Paleontology. — *Pleistocene Vertebrates from Celebes. II. Testudo margae nov. spec.*. By D. A. HOOIJER. (Communicated by Prof. H. BOSCHMA.)

(Communicated at the meeting of October 30, 1948.)

The remains of a gigantic land-tortoise dealt with in the present paper form part of a collection of Pleistocene Vertebrates made by Mr. H. R. VAN HEEKEREN, prehistorian to the Archaeological Survey of the Dutch East Indies, at Desa Beru and at Sompoh, near Tjabengè (Sopeng district), about 100 km N.E. of Macassar in S. Celebes. I am greatly indebted to Prof. Dr. A. J. BERNET KEMPERS, Head of the Archaeological Survey of the Dutch East Indies, for entrusting this valuable material to me, and to Miss D. M. A. BATE, Dr. W. E. SWINTON, and Mr. J. C. BATTERSBY, of the British Museum (Natural History) who kindly placed at my disposal the collections of recent and extinct giant land-tortoises in the Museums at Tring and London.

The Pleistocene fauna associated with the gigantic tortoise of S. Celebes contains a peculiar suid (*Celebochoerus heekereni* Hooijer), a pigmy archidiskodont elephant, a babirusa, and an anoa as noticed already in an earlier paper (HOOIJER, 1948). Stone flakes found with these fossils are identical with those of the uppermost Middle, or Upper Pleistocene Sangiran culture of Java.

Land-tortoises as large as the Pleistocene Celebean form are confined at the present day to the Galápagos Islands on the Equator in the Eastern Pacific, and to some islands in the Western Indian Ocean. These animals are now practically exterminated by Man who found that they were good to eat. Fossil evidence shows that these giant forms once were much more widely distributed; remains of gigantic land-tortoises have been found in Tertiary and Pleistocene deposits in the Holarctic as well as the Ethiopian and Oriental Regions. How these terrestrial animals got to the oceanic islands is a moot question; it is claimed that land-tortoises are drowned within a few hours (GADOW, 1909, p. 373), but it is also stated (SIMPSON, 1943, p. 420) that they float and can survive long periods in salt water. The existence of a *Testudo* species in Patagonia before the late Tertiary land-bridge existed (SIMPSON, 1942) adds to the evidence that the distribution of *Testudo* is not dependent on and not in the main a result of land connections. Our species thus might well have reached the island of Celebes overseas from the Asiatic continent and not by any land connection.

The fossil which forms the object of the following description was embedded in a matrix consisting chiefly of calcite grains of irregular form and containing grains of quartz and also some alkaline felspar.

Testudo margae nov. spec.

Diagnosis: A gigantic species (carapace exceeding one metre in straight length). Shaft of scapula and proscapular process more compressed antero-posteriorly, coracoid facet more elongated and deviating from the vertical axis of the scapula at a more acute angle than in the Galâpagos, Seychelles and Aldabra-Madagascar species of *Testudo*. Distinguished from the Mascarene tortoises by its less slenderly built scapula, and by the coracoid not being ankylosed to the scapula.

Holotype: The right scapula described and figured in the present paper.

Locality: Desa Beru, Tjabengè (Sopeng district), about 100 km N.E. of Macassar, S. Celebes.

Age: Pleistocene.

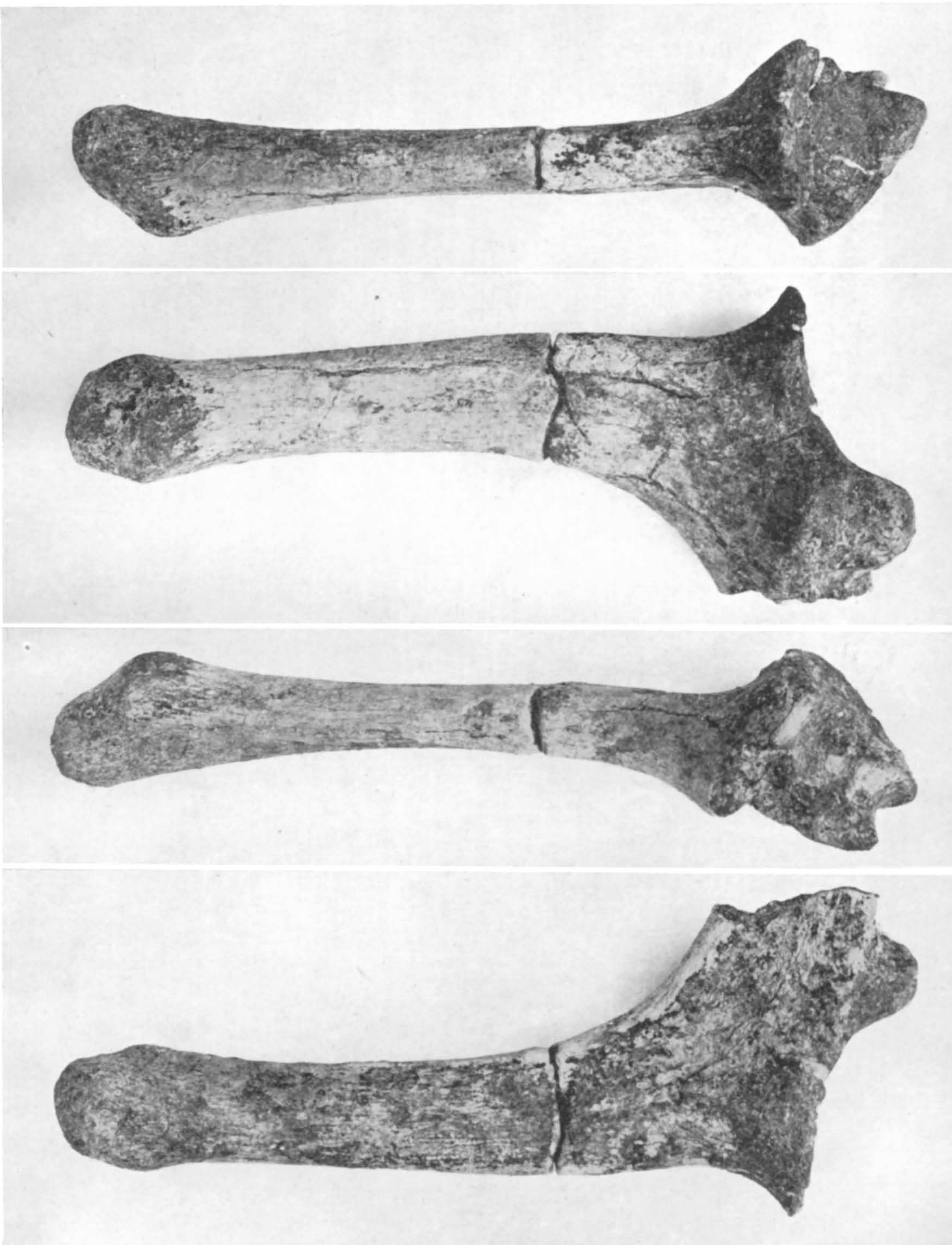
Name: I have named this species in honour to my wife.

