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

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10. *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. By A. LEITH ADAMS, M.B., F.R.S., F.G.S., Professor of Zoology in the Royal College of Science, Dublin. (Read January 10, 1877.)

[PLATES V. & VI.]

THE Maltese fossil remains described in this memoir were collected by Admiral Spratt, C.B., and myself in various ossiferous deposits in the island. A few of the bones have been referred to in a note I communicated to the Geological Society in 1866 *. Having now, however, for the first time had an opportunity of comparing the reptilian remains from the Zebbug Cavern with my own gatherings (in consequence of the collection made by Admiral Spratt having been lately presented to the British Museum), I find the combined assemblage of Chelonian remains display so many features of interest that I have no hesitation in laying the details before the Society.

The singular characters of the associated Proboscidian, Rodentian, and Avian relics have been already described †; so that, with the exception of the *Hippopotami*, this contribution may be said to complete the palæontographical portion of the explorations up to the termination of my researches in 1865.

The following specimens are contained in the Museum of the Society and in the British Museum.

I am indebted to T. C. Archer, Esq., Director of the Museum of Science and Art, Edinburgh, for his kindness in lending me the typical skeleton of *Testudo ephippium* of Günther, to compare with the Maltese remains; and my best thanks are also due to Dr. Günther, F.R.S., for his assistance in the determination of a few of the specimens.

Although Dr. Falconer recognized Chelonian bones and fragments of shields in Admiral Spratt's collection, I can find in his writings no description whatever of their characters further than a simple reference to "two Chelonian forms," one of which, he says, is "of small size" ‡.

SHIELD.

Fragments of the dermal ossifications of dorsal and ventral shields are plentiful in the collection from Zebbug. They embrace pieces of costal and marginal plates of Chelonians of various dimensions, from about the size of the *Testudo græca* up to individuals which

* Quart. Journ. Geol. Soc. vol. xxii. p. 594.

† Falconer, Palæontological Memoirs, vol. ii. p. 292; Busk & Falconer, Trans. Zool. Soc. London, vol. vi. p. 227; Parker, *ibid.* vol. vi. p. 119; Adams, *ibid.* vol. vi. p. 307, and vol. ix. p. 1.

‡ Pal. Mem. vol. ii. p. 305.

rivalled in proportions the largest living and extinct land tortoises of the Mascarene and Galapagos Islands. Several pieces of plates show thicknesses varying from 2 to 20 millimetres, but present no further characters of importance, all being extremely fragmentary. They establish, however, much variability in the dimensions of their owners, which is confirmed by a study of the following bones. It may be observed that the denser outer dermal layer of several fragments belonging to the small Chelonians is marked by numerous white specks, such as are seen on the epidermis of the *Lutremys europæa*, with which, it will be seen, the humerus (Plate VI. fig. 6) and femur (Plate VI. fig. 5) agree in all particulars.

Vertebral Column.

A cervical vertebra from Mnaidra Gap and a caudal vertebra from Benghisa Gap belong to gigantic land-tortoises. Both are referred to in my previous communication *, which was drawn up in Malta during the progress of the explorations, when I had not the means of making comparisons.

The cervical vertebra is much injured: the anterior portion is lost, leaving the posterior condyle and posterior zygapophyses, with a portion of the neural arch; the last, however, is distorted and crushed. Enough remains, nevertheless, to show that it is a fifth cervical. As compared with the same bone in an individual of the large Galapagos form described by Dr. Günther † under the name of *Testudo elephantopus* of Harlan, the above represents not only a larger but also a more robust tortoise; and as the latter character will be seen to prevail in all the large Chelonian remains in our united collections, I propose to distinguish this (the largest) species of tortoise from the others by the name of *Testudo robusta*. As far as the injured condition of the fossil will allow, the following comparisons have been made between it and the typical specimen of *T. elephantopus*, as given by Günther. In both, the neural crest divides and proceeds along the dorsal aspects of the posterior zygapophyses, thereby forming a shallow triangular space between them. The following measurements are procurable:—

	T. elephantopus.	*T. robusta.*
	millim.	millim.
Breadth of condyle	33	37
Thickness of condyle	20	26
Greatest breadth of zygapophysis	10	18
Least breadth of centrum	20	22

* Quart. Journ. Geol. Soc. vol. xxii. p. 595.
† Philosophical Transactions, vol. clxv. 1875, p. 251.

