II. *On the Ancient or Quaternary Fauna of Gibraltar, as exemplified in the Mammalian Remains of the Ossiferous Breccia.* By George Busk, *F.R.S., F.Z.S., &c.*

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[Plates I.–XXVII.]

Contents.

I. Preliminary Remarks.

On a former occasion[1] I gave an account of the human remains &c. and associated animals of the human period, discovered chiefly by Capt. F. Brome in certain of the Gibraltar Caves. In the present communication my object is to describe some of the mammalian remains found in the ossiferous breccia and belonging to a far more ancient fauna, some, in fact, going back, in all probability, to the early Pleistocene, if not Pliocene, epoch.

Some of the species, it will be seen, are now altogether extinct, whilst others no longer exist in Europe, and none in the particular locality in which their remains are found, though not very far off. The paper therefore may be regarded as a contribution to our knowledge of the former distribution of animal life in the Mediterranean region, and of the relations that, within the Quaternary period, must have existed between the South-European and North-African faunas—a subject quite as interesting to the zoologist as to the palæontologist, and, it may also be said, to the geologist, in any inquiry as to the period at which the final severance of land-communication between Europe and North Africa took place.

Although the considerations to which attention will here be directed are chiefly zoological, it will not perhaps be deemed altogether out of place to premise some remarks respecting the general conditions under which the ossiferous breccia of Gibraltar

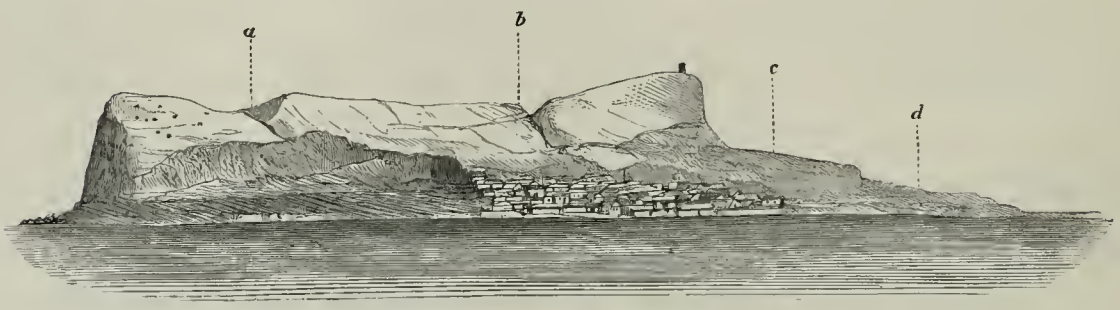
[1] Transactions of the Third Session of the International Congress of Prehistoric Archeology, held at Norwich in 1868, pp. 106–167.

occurs. To render this clear, a few particulars respecting the geological relations of the rock must be given. The substance of what I have to say on this point is taken from Mr. Smith's (of Jordan Hill) excellent and, as it appeared to Dr. Falconer and myself, extremely accurate observations [1] on the geology of Gibraltar.

The rock or, more properly speaking, the mountain peninsula of Gibraltar is a detached promontory, about three miles long and three quarters of a mile in its greatest width, running in a direction nearly due north and south, and attaining an elevation of more than 1400 feet above the level of the sea. Its base on the west side is washed by the waves of the Atlantic, and on the eastern by those of the Mediterranean; and at the northern end it is connected with the mainland by a flat sandy isthmus about half a mile wide and rising not more than 10 feet above the level of the water.

The entire mass of the promontory is divided into two principal segments, of which

Fig. 1.



Outline sketch of the Rock of Gibraltar.

the northern, which includes three fourths of the length, is much more elevated than the southern. The elevated portion, again, is subbivided into three distinct segments or eminences, separated by two irregular, though nearly equidistant, depressions, which are termed the northern and southern "quebrada" or "broken ground" (*a*, *b*, fig. 1).

The northernmost portion of the rock is terminated at the north end by a nearly vertical cliff 1250 high. The middle portion, or "Middle Hill," as it is termed, rises to a height of 1255 feet at the "Signal-station," whilst the southern elevation, the "Pan d'Assucar," or "Sugar Loaf," rises to a height of 1408 feet, where it is crowned by "O'Hara's Tower."

From this eminence there is a rapid declivity to the south, but which is not so precipitous as to prevent its easy ascent. The declivity, after falling about 1000 feet, terminates in the "Windmill-Hill Flats," *c*, a plateau, or nearly level plain, about half a mile long, and a quarter of a mile wide. At its northern limit, close to the Military

[1] In his 'Researches in Newer Pliocene and Pleistocene Geology,' Glasgow, p. 98, 1862; or Geol. Soc. Journ. 1846, ii. pp. 41–51.