Our evidence of the existence of a gigantic land-tortoise in the Pleistocene of S. Celebes is a scapula, of the right side. The bone consists of two pieces which fortunately fit nicely (pl. I). The proscapular process (pl. I fig. 1, lower side at the right) has broken off at its base. The coracoid was not ankylosed to the scapula; the articulating surface for it on the scapula, however, is entire. The bone shows some longitudinal fissures, one on the anterior and one on the posterior side, that are filled with matrix. Near the proximal end there are some more fissures dividing the glenoid cavity into four parts which remained, however, almost in their natural position; the fissures are only a few mm wide. Otherwise the scapula is perfect.

The shaft of the scapula is much compressed antero-posteriorly in its middle portion and widens both proximally and distally. The distal knob of the scapula (above in the figures) that reaches the carapace, is distended chiefly in its antero-posterior diameter (pl. I fig. 2 and fig. 4). It is rounded anteriorly and depressed postero-distally. At the middle of its height the scapula presents an elongated O in cross section, the lateral surface (pl. I fig. 4, and to the left, above the lip of the glenoid cavity, in pl. I fig. 1) is not wider than the medial surface (pl. I fig. 2). The posterior surface is convex transversely throughout its length, most markedly so distally, whilst the anterior surface is flattened in its lower and middle portions, becoming strongly convex above. The shaft increases in transverse diameters only in its proximal fourth, below the fracture. The medial surface (to the right in pl. I fig. 1) is concave longitudinally especially in this portion, where it passes gradually into the upper surface of the proscapular process, the inwardly and anteriorly directed projection of the scapula, only the base of which is preserved in the present specimen. The lateral surface is very slightly convex longitudinally except above the lip of the glenoid cavity which projects slightly too far because of the outward displacement of the lateral marginal fragment.

The glenoid cavity projects well over the posterior, lateral, and especially

D. A. HOOIJER: *Pleistocene Vertebrates from Celebes. II. Testudo margae nov. spec.*



4

3

2

1

Testudo margae nov. spec., right scapula (holotype), from the Pleistocene of Desa Beru, Tjabengè (Sopeng district), about 100 km N.E. of Macassar, S. Celebes. Fig. 1, anterior view; fig. 2, medial view; fig. 3, posterior view; fig. 4, lateral view.
All figures one-half natural size.

over the anterior border of the scapular shaft; it is distinctly concave in transverse direction (pl. I fig. 1 and fig. 3) and but slightly so in antero-posterior direction. It is elongated transversely and truncated at the medial side, where it passes abruptly into a very oblique facet descending toward the anterior side. This facet is the articulating surface for the coracoid, which bone would have made up a further part of the glenoid cavity. The coracoid surface meets the vertical axis of the scapula at an angle of 45° (pl. I fig. 2 and fig. 4), and is roughened and subtriangular in shape. Its lateral margin, forming the suture with the glenoid cavity, is straight; its posterior margin that projects even more than the glenoid cavity, is convex, but the medial margin, below the base of the proscapular process, is concave in its middle part. Between the coracoid facet and the base of the proscapular process is a marked depression limited above by a ridge. The proscapular process is more compressed antero-posteriorly than the shaft of the scapula; its greater diameter exceeds that of the scapular shaft at the fracture.