The caudal vertebra (Plate V. fig. 1) has lost the posterior half of the centrum, but is otherwise entire. The anterior zygapophyses and concave centrum and transverse processes (*a*) are well preserved. The last-named present rugged articular surfaces, indicating that the costæ were not ankylosed. There is a small neural crest. Unfortunately, in the few skeletons of the large recent tortoises in collections, it is rare to find the caudal vertebræ; so that I have had no means of comparing the above with other allied forms. It clearly, however, belonged to a land Chelonian of gigantic size. It was discovered by me in conjunction with several teeth and bones of the small form of Maltese fossil elephant (*E. Falconeri*).

The length of the neck, so characteristic of *T. elephantopus*, and probably of the other Galapagos tortoises, seems to have been also a feature in *T. robusta*, if we may judge from the lengthened centrum of the cervical here alluded to.

Pectoral Arch.

The very large coracoid process of the scapula (Plate V. figs. 2, 2 *a*) is also referred to the *Testudo robusta*. The border of the distal extremity is wanting, and there is a slight abrasion on the inner border of the glenoid cavity; otherwise it is entire, and in an excellent state of preservation, as, indeed, were the majority of the remains from the Zebbug rock-cavity, owing to their investing matrix having been a firm, tenacious blue marl.

The articulating surface of the scapula (fig. 2 *a*, *b*) is triangular; its maximum length is 40 millims, and greatest breadth 45 millims, the glenoid cavity (*c*) being of about the same dimensions. The body presents the usual contorted and trihedral configuration, expanding at both the articular and distal extremities.

The internal border is sharp, and the external rounded and uneven. The superior surface of the body is also rounded, and thins out internally. The lower aspect (fig. 2) presents a triangular-shaped depression (*d*) at the distal extremity, bounded by an outer ridge (*e*) and an inner ridge (*f*). The latter forms also the boundary to the concavity (*g*) on the inner aspect of the bone. This excavation, although not seemingly apparent in *T. elephantopus*, is present to a small extent in the other Galapagos tortoise (*T. vicina*). Concerning the relations with Mascarene tortoises I am unable to say any thing.

The dimensions of fig. 2 as compared with the coracoids of Galapagos tortoises are as follows:—

	T. elephantopus.	*T. vicina.*	*T. robusta.*
	millim.	millim.	millim.
Length of coracoid	86	83	100
Least width of neck	20	33	38

The least girth of the neck in *T. robusta* is 91 millimetres. The greater breadth of the neck in *T. vicina*, as compared with *T. elephantopus*, is characteristic; and the former therefore agrees with *T. robusta*, as, indeed, generally *T. vicina* would appear to possess stouter limbs than either *T. elephantopus* or the still more gigantic *T. ephippium* *. Moreover the angle formed by the junction of the glenoid and scapular articulations (fig. 2) approaches that of *T. vicina*. I presume, however, that the great expansions of the extremities of fig. 2 (to wit, the beetling roof of the glenoid cavity and massive proportions) make the coracoid in question one of the largest as compared with recent land-tortoises.

A portion of a left scapula, from Zebbug, of a tortoise a good deal smaller than the owner of the coracoid just described is represented in Plate VI. figs. 3, 3*a*, 3*b*. The body has been sawn through the middle, and the distal portion is unfortunately not in the collection lately presented to the British Museum by Admiral Spratt. It is otherwise imperfect, the precoracoid having been broken off close to its base (*c*), which is 32 millims in length by 14 millims in breadth. The surface for the coracoid *d* (fig. 3 *a*) is triangular, and is 26×32 millims., and therefore much smaller than the opposing surface in Plate V. fig. 2. The glenoid cavity is slightly injured on its external border; its outline, however, seems to have been ovoid. The largest antero-posterior measurement along the curve of the cavity is 47 millims., and the maximum breadth is 28 millims.

The upper surface is flattened above the articulations, and becomes rounded towards the middle of the body, where the transverse section (fig. 3 *b*) forms a subelliptical outline different from the trihedral section at the same point in the scapula of *T. elephantopus*, and approaching rather to the greatly elongated outline of *T. vicina* †.

The lower aspect is concave at *e*, below the glenoid cavity, and becomes flattened towards the body, and finally rounded at its middle. The internal border is sharp, and the outer is thick and round. The circumference of the bone just below the lip of the glenoid cavity is 97 millims.