Prison, this plateau is about 400 feet above the sea; and it slopes gradually to the south at an angle of about 11°, so that at its southern boundary, which is in a vertical inland cliff about 100 feet high, its level above the sea is from 250 to 300 feet. It is bounded on the east and west sides by nearly perpendicular cliffs, whose base is in a terrace about 100 feet above the sea-level.

The southernmost division of the rock (*d*), termed Europa Flats, is also a tolerably even plain, which gradually slopes to an elevation of not more than 50 feet above the level of the water. The sea-bottom, where visible in calm weather at the base of the eastern cliffs of the Europa Plateau, and beyond the masonry with which its southern flank is covered, also constitutes a rocky plain, with precisely the same waterworn surface as that of the "Windmill Hill" and Europa Plateau, and constituting, in fact, a third level or step. That part of this lower plain which was above water was formerly termed the Lower Europa; but it is now entirely concealed by the military works.

The eastern face of the rock is a nearly perpendicular precipice, being, in fact, the escarpment of the limestone strata. Upon this face, where they have not been removed by denudation or weathering, a succession of sea-worn terraces, one above the other, at distances of about 100 to 150 feet, may be observed up to a height of 800 or 900 feet, apparently indicating so many successive stages of elevation. The western face forms an irregular slope, interrupted by longitudinal cliffs and ravines, and gradually shelving at the bottom into a gentle declivity, partly *talus*, upon which the town is chiefly built.

With the exception of some ferruginous sands and shales on the western flank, the mass of the Rock of Gibraltar consists of hard grey Jurassic limestone. Wherever the surface is sufficiently exposed the rock is seen to be traversed throughout by innumerable ramifying fissures, which occasionally widen out into extensive caverns, either partially empty or, as was formerly seen at Rosia Bay, completely filled with ossiferous breccia.

The principal reason of this fractured condition is undoubtedly to be sought in the circumstance that the strata have been subjected to very great disturbances. They have, in fact, been twisted, as it were, in different directions. This is shown very plainly by the fact that the angle of the dip varies very much in different parts—to such an extent, indeed, that its direction is reversed at the opposite extremities of the promontory. These changes, moreover, are very abrupt; and the points at which they take place seem to correspond with the two lines of fracture termed "Quebradas" (*a*, *b*, fig. 1, p. 54), and with the line of passage from the elevated to the lower portion of the rock (*c*). And it is precisely at or near these lines of fracture that the principal known caves and fissures are situated.

But, besides the movements by which the strata have been thus affected, Mr. Smith is of opinion, and has pretty conclusively shown, that the whole mass of the rock has been elevated and depressed more than once to the extent of its entire height, even "since the testaceous fauna was the same as at present."

This brief geological notice will suffice to account for the innumerable caverns and fissures by which the Rock of Gibraltar is penetrated in all parts from its summit to the base, and whence it has occasionally been termed the "Hill of Caves."

From a general survey of the conditions under which the osseous remains occur, all the phenomena may be explained, as was remarked by Major Imrie, on the supposition that they were washed into the more or less vertical open cavities by the heavy autumnal floods. In support of this it may also be stated that most of the bones, more especially at the articular surfaces, are sun-cracked, or have that peculiar kind of reticulated fissuring which arises from exposure to atmospheric agency. Others, again, are simply crushed, the splinters being recemented by a fine, ochreous, crystalline stalagmite. This condition can only be accounted for on the supposition (in the absence of tooth-marks) that the bones had either fallen from a considerable height or, what is more probable, had been broken by the falling upon them of heavy portions of rock after they had become lodged in the fissure. To this mode of introduction must be added the circumstance, now for the first time made known, that in all probability the entire bodies of animals, either before or after death, were occasionally precipitated into the gaping cracks. Instances of this will appear in the sequel.

With respect to mineral condition, many of the fossil bones are heavy, dense, hard, and strongly infiltrated with manganese; whilst others, though deprived to an equal extent of the animal substance, which is replaced in some measure by carbonate of lime, are perfectly white, easily cut or powdered, and without any trace of manganese[1]. Notwithstanding the abundant evidence of the existence of the Hyæna as a former member of the Rock-fauna, not a single bone has as yet been detected bearing indubitable marks of its teeth. The only bones showing marks of gnawing (by *Arvicola*, or perhaps the Fox) belonged wholly to the upper compartments of the Genista Cave; and they are either human or of species coexistent with man.