I have compared the present fossil specimen with a great number of scapulae of gigantic land-tortoises from the Galâpagos Islands, the Seychelles and Aldabra-Madagascar group, and the Mascarenes (Mauritius, Réunion or Bourbon, and Rodriguez) in the Leiden Museum, the British Museum (Natural History) at London and the Zoological Museum at Tring. The specimens are listed below, and the numbers given to the specimens refer to those in the tables 1—3 and 5.

Galâpagos group

Testudo darwini Van Denburgh

1. Male skeleton. Tring Museum, no. 62.

Testudo ephippium Günther

2. Male skeleton. Leiden Museum, cat. a.
3. Id. Tring Museum, no. 25.

Testudo nigrita Dum. & Bibr.

4. Skeleton. British Museum, no. 76.10.23.2.
5. Id. British Museum, no. 47.3.5.27.
6. Male skeleton. Leiden Museum, from C. Blazer, 27-4-1928.
7. Id. Leiden Museum, from the Rotterdam Zoo, 24-1-1928.
8. Female skeleton. Leiden Museum, from the Rotterdam Zoo, 14-4-1928.
9. Male skeleton. Leiden Museum, from the Rotterdam Zoo, 30-5-1931.
10. Id. Leiden Museum, from the Rotterdam Zoo, 31-3-1927.
11. Female skeleton. Leiden Museum, reg. no. 7438.

Testudo vicina Günther

12. Male skeleton. Leiden Museum, reg. no. 7041.
13. Id. Tring Museum, no. 136.
14. Id. Tring Museum, no. 60.
15. Id. Tring Museum, no. 61.

Seychelles and Aldabra-Madagascar group
Testudo elephantina Dum. & Bibr.

16. Female skeleton. Leiden Museum, cat. b.
17. Male skeleton. Leiden Museum, cat. a.
18. Id. Tring Museum, no. 153.
19. Id. Leiden Museum, from the Rotterdam Zoo, July 1935.

Testudo elephantina Dum. & Bibr. × *T. daudinii* Dum. & Bibr.

20. Male skeleton. Tring Museum, no. 142.

Testudo daudinii Dum. & Bibr.

21. Female skeleton. Tring Museum, no. 148.
22. Male skeleton. Tring Museum, no. 184.

Testudo daudinii Dum. & Bibr. × *T. gigantea* Schweigger

23. Male skeleton. Tring Museum, no. 140.

Testudo gigantea Schweigger

24. Female skeleton. Tring Museum, no. 180.
25. Male skeleton. Tring Museum, no. 176.
26. Female skeleton. Leiden Museum, reg. no. 7440.

Testudo gouffei Rothschild

27. Male skeleton. Tring Museum, no. 144.

Testudo grandidieri Vaillant

28. Female skeleton, subfossil, from Madagascar. British Museum, R. 1974, described by BOULENGER (1894).

Mascarene group
Testudo vosmaeri Schoepff

29—43. Fifteen isolated scapulae from Rodriguez, secured by the Transit-of-Venus Expedition. British Museum, nos. 76.11.1.1 → (1947.3.4.97).

Testudo inepta Günther

44—45. A left and a right scapula from Mauritius. British Museum, nos. 39938 and 39937 (1947.3.4.99).

Testudo leptocnemis Günther

46—47. Two right scapulae from Mauritius. British Museum, nos. 76.11.4.12 and 76.11.4.13.

Tortoises are distinguished chiefly by characters of their carapace and plastron. Monographs like those of VAN DENBURGH (1914), ROTHSCHILD (1915 a and b) and GARMAN (1917) give no information as to shoulder girdle, pelvis, or limb bones. The authors that have dealt with distinguishing characters of the scapula of gigantic land-tortoises will be cited below.

In his first paper on the Galápagos giants GÜNTHER (1875, pp. 265 and 279) calls attention to differences between the scapulae of *T. elephantopus* and *T. vicina* respectively. While in the first mentioned species the angle at which the scapula and the proscapular process (named acromium by GÜNTHER) meet is very obtuse, and the cross section of the scapular shaft in the middle is trihedral with the lateral (anterior in GÜNTHER's description) surface convex and much wider than the medial surface, in *T. vicina* the angle formed by scapula and proscapular process is much less obtuse, and the shaft of the scapula is elliptical in cross section with both its lateral and medial surface equally convex. In a Leiden Museum skeleton of *T. vicina* (reg. no. 7041), however, the proscapular process meets the scapula at an angle even more obtuse than that in the example of *T. elephantopus* figured by GÜNTHER (l.c., pl. 44 C). The cross section of the scapula at its middle indeed is rather more elliptical than triangular in the Leiden specimen, the medial surface being not much narrower than the lateral, but in skeletons of *T. vicina* in the Tring Museum (especially nos. 60 and 61) I found the scapulae to be distinctly triangular in cross section. One or both of the broader surfaces of the scapular shaft, the anterior and the posterior surfaces, are concave transversely, whilst the lateral surface, convex or flattened, is decidedly wider than the medial surface that mostly is not more than a ridge. This is the shape of cross section of the scapula most commonly found, the elliptical form of cross section being rather exceptional. The scapula of one of the skeletons of *T. daudinii* in the Tring Museum (no. 148) is elliptical in cross section, and in another skeleton of the same species (Tring Museum, no. 184) the scapula has the common triangular cross section.