The coracoid, as in the last, was not ankylosed to the scapula, which appears to have belonged to a full-grown tortoise of much smaller dimensions than the owners of any of the bones yet described. For that reason, and, as will be shown in the sequel, from its relationship as regards relative size with other bones, I am disposed to consider that it belonged to a distinct form or species rather than to a small individual or female of *T. robusta*. To this smaller-sized form I provisionally give the name of *Testudo Spratti*, in consideration of the valuable collections obtained by Admiral Spratt from the rock-cavity of Zebbug.

This scapula, compared with the same bone in the typical speci-

* Unfortunately the pectoral girdle of *T. ephippium* is unknown.
† Günther, *op. cit.* pp. 265, 279.

mens of *T. elephantopus* and *T. vicina*, gives the following data. The loss of the precoracoid somewhat vitiates the determination as to the angle formed by the union of the scapula and that bone. It would appear, however, to have been more obtuse than in either of the above-named recent species. As to available dimensions:—

	T. elephantopus.	*T. vicina.*	*T. Spratti.*
	millim.	millim.	millim.
Maximum breadth at the glenoid cavity	77	77	73
Girth at the middle of the shaft	75	75	70
Length of glenoid cavity............................	50	55	45

HUMERUS.

The proximal extremity of a right humerus from Zebbug (Plate VI. figs. 6, 6 *a*) is the only specimen of that bone in the collections. It was picked up by me among the débris of the Zebbug rock-cavity several years subsequent to Admiral Spratt's explorations. This humerus evidently belonged to a rather smaller individual than the owner of the femur (Pl. VI. figs. 5, 5 *a*, 5 *b*), and to a tortoise about the size of *Lutremys europæa*, with whose femur it agrees closely in characters and dimensions. The large tuberosity diverging from the head expands and rises considerably above the latter, whilst the smaller tuberosity is nearly on the same level with the head. The intervening pit is deep and broad. The head is elliptical, and measures 11 millimetres along its curve, and has a deep pit under it. The least girth of the shaft is 13 millimetres. On the radial side of the head at *b*, fig. 6, is a groove with a sharp outer margin.

As compared with *Lutremys europæa* these characters are absolutely identical. In *T. græca* the great tuberosity is not nearly so much expanded, and the groove *b* (fig. 6) is wanting; the shaft, also, is stouter, and there is no pit under the head. Considering that the affinities with *Lutremys europæa* are also confirmed by the femur (fig. 5), I do not, in the absence of further data, deem it necessary to separate the fossil from this recent freshwater species, an adult specimen of which in the British Museum has a humerus of 44 millimetres and a carapace of 210 millimetres. This tortoise is still found in the lakes and muddy waters of Sardinia, Italy, and elsewhere in Southern and South-eastern Europe.

Radius.

This bone is represented by two specimens from Zebbug. The one is about a fourth part longer than the other; they agree, however, in every determinable particular; so that, admitting variability in size according to sexual and individual peculiarities, it seems probable that they belonged to the adult male and female of *T. robusta*.

The larger (Plate VI. fig. 1) has lost a portion of the outer aspect of the head and a fragment of the distal extremity; but fig. 2, also belonging to the left forearm, is quite entire.

The dimensions of these bones, as compared with one another and with the large Galapagos tortoises described by Günther *, are as follows:—

	T. robusta ♂.	*T. robusta* ♀.	*T. ephippium* ♂.	*T. vicina* ♂.	*T. elephantopus* ♂.
	millim.	millim.	millim.	millim.	millim.
Length of radius	156	110	149	122	121
Least girth of radius	76	58	51	49	50

These measurements at once demonstrate the greater thickness in *T. robusta* of the shaft as compared with the length, the girth of even the smaller being greater than obtains in any of the more gigantic recent species.

Other comparisons as regards the articular surfaces furnish equally interesting results. As compared with the radius of the immature female of *T. elephantopus* referred to by Günther † (No. 1011 of the Cat. Mus. R. Coll. Surgeons), the smaller radius (fig. 2) is precisely of the same length, whilst the girth, midshaft, of the recent bone is 43 against 58 millims. of the smaller *T. robusta*.

The dimensions of the extremities of the Galapagos radii are not given by Günther; but the typical radius of *T. ephippium* now before me furnishes the following comparisons with the two radii of *T. robusta*:—

* *Op. cit.* p. 280.
† Phil. Trans. vol. clxv. p. 261.

	T. robusta ♂ & ♀.	*T. ephippium* ♂.
	millim.	millim.
Largest diameter of the humeral articulation	43 40	35
Largest diameter of the carpal articulation	55×28 45×18	36×19
Largest diameter of the proximal rădial articulation	37 25	30

It would be interesting to establish comparisons between the Maltese specimens and the recent and extinct Mascarene species, or, in fact, any of the recent gigantic species I have been unable to examine; the materials, however, as regards the latter are rare in public collections.