As regards the amount and nature of its osseous constituents, the breccia differs very much in different parts of the rock and at different elevations. In fissures near the base the breccia contains usually but few bones, being chiefly formed of angular fragments of the grey limestone imbedded in the universal ochreous indurated matrix; in other places the extraneous contents are almost entirely land shells (*Helix*, *Bulimus decollatus*, &c.); whilst in the more elevated and precipitous points of the mountain the narrow fissures are filled with a breccia consisting almost entirely of the bones of birds and other small animals, no doubt conveyed by the Hawks which there find their habitation and breeding-places.

In most parts the fissures appear to have remained open until they were filled with

[1] Small fragments of bone, usually, if not wholly, of *Cervus* or *Ibex*, and deeply carbonized, were met with even in the deepest part of the Genista Cavern. These fragments, probably representing the relics of human repasts, have doubtless found their way through small fissures in the floor or sides of the upper chamber. They are never coated with stalagmite.

the surface-materials and mud &c. washed into them, together with fragments of limestone detached from the sides of the fissure. Under these circumstances the breccia is usually very compact and exceedingly hard, and the bones are commonly much broken or even comminuted, and the fragments very irregularly dispersed. The hardness and very close adhesion of the matrix in this sort of breccia renders the extraction of any considerable portion of a bone extremely difficult and tedious. It is no wonder, therefore, that observers have hitherto been obliged to be content with a very cursory view of the osseous remains thus imperfectly displayed.

It fortunately happened, however, in the year 1863, that a completely sealed fissure-cavern was accidentally discovered in the making of an excavation for a water-tank within the precincts of the military prison on Windmill Hill; and it was still more fortunate that the discovery was made by one zealous and eager for the further exploration of the cavity thus disclosed. By the unwearied exertions of Capt. Fred. Brome, at that time governor of the prison, with the enlightened aid and encouragement of Gen. Sir W. Codrington, K.C.B., the then governor of the fortress, the exploration of the Genista cave and fissures in communication with it was carried on for several years and to a depth of between 300 and 400 feet. The result of this exploration was the collection of an enormous quantity of animal remains, varying in age from the Prehistoric human period to probably the Pleistocene epoch. These more ancient relics have afforded the principal materials for the present communication; but for some very interesting additions I have been indebted to General Frome, who forwarded a large quantity of very valuable breccia from Poca Roca—and also to Captain Luard, who has contributed some very interesting specimens.

One of the principal advantages derived from the Genista-fissure specimens arises from the circumstance that a very large proportion of the bones were not imbedded in the usual hard matrix, and that very many among them were entire or nearly so; and what is still more remarkable, instances occurred of bones belonging to the same individual found either in juxtaposition or at no very great distance apart.

This happy combination of circumstances placed Dr. Falconer and myself, of course, at a great advantage over our predecessors, so far as the determination of species was concerned; and our lamented friend Capt. Brome might justly congratulate himself upon carrying out the wish and fulfilling the anticipations of Cuvier[1]:—

"Que serait-ce si quelque naturaliste résidant sur les lieux prenait la peine de recueillir et de dégager avec soin ceux qui se découvriraient pendant quelques années, comme je l'ai fait pour les ossemens de nos gypses! D'après ce que nous allons voir, on ne peut douter qu'il n'y fît des récoltes abondantes et intéressantes."

Although the bone-breccia of Gibraltar, in common with that met with under pretty nearly similar conditions at numerous sites around the shores of the Mediterranean and Adriatic, has been long well known, and from an early period been viewed with

[1] 'Ossemens Fossiles,' 4th ed. tom. vi. p. 347.

much interest by various writers, up to the present time very little has been really known with respect to the number or names of the species of Mammals &c. whose remains are imbedded in it.

The earliest notice respecting this point which it seems worth while to cite is that given by Major Imrie [1], who appears to have been a very acute observer. The only species he mentions is what he terms the "Sheep," founding his diagnosis upon a perfect lower jaw, but which was most probably that of the Ibex. He also relates the discovery, at a great depth near the summit of the mountain, of two skulls, which were supposed to be human, but which he himself, from their size, was disposed to consider those of the Barbary Ape [2]. In 1794 some bones, sent to W. Hunter, were pronounced by his illustrious brother [3] to belong to the family of Ruminants, a species of *Lepus*, besides those of various birds, and a small Dog or Fox.