In a subsequent paper by GÜNTHER (1877, pp. 67 and 75) we find the same remarks on the scapula of the Galápagos tortoises, but also descriptions of that bone in *T. elephantina* (l.c., p. 31) and *T. "ponderosa"* (l.c., p. 37; the specimen on which this species is founded is regarded as a hybrid of *T. gigantea* and *T. elephantina* by ROTHSCHILD, 1915 b, p. 426) which resemble the scapula of *T. elephantopus* in the shape of their cross section [1]). GÜNTHER gives the angle between scapula and proscapular process as about 100° in *T. elephantina*, and as 130° in *T. "ponderosa"*. The gigantic Leiden Museum skeleton of *T. elephantina*, however, has a scapula in which this angle is 130°. Unlike the Galápagos specimens and those of *T. elephantina* the scapula of *T. "ponderosa"* has the coracoid ankylosed (GÜNTHER, l.c., p. 37). This is an exceptional phenomenon in recent giant land-tortoises but it is found in the extinct Rodriguez form *Testudo vosmaeri* (GÜNTHER, l.c., p. 58/59). GÜNTHER states that in *T. vosmaeri* the coracoid becomes ankylosed to the scapula at an early age of the animal, but found one pair of scapulae with not-ankylosed coracoids. HADDON (1881, p. 160) found 32 out of 85 scapulae of *T. vosmaeri* with ankylosed coracoids and thinks it to be a characteristic of this species for the coracoid to be very irregular in its ankylosis with the scapula.

1) DEPÉRET and DONNEZAN (1893, p. 149) state the scapula of *T. elephantina* to be elliptical in cross section.

GÜNTHER (1877, pp. 46—47) also describes three slender types of scapulae from Mauritius, one with a triangular cross section, straight proscapular process, and ankylosed coracoid (*T. triserrata* and *T. leptocnemis*), the second with the cross section also triangular but with a compressed and curved proscapular process and not-ankylosed coracoid (*T. inepta*), and the third with a sub-rectangular cross section which is regarded as anomalous. HADDON (1881, p. 156) records a scapula from Mauritius with the coracoid ankylosed as in *T. triserrata* but with the compressed curved proscapular process of *T. inepta*. GADOW (1894, p. 321/22) emphasizes the great amount of variation in the shoulder girdle bones of these tortoises and regards the specific identity of the isolated scapulae from Mauritius as uncertain.

The measurements of the 47 scapulae used by me for comparison with that of *T. margae* nov. spec. are recorded in tables 1—3. Because of the enormous variation in size I give all dimensions also as percentages of the length. The variation ranges of these percentages will be found in table 4. It is evident that the scapulae in the Galâpagos and in the Seychelles and Aldabra-Madagascar groups are much alike, and that both groups are rather different in proportions from the scapulae of the Mascarene group.

The scapulae in the Galâpagos and in the Seychelles and Aldabra-Madagascar groups differ from our fossil in the shaft and proscapular process being less compressed antero-posteriorly. The coracoid facet is relatively shorter than that in the fossil species. While in the Galâpagos scapulae the glenoid cavity is more compressed antero-posteriorly that that in the fossil, the Seychelles and Aldabra-Madagascar scapulae have the glenoid cavity only less distended transversely. In both groups, again, the coracoid facet meets the vertical axis at a greater angle (65°—80°) than in the fossil (45°).

The scapulae of the Mascarene group of tortoises are invariably more slender than that of *Testudo margae* nov. spec., and agree with the latter only in the relative antero-posterior diameters of the shaft and of the proscapular process, just two points of difference between the fossil Celebean form and the Galâpagos and Seychelles and Aldabra-Madagascar groups. In all scapulae of the Mascarene group the coracoid is ankylosed except in one out of the fifteen specimens of *T. vosmaeri* (no. 41 of the table) and in the two of *T. inepta*. The angle between the coracoid facet and the vertical axis (55°—60°) is somewhat smaller in these three specimens than that in the other groups and thus is nearer to that in the fossil.

The above comparisons show that the fossil *Testudo* from Celebes combines characters found in the Galâpagos group, the Seychelles and Aldabra-Madagascar group and the Mascarene group. It is difficult to make out whether it is most closely related to the first or to the second of these groups; the Mascarene group is most clearly distinct from our fossil.

TABLE 1.

Comparative measurements of the scapula of *Testudo margae* nov. spec. and of *Testudo* species of the Galàpagos group.