In general characters the radius of *T. robusta* presents large and expanding articular surfaces. The humeral is concave, and of the outline shown in fig. 2 *a*. The distal ulnar facet is very prominent, thus enlarging the concavity on the ulnar aspect of the bone. The gnarled surfaces for muscular attachments contrast with the general smoothness of the same parts in *T. elephantopus* and *T. ephippium*, to a less extent in *T. vicina*, whilst they at the same time prove that both fig. 1 and fig. 2 belong to fully adult, if not aged individuals.

The shafts in the fossil bones are round in the middle and flattened on their upper and outer aspects. The distal extremities are convex in front (fig. 2) and concave behind (fig. 1). The extensive distal ulnar facet is similar to that of *T. ephippium*, which appears to be relatively larger than that of *T. elephantopus*.

A few Tarsal and Carpal bones were found in Mnaidra Gap; but these are too much broken to be useful for comparison.

The very large Ungual Phalanges (Plate V. figs. 5, 6, 7) from Zebbug attest to the dimensions of their owners, and may be safely referred to *T. robusta*.

Pelvic Girdle.

Pubis.

The following pelvic fragments referable to *T. robusta* are contained in the Zebbug collection:—

1. A portion of a right pubis, extending from the obturator foramen outwards (including the process), is 87 millimetres in length,

the maximum breadth of the process being 24 millimetres. The same measurements of the pubis of *T. ephippium* are 76 and 18 millimetres.

2. A mutilated process of another pubis presents about the same measurements.

3. A fragment of the symphysial end of a right os pubis indicates a tortoise as large as the owner of the preceding, but shows no important characters.

Femur.

Two proximal extremities of femora of gigantic tortoises were found by me in Mnaidra Gap. The left, being the more entire, is represented in Plate V. figs. 4, 4 *a*, 4 *b*.

It shows the head, trochanters, and a small portion of the shaft. There is a loss of substance on the outer side of the head and great trochanter, which, however, is preserved in the other specimen of the right side. There is also a small abrasion on the inner side of the head. Otherwise the fragment is entire and well preserved. It will be seen from the figures that the head is elliptical, and does not rise above the summit of the great trochanter.

The conspicuous notch (fig. 4 *a*) is also present in the recent *Testudo ephippium*, and is apparently wanting in *T. elephantopus* *: thus the femur of the former and that of *T. robusta* agree so far. Moreover the cartilaginous capping of the trochanters is apparently confined to the latter by a smooth dividing groove, whereas in *T. elephantopus* the cartilage extends along an unbroken ridge from trochanter to trochanter.

The condition of the fossil renders it impossible to state whether or not one or other of these two conditions existed.

The pit embraced between the head and the trochanters is about as broad as long; and the notch between the head and small trochanter is broader than between the former and the great trochanter, but it is relatively smaller than in *T. elephantopus* and *T. ephippium*. And whilst the head in the former and in *T. robusta* assimilate, *T. robusta* and *T. ephippium* consort as to the intertrochanteric notch and the configuration of the intervening pit (fig. 4 *b*).

A detached left femur of a recent tortoise (No. 1021 B. in the Osteological Collection of the Royal College of Surgeons) agrees with the characters of *T. ephippium* and *T. robusta*; but the cartilaginous covering dips into the notch, and is continuous from one trochanter to the other.

The locality from which this specimen was obtained is unknown; but it evidently belonged to a very large tortoise, and an individual of nearly the dimensions of the fossil. The greatest length and breadth of the heads in the three (by callipers, and along the curve) are as follows:—

* Günther, *op. cit.* pp. 267, 274.

	T. robusta.	R. C. S. No. 1021 B.	*T. ephippium.*
	millim.	millim.	millim.
Length by callipers	66	60	43
Length by tape......................	92	82	60
Breadth by callipers...............	55	50	35
Breadth by tape	72	70	52

I have given the chief measurements of fig. 4 in my former paper. Suffice it to state, as to the comparative dimensions, that the fossil exceeds in size any recent femur I have been enabled to examine, and shows that the owner was a gigantic tortoise, but possibly not quite so large as the owner of the coracoid just described.