Cuvier [4] describes in detail and gives figures of a Ruminant's jaw and other bones, which he assigned to a species of *Cervus* corresponding in size to *C. dama*. He did not himself notice any bones of Rodents amongst those submitted to his inspection, but gives a figure taken from a drawing by Adrian Camper from a specimen of breccia in his possession, in which are exposed the two mandibles of a Hare-like animal, regarded by Cuvier as a species of *Lagomys*. We may, however, in the absence of further information, perhaps be allowed to doubt whether the specimens in question really came from Gibraltar, where certainly in the enormous mass of bones and breccia examined by Dr. Falconer and myself nothing of the kind has turned up.

This brief *résumé* will show how important and numerous are the additions now made to the ancient fauna of Gibraltar, and how great is the assistance thence afforded towards our knowledge of its former zoological relations.

Amongst the main results, in a zoological point of view, which may be drawn from the discoveries recorded in the present communication, the following appear to be the most prominent:—

1. That at a remote period, after the Rock of Gibraltar had undergone its last changes, but had probably not been completely severed from the African continent, being covered with an abundant arboreal vegetation, it harboured a numerous fauna of large Mammals, herbivorous and carnivorous, the former including not improbably a species of Elephant (*E. antiquus*), certainly a Rhinoceros, two species of Deer, together with vast numbers of a species of Ibex, the Wild Boar, Hares and Rabbits; whilst the latter were represented by the Leopard, Hyæna, Southern Lynx, and one or two other

[1] Trans. Roy. Soc. Edinburgh, vol. iv. 1798.

[2] Cuvier (*l. c.* p. 341) suggests that more probably these might have been portions of the skulls of a Ruminant. But I see no *a priori* reason against Major Imrie's suggestion. On this point a few remarks will be found in the sequel.

[3] Phil. Trans. vol. lx. p. 412, 1794.

[4] *Op. cit.* p. 339.

feline species, one of which was probably the *Felis caligata* of Egypt and Abyssinia, together with a large species of Bear, apparently intermediate between *U. ferox* or *priscus* and *U. arctos*, which there is reason to believe at that period also abounded in the opposite regions of Africa [1].

2. That while some of these species, as the Elephant and Rhinoceros, are now wholly extinct, and known only by fossilized remains of the Pleistocene epoch, others, as the Spotted Hyæna, now only exist in the widely distant regions of Southern and Western Africa, being wholly unknown in the northern parts of the continent.

3. That some, again, as the Leopard and Booted Cat, are now no longer found in the European area; whilst others, as the Southern Lynx and Spanish Ibex, are still frequent in the mountainous regions of the Iberian peninsula.

4. That the entire fauna exhibits purely African affinities.

5. That the occurrence of *Elephas antiquus* [2], *Rhinoceros hemitœchus*, *Hyæna crocuta*, *Felis pardus*, *F. caligata* seu *caffra*, &c., at this remote southern point of Europe, unmixed with species of northern origin, serves strongly to indicate that those species made their way (in part at least) to the more northern regions, where their remains occur in Pleistocene deposits, through the isthmus at one time connecting Europe and Africa at the present Straits of Gibraltar.

II. General Remarks on the Mammalian Remains.

The Mammals whose remains alone constitute the subject of this paper belong to the following genera:—

I. Carnivora.

1. *Ursus.* 2. *Hyæna.* 3. *Felis.* 4. *Canis.*

II. Perissodactyla.

5. *Equus.* 6. *Rhinoceros.*

III. Artiodactyla.

A. Ruminantia.

7. *Cervus.* 8. *Capra.* 9. *Bos.*

B. Non-Ruminantia.

10. *Sus.*

IV. Rodentia.

11. *Lepus.*

V. Proboscidea.

12. *Elephas.*

[1] On this point, *vide* Cuv. *l. c.* tom. vii. p. 200.

[2] Can this be the Elephant that, according to Pliny, at one time abounded on the Atlas range?

III. Ursus.

The Genista Cave has yielded a considerable number of bones of a species of Bear, all of which were procured from the deeper passages. They are completely fossilized, and thickly incrusted with hard ferruginous stalagmite. The principal specimens are:—

1. A portion of the right maxilla (Pl. V. fig. 3), extending from the anterior border of the first true molar to a short distance beyond the second, and containing both teeth quite entire though a good deal worn. Their dimensions are, m. 1 ·93×·70, m. 2 1″·5×·8. All the finer sculpturing is worn away; and the third or posterior cusp on the outer border of m. 2 is entirely obliterated. What remains of the sides of the tooth indicates that the crown-surface must originally have been much compressed.