No. of specimen	Celebes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Length from lateral lip of glenoid cavity	240	266	133	142	72	79	84	84	102	117	124	128	153	218	225	258
Middle width	38	54	20	25	13	11	12	14	17	21	26	25	32	43	47	50
Middle antero-posterior diameter	21	32	13	15	10	8	8	9	11	16	18	18	17	21	30	31
Transverse diameter of glenoid cavity (to middle of coracoid suture)	63	—	32	—	—	—	21	24	28	31	35	38	40	—	—	—
Antero-posterior diameter of idem	52	51	20	22	15	11	12	15	17	20	22	24	29	32	40	49
Greater diameter of coracoid facet	62	—	21	—	—	—	14	16	20	25	28	26	36	—	—	—
Smaller diameter of idem	40	—	20	—	—	—	12	13	17	22	25	23	28	—	—	—
Greater diameter of proscapular process	ca. 45	52	20	26	14	12	14	16	19	22	24	25	27	45	40	48
Smaller diameter of idem	14	34	14	18	10	8	9	11	12	16	18	19	21	34	30	32
Angle between coracoid facet and vertical axis of scapula	45°	—	75°	—	—	—	70°	75°	70°	75°	80°	70°	75°	—	—	—
Percentages of length: Middle width	16	20	15	18	18	14	14	17	17	18	21	20	21	20	21	19
Middle antero-posterior diameter	9	12	10	11	14	10	10	11	11	14	15	14	11	10	13	12
Glenoid cavity, transverse	26	—	24	—	—	—	25	29	27	27	28	30	26	—	—	—
Idem, antero-posterior	22	19	15	15	21	14	14	18	17	17	18	19	19	15	18	19
Coracoid facet, greater diameter	26	—	16	—	—	—	17	19	20	21	23	20	24	—	—	—
Idem, smaller diameter	17	—	15	—	—	—	14	15	17	19	20	18	18	—	—	—
Proscapular process, greater diameter	ca. 19	20	15	18	19	15	17	19	19	19	19	20	18	21	18	19
Idem, smaller diameter	6	13	11	13	14	10	11	13	11	14	15	15	14	16	13	12

TABLE 2.

Comparative measurements of the scapula of *Testudo margae* nov. spec. and of *Testudo* species of the Seychelles and Aldabra-Madagascar group.

No. of specimen	Celebes	16	17	18	19	20	21	22	23	24	25	26	27	28
Length from lateral lip of glenoid cavity	240	136	149	196	238	215	168	240	204	141	147	178	210	153
Middle width	38	20	20	34	44	43	32	47	36	24	25	33	52	36
Middle antero-posterior diameter	21	15	15	27	27	33	19	36	25	16	20	20	34	25
Transverse diameter of glenoid cavity (to middle of coracoid suture)	63	33	36	—	53	—	—	—	—	—	—	42	—	—
Antero-posterior diameter of idem	52	21	25	32	41	43	30	54	39	23	21	26	41	37
Greater diameter of coracoid facet	62	24	28	—	49	—	—	—	—	—	—	35	—	—
Smaller diameter of idem	40	23	23	—	39	—	—	—	—	—	—	32	—	—
Greater diameter of proscapular process	ca. 45	22	25	40	34	45	26	47	36	26	28	29	40	38
Smaller diameter of idem	14	12	12	24	25	30	16	26	28	16	19	19	22	21
Angle between coracoid facet and vertical axis of scapula	45°	75°	65°	—	70°	—	—	—	—	—	—	70°	—	—
Percentages of length: Middle width	16	15	13	17	18	20	19	20	18	17	17	19	25	24
Middle antero-posterior diameter	9	11	10	13	11	15	11	15	12	11	14	11	16	16
Glenoid cavity, transverse	26	24	24	—	22	—	—	—	—	—	—	24	—	—
Idem, antero-posterior	22	15	17	16	17	20	18	23	19	16	14	15	20	24
Coracoid facet, greater diameter	26	18	19	—	21	—	—	—	—	—	—	20	—	—
Idem, smaller diameter	17	17	15	—	16	—	—	—	—	—	—	18	—	—
Proscapular process, greater diameter	ca. 19	16	17	20	14	21	15	20	18	18	19	16	19	25
Idem, smaller diameter	6	9	8	12	11	14	10	11	14	11	13	11	10	14

TABLE 3.

Comparative measurements of the scapula of *Testudo margae* nov. spec. and of *Testudo* species of the Mascarene group.

No. of specimen	Celebes	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Length from lateral lip of glenoid cavity	240	73	81	87	93	94	100	100	102	105	109	121	123	126	141	198	115	162	121	142
Middle width	38	8	8	9	11	11	10	11	12	13	14	14	13	14	16	22	14	20	18	21
Middle antero-posterior diameter	21	7	6	8	8	8	9	10	9	9	11	11	10	10	13	19	10	18	11	15
Transverse diameter of glenoid cavity (to middle of coracoid suture)	63	—	—	—	—	—	—	—	—	—	—	—	—	25	—	—	23	35	—	—
Antero-posterior diameter of idem	52	11	12	12	14	15	13	16	16	15	14	17	16	17	20	26	18	26	19	23
Greater diameter of coracoid facet	62	—	—	—	—	—	—	—	—	—	—	—	—	20	—	—	21	34	—	—
Smaller diameter of idem	40	—	—	—	—	—	—	—	—	—	—	—	—	13	—	—	17	21	—	—
Greater diameter of proscapular process	ca. 45	10	9	12	15	13	13	15	16	15	15	16	16	16	20	24	16	25	18	23
Smaller diameter of idem	14	4	4	5	6	6	6	7	6	8	8	9	8	8	9	14	8	13	10	10
Angle between coracoid facet and vertical axis of scapula	45°	—	—	—	—	—	—	—	—	—	—	—	—	60°	—	—	55°	55°	—	—
Percentages of length																				
Middle width	16	11	10	10	12	12	10	11	12	12	13	12	11	11	11	11	12	12	15	15
Middle antero-posterior diameter	9	10	7	9	9	9	9	10	9	9	10	9	8	8	9	10	9	11	9	11
Glenoid cavity, transverse	26	—	—	—	—	—	—	—	—	—	—	—	—	20	—	—	20	22	—	—
Idem, antero-posterior	22	15	15	14	15	16	13	16	16	14	13	14	13	14	14	13	16	16	16	16
Coracoid facet, greater diameter	26	—	—	—	—	—	—	—	—	—	—	—	—	16	—	—	18	21	—	—
Idem, smaller diameter	17	—	—	—		—	—	—	—	—	—	—	—	10	—	—	15	13	—	—
Proscapular process, greater diameter	ca. 19	14	11	14	16	14	13	15	16	14	14	13	13	13	14	12	14	15	15	16
Idem, smaller diameter	6	5	5	6	6	6	6	7	6	8	7	7	7	6	6	7	7	8	8	7

TABLE 4.