A distal extremity of a right femur, comparable as regards dimensions with the form to which I assign the name of *T. Spratti*, is also from Mnaidra Gap. It is relatively small as compared with the same part in the immature skeleton (No. 1011 of the Museum of the Royal College of Surgeons) referred by Günther to *T. elephantopus* *. The breadth of the condyles in the last is 78 millimetres, whereas it is only 56 in the fossil. In the latter there is a shallow depression above the condyles superiorly, and a deep pit at the same point on the opposite or inferior side. The condyles are stouter relatively and more confluent than in *T. ephippium*, and more like what obtains in *T. vicina*; the specimen, however, is too fragmentary for precise determination.

The small right femur from Zebbug (Plate VI. figs. 5, 5*a*, 5*b*) has lost its distal extremity. The head is elliptical, and confluent with the great trochanter, and is at the same level. The great trochanter (fig. 5*a*), as in the large femur, is separated by a deep notch from the lesser trochanter, the enclosed pit (fig. 5*b*) being almost circular. The largest diameter of the head is 12 millimetres, and the least girth of the shaft is 18 millimetres. In *T. græca* there is no notch, the shaft is less bent, and the trochanters are more convergent. Although somewhat larger than a femur of *Lutremys europæa* (46 millimetres in length), it agrees with it in every respect, in common with the humerus (fig. 6), both of which therefore may be accepted provisionally as belonging to that species.

Tibia.

The two tibiæ, right and left (Plate V. figs. 3, 3*a*, and Plate VI. figs. 4, 4*a*) are from Zebbug. The larger, or right tibia (Plate V. fig. 3), is not entire, having lost portions of the head on its outer

* *Op. cit.* p. 261.

and inner aspects, and also a portion of the distal end in front. As regards size, it is about a third longer than fig. 4, and, as will be seen presently, differs from it morphologically. Both bones represent aged individuals, as is well shown by their gnarled appearances. Moreover, relatively, they are stouter than the tibiæ of *T. elephantopus* and *T. ephippium*, and come closer in that respect to *T. vicina*. I conceive that the larger (fig. 3) belonged to *T. robusta*, and the smaller (fig. 4) to *T. Spratti*.

The following establishes their proportional greater thickness as compared with certain recent species that I have been enabled to examine:—

	T. ephippium.	*T. elephantopus.*	*T. vicina.*	*T. robusta.*	*T. Spratti.*
	millim.	millim.	millim.	millim.	millim.
Length of tibia........................	150	136	129	115	85
Least girth of tibia	72	60	57	73	53

Thus it appears that the smallest girth of the shaft in *T. robusta* is greater than that of the tibia of the more slender *T. ephippium*, which is 2·2 inches longer, and that, whilst the antero-posterior diameter of the femoral articulation is 41 millimetres in *T. robusta*, it is 38 millimetres in *T. ephippium*; but their distal articulations are about equal in size.

The tibia of *Testudo Spratti* has the groove on the astragalo-calcaneal aspect deep (Plate VI. fig. 4 *a*), whereas it is barely indicated in *T. robusta* (Plate V. fig. 3 *a*). There are two prominent muscular tuberosities about midshaft in *T. Spratti*.

The anterior aspects in both are more concave than appears to be the case in the recent species named above; and there is greater dilatation at the articular surfaces; otherwise they do not appear to present further characters to distinguish them from the tibiæ of recent species and from one another.

Fibula.

The distal half of a left fibula from Zebbug represents a tortoise considerably larger than the owner of the tibia, Plate V. fig. 3, but not apparently of greater dimensions than the individuals to which the large femora and coracoid belonged. The tarsal articular surface is trihedral in outline and somewhat convex, whereas it is even in *T. ephippium*. There is the usual expansion of the articulation as seen in the other large bones with prominent rugosities. The shaft is flat below, becoming rounded towards the middle. In *T. ephippium* the shaft is rounded posteriorly and flat, with a concavity close to the articulation on its tibial aspect. The circumference at midshaft is 60 millimetres in the fossil, and only 45 millims. in *T. ephippium*. A prominent rugosity for muscular attachment occupies the anterior border near the distal extremity, whilst a well-defined ridge runs up the posterior border and is lost about midshaft. Altogether this bone presents different characters from the fibula of *T. elephantopus* and *T. ephippium*, and bears a closer resemblance to that of *T. vicina*, and perhaps also of *T. ponderosa*, as far as I have been enabled to compare it with a specimen of the fibula of the latter in the possession of Dr. Günther, to whose masterly determinations we are indebted for the only lucid descriptions yet given of the osteology of the gigantic land-tortoises of the Galapagos Islands.

