   | 20 | 18  | 73  | 73  | 70                | 68  | 67                | 66 | 45 | 45 |
| Depth      | proximal | 31 | 28  | 65  | 41  | 37                | 35  | 37                | 37 | 32 | 31 |
|            | middle   | 16 | 14  | 22  | 22  | 18                | 20  | 19                | 20 | 15 | 15 |
|            | distal   | 17 | 13  | 41  | 33  | 32                | 31  | 29                | 28 | 20 | 22 |
| 2nd Length |          |    | 91  | 92  | 96  | 100 <sup>1)</sup> | 79  | 82                | 53 | 54 |    |
| Breadth    | proximal |    | 64  | —   | 62  | 63                | 55  | 56                | 37 | 39 |    |
|            | middle   |    | 36  | 38  | 30  | 30                | 26  | 27                | 27 | 27 |    |
|            | distal   |    | 48  | 50  | 47  | 50                | 42  | 41                | 29 | 31 |    |
| Depth      | proximal |    | 32  | 34  | 29  | 30                | 27  | 25                | 12 | 31 |    |
|            | middle   |    | 17  | 16  | 16  | 16                | 13  | 14                | 10 | 10 |    |
|            | distal   |    | 22  | 21  | 19  | 15                | 19  | 19                | 12 | 13 |    |
| 3rd Length |          |    | 68  | 68  | 70  | 69 <sup>1)</sup>  | 58  | 59                | 24 | 28 |    |
| Breadth    | proximal |    | 41  | 42  | 41  | 39                | 35  | 32                | 17 | 19 |    |
|            | middle   |    | 27  | 26  | 19  | 19                | 20  | 20                | 12 | 12 |    |
|            | distal   |    | 35  | 33  | 37  | 37                | 32  | 31                | 10 | 10 |    |
| Depth      | proximal |    | 21  | 19  | 22  | 22                | 17  | 17                | 7  | 9  |    |
|            | middle   |    | 11  | 11  | 12  | 12                | 14  | 9                 | 4  | 5  |    |
|            | distal   |    | 13  | 13  | 14  | 14                | 10  | 10                | 5  | 5  |    |
| 4th Length |          |    | 45  | 46  | 45  | 44                | 30  | 32                |    |    |    |
| Breadth    | proximal |    | 25  | 43  | 27  | 26                | 20  | 17                |    |    |    |
|            | middle   |    | 20  | 19  | 21  | 21                | 13  | 15                |    |    |    |
|            | distal   |    | 22  | 20  | 27  | 24                | 11  | 12                |    |    |    |
| Depth      | proximal |    | 12  | 11  | 13  | 13                | 7   | 8                 |    |    |    |
|            | middle   |    | 6   | 6   | 7   | 12                | 5   | 5                 |    |    |    |
|            | distal   |    | 6   | 6   | 7   | 8                 | 4   | 4                 |    |    |    |
| 5th Length |          |    | 22  | 22  | 20  | 21 <sup>1)</sup>  |     |                   |    |    |    |
| Breadth    | proximal |    | 15  | 14  | 18  | 20                |     |                   |    |    |    |
|            | middle   |    | 14  | 13  | 17  | 18                |     |                   |    |    |    |
|            | distal   |    | 12  | 13  | 14  | 16                |     |                   |    |    |    |
| Depth      | proximal |    | 5   | 5   | 7   | 7                 |     |                   |    |    |    |
|            | middle   |    | 3   | 3   | 3   | 6                 |     |                   |    |    |    |
|            | distal   |    | 2   | 2   | 3   | 5                 |     |                   |    |    |    |

1) has some deficit

EXPLANATION ON PLATES

PLATE I

Lateral view of the skull with mandible attached; anterior and posterior views of the skull; right (upper) and left (lower) side mandibular tooth (anterior teeth are shown in left).

PLATE II

Lateral, dorsal and ventral views (top to bottom) of the skull.

PLATE III

Lateral, dorsal and reversed lateral views (top to bottom) of mandible.

PLATE IV

Lateral views of vertebral column. Cervicals, thoracics, lumbar, caudals 1-7 and caudals 8-24 (top to bottom). Vertebral formula is  $C7+D11+L8+Ca24=50$ .

PLATE V

Lateral, cranial and caudal views of cervical vertebrae. left: lateral views of 1st and from 2nd to 7th cervicals; upper right: cranial (left) and caudal (right) views of 1st cervical; lower right: cranial (left) and caudal (right) views of from 2nd to 7th cervicals (fused).

PLATE VI

Left and right ribs (top to bottom).

PLATE VII

Left and right flipper bones (top to bottom).