Variation ranges of dimensions of scapulae as percentages of their length in *Testudo margae* nov. spec. and other *Testudo* species

	Celebes	Galápagos group	Seychelles Aldabra-Madagascar group	Mascarene group
Middle width	16	14—21	13—25	10—15
Middle antero-posterior diameter	9	10—15	10—16	7—11
Glenoid cavity, transverse	26	24—30	22—24	20—22
Idem, antero-posterior	22	14—21	14—24	13—16
Coracoid facet, greater diameter	26	16—24	18—21	16—21
Idem, smaller diameter	17	14—20	15—18	10—15
Proscapular process, greater diameter	ca. 19	15—21	14—25	11—16
Idem, smaller diameter	6	10—16	8—14	5— 8

Since we know nothing as yet of the carapace or plastron of the fossil Celebean tortoise it is only possible to give estimates as to the actual size of this form. However, even the exact length of the carapace would be of limited value only because giant tortoises continue to grow during a considerable time of their life, though most rapidly so while they are young (TOWNSEND, 1931, p. 461). ROTHSCHILD (1915 a, p. 404) writes that a very large male of *Testudo darwini*, at least a hundred years old, was growing between the scutes to the day of his death. In table 5 the lengths of the

TABLE 5.

Scapula and carapace length in various individuals of giant species of *Testudo*.

	Scapula length (mm)	Straight carapace length (cm)	Scapula/ carapace ratio
Testudo darwini (no. 1)	266	123	0.22
Testudo vicina (no. 13)	218	98	0.22
Id. (no. 14)	225	114	0.20
Id. (no. 15)	258	117	0.22
Testudo elephantina (no. 19)	238	106	0.22
Testudo elephantina × *T. daudinii* (no. 20)	215	116	0.19
Testudo daudinii (no. 22)	240	133	0.18
Testudo daudinii × *T. gigantea* (no. 23)	204	103	0.20
Testudo gouffei (no. 27)	210	116	0.18
Testudo grandidieri (no. 28)	153	97	0.16

scapula and carapace are given for nine giant specimens of *Testudo* in which the scapula is longer than 200 mm, as well as those of the subfossil specimen of *T. grandidieri* from Madagascar in the British Museum. The ratio scapula length/carapace length is seen to vary from 0.22 in dome-shaped forms like *T. elephantina* to 0.16 in *T. grandidieri* which has the most depressed shell of any gigantic land-tortoise (ROTHSCHILD, 1915 b,

p. 437). We do not know whether *Testudo margae* nov. spec. has a dome-shaped or a depressed carapace but we may safely accept that the straight carapace length of the individual to which the Beru scapula has belonged was more than one metre. If dome-shelled like *T. elephantina* with a scapula/carapace length ratio of 0.22 the straight carapace length of the Celebean individual would be 109 cm, and if depressed-shelled like *T. grandidieri* with a scapula/carapace length ratio of 0.16 the carapace would even measure 150 cm in straight length which exceeds the maximum carapace length recorded in any living land-tortoise (the male *T. daudinii* purchased by Lord ROTHSCHILD, straight carapace length 52.25 inch or 133 cm (ROTHSCHILD, 1928, p. 660), now in the Tring Museum (no. 184); it is no. 22 of my list).

Fossil remains of gigantic land-tortoises may indicate animals even of larger dimensions. LYDEKKER (1885, p. 159) estimates the carapace length of *Testudo atlas* (Falconer et Cautley) from the Lower Pleistocene of the Siwaliks of India to be about 8 feet (244 cm). A reconstructed carapace exhibited in the British Museum and made onder FALCONER's supervision measures more than 250 cm. The most complete specimen of this form is in the American Museum of Natural History (BROWN, 1931) and is much smaller; the carapace length being about 180 cm. VON KOENIGSWALD (1935, p. 195) records a humerus 60 cm in length from the Upper Pliocene or Lower Pleistocene of Java as probably belonging to the gigantic Siwalik form, the humerus of which indeed is probably about that long (LYDEKKER, 1885, p. 160).

Gigantic land-tortoises have been recorded from the Pleistocene of East Africa by LEAKEY (1935) who states the animal to be ca. 6 feet long, and by ARAMBOURG (1948, p. 468). Large forms occur also in the Oligocene Vertebrate fauna of the Fayum in Egypt; one shell of *Testudo ammon* Andrews (1908, p. 284) is 88 cm long.