The foregoing Testudinea and Emydea must be admitted as interesting additions to the already goodly list of remarkable animal remains from the rock-rents of Malta.

The gigantic land Chelonians and their freshwater congener, when considered in relation to the gigantic Dormouse and water-birds and the small Pachydermata, furnish further proofs of the physical conditions requisite for the maintenance of such a varied fauna. This subject, however, deserves special consideration, not contemplated in the present communication.

The vertebrated and invertebrated animals hitherto recorded from the Cavern and alluvial deposits of Malta may be enumerated as follows:—

MAMMALIA.

Equus, sp. Horse, sp.?
Hippopotamus Pentlandi. Pentland's Hippopotamus.
Hippopotamus minutus. Pygmy Hippopotamus.
Cervus dama. Fallow Deer.
Cervus vel *Capra*. Deer or Goat, sp.?
Canis. Fox, sp.?.
Elephas mnaidriensis. Large Maltese Elephant.
Elephas melitensis. Smaller Maltese Elephant.
Elephas Falconeri. Pygmy Maltese Elephant.
Myoxus melitensis. Great Dormouse.
Myoxus Cartei (?). Carte's Dormouse.
Arvicola amphibia. Water-Vole.

AVES.

Cygnus Falconeri. Falconer's Swan.
Cygnus musicus (?). Wild Swan.
Bernicla vel *Anser*. Bernicle or Goose, sp.
Anas, sp. Duck, sp.?

REPTILIA, AMPHIBIA.

Testudo robusta. Gigantic Maltese Tortoise.
Testudo Spratti. Spratt's Tortoise.
Lutremys europæa (?). Speckled Tortoise.
Lacerta, sp. Lizard, sp.?
Batrachia, sp. Frogs or Toads, sp.

MOLLUSCA *.

Helix aspersa.
Helix vermiculata.
Helix candidissima.
Helix aperta.
Helix Sprattii.
Helix striata.
Bulimus acutus.
Cyclostoma, sp.
Clausilia syracusana.

The stratigraphical conditions under which these animal remains were discovered varied considerably. On that account it may be inferred that all were not conveyed into the rock-cavities and hollows at the same time and under exactly the same conditions; and it is not wholly improbable that a redeposition of remains may in one or more instances have taken place. At all events, a contemporaneity may be claimed for the Elephants, Hippopotami, Myoxi, Anatidæ, Chelonia, Lacertilia, and certain Helicidæ, inasmuch as their remains were intimately associated.

I exclude the remains of Horse, Fallow deer, Deer or Goat, and a canine tooth referable to a small *Canis*, also the remains of the Water-rat, Frogs, and several species of land shells, on account of the following circumstances connected with their discovery:—

The exuviæ of the Horse, Fallow deer, and of a small carnivore of about the size of a Fox were found together in a rock-rent containing red soil and fragments of the parent rock. The other ruminants' teeth, also the canines of a small *Vulpes*, *Arvicola*, and Frog-bones, were met with in close proximity to the larger quadrupeds; but the deposits being composed of closely packed red soil, it may not be improbable that, in the case of the two last-named and several species of land Snails, they had made their way into the bed after its deposition. At all events, the *entire* absence of large Carnivora is not the least remarkable feature of the collections.

NOTE on CHELONIAN REMAINS *from the* ROCK-FISSURES *of* GIBRALTAR.

As far as yet ascertained, the mammalian and avian remains from the rock-cavities of Malta and Gibraltar belong to different faunas, the Maltese being the more ancient.

* The Mollusca were determined by the late Dr. S. P. Woodward.

In the collections made by Captain Luard, R.E., in the Gibraltar caverns are two bones of Chelonians which Mr. Busk has kindly permitted me to inspect.

The larger is a much mutilated humerus or femur; which of the two it is difficult to say, from injuries, it having lost the proximal and a portion of the distal extremity. It belonged, however, to a large Chelonian, inasmuch as the remaining length is 130 millimetres, and least girth of the shaft 71 millimetres. A deep circular pit on the anterior and inner aspect of the shaft near the head seems peculiar as compared with the larger recent marine and land species. To which of the two groups it belongs is not evident; but possibly, from the prominent ridges, it may have belonged to the latter.

The small right radius (Plate VI. figs. 7, 7 *a*) has lost its distal articular aspect, but is otherwise entire. The surface is remarkably smooth, and without the rugosities of the humerus of the larger Maltese Testudinea.