GARDNER and BATE (1937) have recorded remains of a giant land-tortoise from the Pleistocene of Palestine. During my recent visit to the British Museum (Natural History) Miss D. M. A. BATE showed me a humerus from Bethlehem which has a length of 42 cm. This bone is almost one-half longer than the humerus of the skeleton of *Testudo elephantina* in the Leiden Museum, 106 cm in straight carapace length. The humerus of the skeleton of *T. grandidieri* in the British Museum, 97 cm in carapace length, however, is only 21 cm long. The carapace of the individual to which the Bethlehem humerus has belonged thus even might have been about two metres in length.

A description of remains of giant land-tortoises from the Pleistocene of Malta by ADAMS permits of a closer comparison with *Testudo margae* nov. spec. In *T. robusta* Adams (1877, p. 179, pl. V figs. 2, 2a) the articulating surface for the scapula on the coracoid measures 45 by 40 mm. In the smaller form, *T. spratti* Adams (l.c., p. 180, pl. VI figs. 3, 3a) the coracoid facet on the scapula is 31 by 26 mm, or only about one-half as large as that in the type specimen of *Testudo margae* nov. spec. (62 by 40 mm). It will be observed that in the Maltese forms the coracoid facet is less elongated in shape than that in the Celebean species; the scapulae of the recent Galápagos and Seychelles tortoises differ from the latter by the same character. Additional remains of giant tortoises from Malta have been recorded by BATE (1914, p. 101, 1935, p. 250), and the same authoress has discovered and described a giant species (*Testudo gymnesicus* Bate) in the island of Menorca (BATE, 1914) the scapula of which is not preserved.

From France we have *Testudo gigas* Bravard from the Upper Oligocene of Bournoncle-St.-Pierre (Allier) the longest carapace of which measures 80 cm (GERVAIS, 1859, p. 436), *T. leberonis* Depéret from the Pontian of Mt. Lebéron 150 cm in length, and *T. perpiniana* Déperet from the Astian of Perpignan (carapace length 120 cm) reported upon by DEPÉRET and DONNEZAN (1893). Remains of a gigantic *Testudo* species have been found in the neighbourhood of Zürich in Switzerland (PEYER, 1940). ARAMBOURG and PIVETEAU (1929, p. 76) and SZALAI (1931) describe remains of giant land-tortoises from the Pontian of Salonica and from that of Samos respectively.

The Canary Islands yield fossil remains of *Testudo* the carapaces of which are about 50 cm and 80 cm long (AHL, 1925, BURCHARD and AHL, 1927).

Large fossil North American forms have been dealt with by HAY (1908) and others.

Gigantic land-tortoises survived up to the present day only on some oceanic islands devoid of any but small and harmless Mammals, but their once world-wide distribution in N. America, Europe, Africa and Asia shows that they must have been able to live under less favourable conditions too. So HAY (1908, p. 373) found that the large land-tortoises from the Lower Eocene to the Pliocene of N. America were exposed to the attacks of large carnivores. It seems, however, probable, as BATE (1914, p. 101) writes, that the extinction of a race of giant tortoises would be more easily brought about by the continued and wholesale destruction of the eggs and young. An interesting coincidence lies in the fact that in Malta, like in Celebes, the giant tortoise was associated with a pigmy elephant. While most of the insular Mammals are smaller than corresponding continental forms, among Reptiles the tendency to develop gigantic forms is about as frequently met with as that toward insular nanism (MERTENS, 1934, p. 67). It is quite imaginable, however, that *Testudo margae* nov. spec. is a small representative of *Testudo atlas* (Falconer et Cautley) from the Lower Pleistocene of the Siwaliks and perhaps Java. Whether or not the Pleistocene Celebean form eventually grew to these colossal dimensions is only to decide upon further discovery.

Rijksmuseum van Natuurlijke Historie, Leiden.

LITERATURE.

ADAMS, A. L., 1877. On Gigantic Land-Tortoises and a small Freshwater Species from the ossiferous Caverns of Malta, together with a List of their Fossil Fauna; and a Note on Chelonian Remains from the Rock-cavities of Gibraltar. Quart. Journ. Geol. Soc., vol. 33, pp. 177—191, pls. V—VI.

AHL, E., 1925. Über eine ausgestorbene Riesenschildkröte der Insel Teneriffa. Zeitschr. deut. geol. Ges., vol. 77, Abh., pp. 575—580, 12 figs.

ANDREWS, C. W., 1906. A descriptive catalogue of the Tertiary Vertebrata of the Fayûm, Egypt; based on the collection of the Egyptian Government in the Geological Museum, Cairo, and on the collection in the British Museum (Natural History). London, XXXVII + 324 pp., 26 pls.

ARAMBOURG, C., 1948. Contribution à l'étude géologique et paléontologique du bassin du lac Rodolphe et de la basse vallée de l'Omo, part 2, Paléontologie, in: Mission scientifique de l'Omo 1932—1933, vol. 1, fasc. 3, pp. 231—562, 40 pls., 91 figs.

ARAMBOURG, C. and J. PIVETEAU, 1929. Les Vertébrés du Pontien de Salonique. Ann. de Paléont., vol. 18, 83 pp., 12 pls.

BATE, D. M. A., 1914. A Gigantic Land Tortoise from the Pleistocene of Menorca. Geol. Mag., n.s., dec. 6, vol. 1, pp. 100—107, 2 figs.

———, 1935. Two new Mammals from the Pleistocene of Malta, with notes on the associated fauna. Proc. Zool. Soc. London, 1935, part 2, pp. 247—264, 2 figs.

BOULENGER, G. A., 1894. On Remains of an Extinct Gigantic Tortoise from Madagascar (Testudo grandidieri, Vaillant). Trans. Zool. Soc. London, vol. 13, pp. 305—311, pls. XXXIX—XLI.

BROWN, B., 1931. The largest known Land Tortoise. Nat. Hist., vol. 31, pp. 183—187, figs.

BURCHARD, O. and E. AHL, 1927. Neue Funde von Riesen-Landschildkröten auf Teneriffa. Zeitschr. deut. geol. Ges., vol. 79, Abh., pp. 439—447, 2 figs.

DENBURGH, J. VAN, 1914. The Gigantic Land Tortoises of the Galapagos Archipelago. Proc. Calif. Acad. Sci., ser. 4, vol. 2, pp. 203—374, pls. 12—124.

DEPÉRET, CH. and A. DONNEZAN, 1893. Chersites ou tortues terrestres, in: CH. DEPÉRET, Les animaux pliocènes du Roussillon. Mém. Soc. Géol. France, Paléont., vol. 4, pp. 140—152, pls. XIV—XV.

GADOW, H., 1894. On the Remains of some Gigantic Land-Tortoises, and of an extinct Lizard, recently discovered in Mauritius. Trans. Zool. Soc. London, vol. 13, pp. 313—324, pls. XLII—XLIV.

———, 1909. Amphibia and Reptiles. Cambridge Nat. Hist., vol. 8, London, XIII + 668 pp., 181 figs.

GARDNER, E. W. and D. M. A. BATE, 1937. The Bone-Bearing Beds of Bethlehem: Their Fauna and Industry. Nature, vol. 140, pp. 431—433, 1 fig.

GARMAN, S., 1917. The Galapagos tortoises. Mem. Mus. Comp. Zool. Harvard, vol. 30, no. 4, pp. 261—296, 42 pls.

GERVAIS, P., 1859. Zoologie et Paléontologie Françaises, 2nd ed., Paris, VIII + 544 pp., figs.

GÜNTHER, A., 1875. Description of the living and extinct races of gigantic land-tortoises. — Parts I & II. Introduction, and the Tortoises of the Galapagos Islands. Phil. Trans. Roy. Soc. London, vol. 165, pp. 251—284, pls. 33—45.

———, 1877. The gigantic land-tortoises (living and extinct) in the collection of the British Museum. London, IV + 96 pp., 54 pls., 3 figs.

HADDON, A. C., 1881. On the extinct land-tortoises of Mauritius and Rodriguez. Trans. Linn. Soc. London, ser. 2, vol. 2, Zoology, pp. 155—163, pl. XIII.

HAY, O. P., 1908. The fossil turtles of North America. Carn. Inst. of Wash. Publ. no. 75, IV + 568 pp., 113 pls., 704 figs.

HOOIJER, D. A., 1948. Pleistocene Vertebrates from Celebes. I. Celebochoerus heekereni nov. gen. nov. spec. Proc. Kon. Ned. Akad. v. Wetensch., Amsterdam, vol. 51, pp. 1024—1032, 1 pl., 1 fig.

KOENIGSWALD, G. H. R. VON, 1935. Die fossilen Säugetierfaunen Javas. Proc. Kon. Akad. v. Wetensch., Amsterdam, vol. 38, pp. 188—198.

LEAKEY, L. S. B., 1935. [Pleistocene Vertebrates from E. Africa.] Ill. London News, vol. 187, no. 5037, Nov. 2, pp. 730—733, 10 figs., double page plate.

LYDEKKER, R., 1885. Siwalik and Narbada Chelonia. Mem. Geol. Surv. Ind., ser. 10, vol. 3, pp. 155—208, pls. XVIII—XXVII, 1 fig.

MERTENS, R., 1934. Die Insel-Reptilien, ihre Ausbreitung, Variation und Artbildung. Zoologica, vol. 84, 209 pp., 6 pls., 9 figs.

PEYER, B., 1940. Eine Riesenschildkröte aus der Molasse der Umgebung von Zürich. Verh. schweiz. naturf. Ges., vol. 120, p. 156.

ROTHSCHILD, LORD, 1915 *a*. The giant land tortoises of the Galapagos Islands in the Tring Museum. Novitat. Zool., vol. 22, pp. 403—417, pls. 21—32.

————, 1915 *b*. On the gigantic land tortoises of the Seychelles and Aldabra-Madagascar-group, with some notes on certain forms of the Mascarene group. Ibid., vol. 22, pp. 418—442, pls. 33—76.

————, 1928. Notes on gigantic land tortoises. Proc. Zool. Soc. London, 1928, pp. 658—660.

SIMPSON, G. G., 1942. A Miocene tortoise from Patagonia. Amer. Mus. Novitates, no. 1209, 6 pp., 2 figs.

————, 1943. Turtles and the origin of the fauna of Latin America. Amer. Journ. Sci., vol. 241, pp. 413—429.

SZALAI, T., 1931. Schildkrötenstudien. Ann. naturh. Mus. Wien, vol. 46, pp. 153—163, pls. V—VII, 3 figs.

TOWNSEND, C. H., 1931. Growth and Age in Giant Tortoises of the Galapagos. Zoologica, vol. 9, pp. 459—474, figs. 357—368.