The above is clearly the radius of a land or freshwater tortoise of larger dimensions than any recent European species.

The humeral aspect (fig. 7 *a*) is slightly concave; but, excepting the dimensions, the specimen does not present other noteworthy peculiarities; the least girth of its shaft is 28 millimetres.

The two bones represent species differing very much in size, and are of interest with reference to further discoveries in connexion with the fossil fauna described by Mr. Busk, F.R.S., in a paper read before the Zoological Society of London on May 2, 1876.

EXPLANATION OF THE PLATES.

Plate V.

Fig. 1. Caudal vertebra of *Testudo robusta*, natural size.

Figs. 2, 2 *a*. Right coracoid of the scapula of *T. robusta*, natural size.

Figs. 3, 3 *a*. Right tibia of *T. robusta*, natural size.

Figs. 4, 4 *a*, 4 *b*. Proximal third of the left femur of *T. robusta*, natural size.

Figs. 5, 6, 7. Phalangeal bones of *T. robusta*, natural size.

Plate VI.

Fig. 1. Left radius of *Testudo robusta*, natural size.

Figs. 2, 2 *a*. Left radius of *T. robusta*, natural size.

Figs. 3, 3 *a*, 3 *b*. Portion of a left scapula of *T. Spratti*, natural size.

Figs. 4, 4 *a*. Left tibia of *T. Spratti*, natural size.

Figs. 5, 5 *a*, 5 *b*. Portion of a right femur of *Lutremys europæa*?, natural size.

Figs. 6, 6 *a*. Portion of a right humerus of *L. europæa* ?, natural size.

Figs. 7, 7 *a*. Right radius of a Tortoise from the rock-cavities of Gibraltar, natural size.

Discussion.

Prof. Ramsay inquired what was the probable geological age of these remains, as this seemed to him a point of much interest.

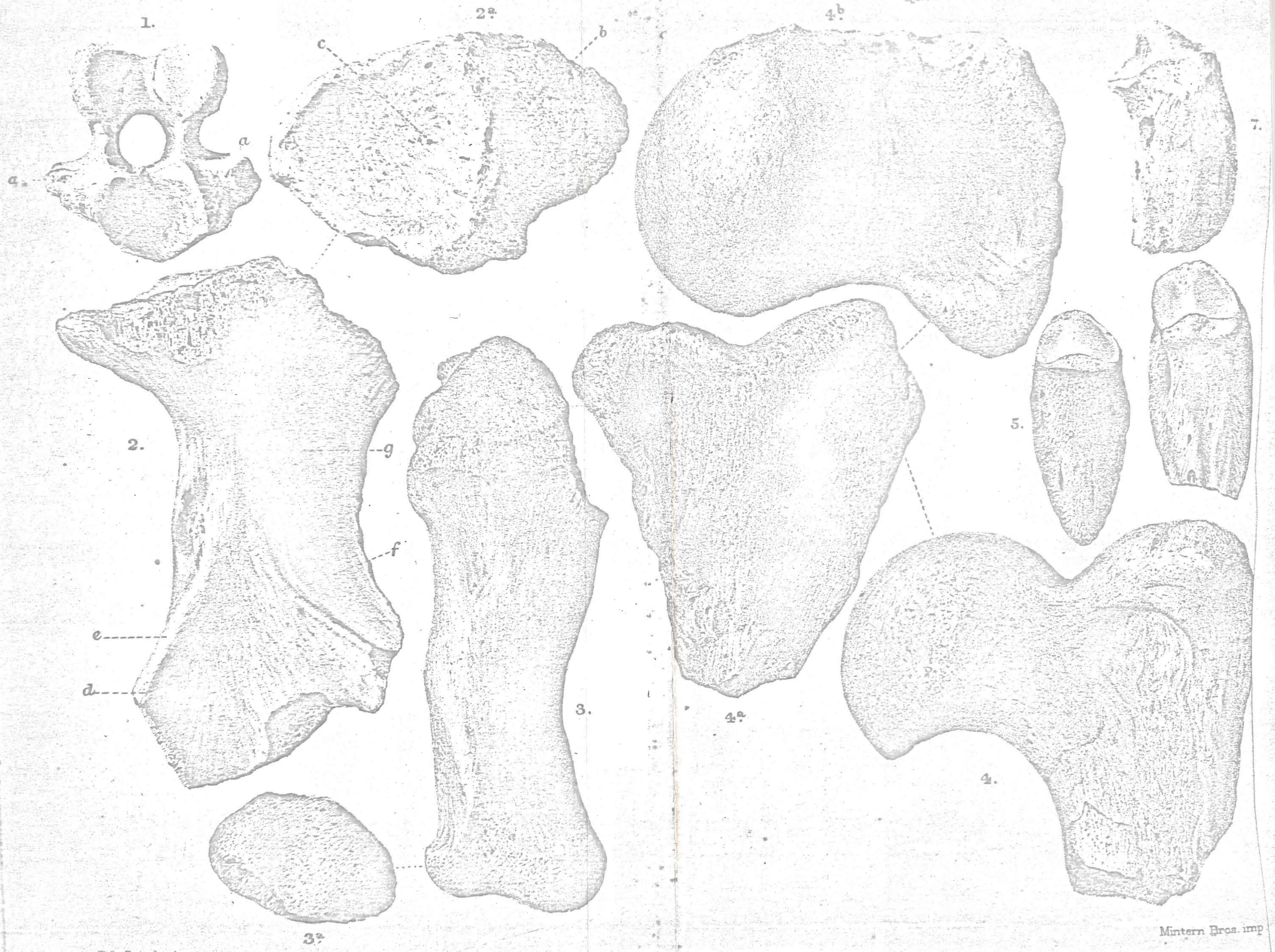
The Author stated that his paper was purely palæontological, and that he had not touched upon any geological questions in it. No judgment could be formed from Sicilian deposits, as there seemed to have been no connexion between the islands; and with regard to the Maltese deposits, he stated that remains of *Hippopotamus* were found in breccia and in conglomerates in rock-cavities which appeared to have been caves, and also in fissures with red soil like that of the surface, containing angular fragments of the parent rock. In one cavity he found whole carcasses of Elephants, just as if they had been carried in suddenly, and filled in with earth by a wave. The remains might have been derived from a Pliocene deposit broken up and swept into the cavities.

Prof. Ramsay remarked that when the small Maltese Elephants were first described he thought they were generally spoken of as Miocene; but this might be a misunderstanding. It was, however, confirmed by the prevalence of Miocene rocks in Malta; but the *gisement* of these remains might be of later date. He was much struck by the number of Tortoises, but regretted that it could not be decided whether those from Gibraltar were land or freshwater species. If the latter, their presence was exceedingly interesting, fresh water being now so scarce in Gibraltar; and such remains occur in Gibraltar high up in the rock, where there is now no water. This, it seemed to him, would indicate an enormous change in the physical geography of the region. In a late visit to the north coast of Africa, near Tangier, he had found what were probably Jurassic strata very much contorted, and above them Coralline sands, half consolidated at their junction with the Jurassic rocks; and here on the old land surface he obtained a jaw of an Elephant, containing a molar tooth which proved it to belong to *E. antiquus*. This was interesting, from the alliance of that species with the existing African Elephant. From his point of view, he said, the chief interest of the paper was its bearing upon the changes in the physical geography of the Mediterranean and Aralo-Caspian areas.

Prof. T. Rupert Jones remarked that some of the Maltese gravels contain rock-matter not now existing in Malta. This indicates a great lapse of time, a great depth of rock having been washed away.

Prof. Seeley inquired whether the author had examined into the affinities of the large Maltese Chelonia and those from the Siwaliks. He noticed differences in the form of the femur, reminding one of the Indian forms, but perhaps indicating a still closer relationship to American types. He inquired whether there was any apparent relation of descent between the Miocene and later forms, and remarked that it seemed to him there was evidence proving the migration of animals and plants, with specific modification, from east to west. With regard to the thickness of the plates of the carapace and plastron, he said that this was no evidence of size. Thus *Emys crassus*, although but a small species, has plates at least as thick as those from Malta; and he had seen a Kimmeridge-clay species which illustrated the same fact.

The AUTHOR, in reply to Prof. Ramsay, said that it was impossible to tell whether the remains from Gibraltar belonged to a land or freshwater species, as the parts of the skeleton preserved did not furnish the necessary evidence; but the characters of the radius showed that it was not a marine Turtle. In reply to Prof. Seeley, he said that the head of the femur of the large Maltese Chelonian was quite different from that of *Colossochelys atlas* from the Siwaliks, and added that he quite agreed with him that the thickness of the carapace was by itself no evidence of gigantic size.



C. L. Griesbach.

Mintern Bros. imp.

MALTESE GIGANTIC TORTOISES.

G. L. Griesbach.

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MALTESE AND GIBRALTAR TORTOISES.