2. The right mandible (Pl. IV. figs. 1, 2). This specimen comprises the whole of the horizontal ramus as far back as the angle, and showing the small inferior *uncinus*[1]. The ascending ramus, including the condyle, coronoid process, and angle with the "crochet"[2], are wanting, having evidently been detached before the bone was invested with stalagmite. The remainder of the jaw is complete. It includes the following teeth or empty alveoli:—

The empty alveoli of the three incisors; the fang of the canine, broken off level with the border of the alveolus; the empty alveolus of the first premolar (pm. 1); the absorbed alveolus of the third premolar (pm. 3), which was probably shed from violence; the fourth premolar (pm. 4) and first molar (m. 1) entire, and corresponding in amount of wear with the maxillary teeth above described; and the empty alveolus of the last molar (m. 2). The length of the ramus from the incisive border to the extremity of the *uncinus* is 8″·35, its vertical diameter immediately behind the last molar 2″·5, and at the diasteme 1″·9; the length of the diasteme is 1″·7, and of the symphysis 3″·0. The teeth or sockets afford the following measurements:—

	in.
Canine	1·00×·74
pm. 1	·25×·20
m. 1	1·07×·50
m. 2	1·13×·70
m. 3	·7×·60
Molar series	3·20

The lower border of the bone is thick and rounded but nearly straight.

3. The third specimen is about half the right ramus of a young animal, in which the canine is only partly protruded from the alveolus. It contains that tooth entire,

[1] "Crook-process" of Falconer. [2] "Angular process" of Falconer.

the open alveoli of the first and second premolars (pm. 1 and pm. 2), the latter much smaller than the former; the fourth premolar (pm. 4) recently broken off, but the fangs remaining in the alveolus; the first molar perfect and unworn, and about two thirds of the second molar. The vertical diameter of the ramus at the second molar tooth is about 1″·4, and the same at the diasteme. The diasteme measures 1″·0, and the symphysis 2″·0. The teeth measure:—

	in.
pm. 1	·25×·25
pm. 2	·10×·10
pm. 4	·40×·21
m. 1	1·0 ×·5
m. 2	1·1 ×·64

The teeth in other respects correspond exactly in pattern with those in the other mandible above described, the only difference at all worthy of note being that the first molar is slightly narrower.

4. The next specimen is the anterior part, also of a right mandible (Pl. IV. figs. 3, 4), of a fully mature animal, containing the canine with the apex recently broken off, the open alveolus of the first premolar (pm. 1) close to the canine, the fourth premolar (pm. 4) fortunately quite entire though somewhat worn, with a portion of the alveolus of the first molar (m. 1) filled with stalagmite. There are no traces of the alveoli of the second and third premolars. The fracture by which this portion was detached from the remainder of the jaw is ancient, the surface being covered with hard stalagmite; and it may not very improbably have been the work of the Hyæna.

The diasteme measures 1″·7; and the vertical height of the ramus at that part is 1″·7; the length of the symphysis 2″·5. The teeth measure:—

	in.
Caniue	·9×·7
pm. 1	·20×·20
pm. 4	·47×·25

This specimen is particularly valuable in a diagnostic point of view, from its presenting the fourth premolar in a tolerably perfect condition. The dimensions of this tooth show its small size as compared with the other teeth; and in its pattern it also corresponds exactly with the usual form of the same tooth in *U. arctos*, as will afterwards be more particularly pointed out.

5. The posterior half, or nearly so, of the left mandible of a young animal, but apparently not the same individual as that to which the immature mandible above described belonged, since the teeth appear to be rather larger. The specimen has been much comminuted; and different portions were found widely apart; so that at the time when the figures were prepared the several fragments had not been recognized as belonging to the same bone, and consequently one portion only of it is represented

in Pl. V. figs. 4, 5, whilst that containing the second molar is shown separately in fig. 7.

The specimen when put together exhibits the small angular crochet and a mere rudimentary *uncinus*, about half of the condyle, and a portion of the coronoid process, together with a part of the horizontal ramus containing the two hinder molars $\overline{\text{m. 2}}$ and $\overline{\text{m. 3}}$ in beautiful condition. These teeth measure:—

	in.
$\overline{\text{m. 2}}$	1·0 × ·7
$\overline{\text{m. 3}}$	·9· × 6

The third molar is oblong with parallel sides, but constricted behind, chiefly on the inner side. There is no trace of a sulcus on the outer border (vide *infra*); and the surface is very faintly sculptured.

6. The only other specimens connected with the dentition are two detached canines, both of comparatively small size, and resembling in general characters those of *U. arctos*. They measure ·9 × ·55 and ·9 × ·65 respectively. One is figured in Pl. V. fig. 6.

Of the other parts of the skeleton those chiefly worth noticing are:—

7. A nearly entire *axis* vertebra, wanting only the posterior epiphysis of the centrum (Pl. VI. figs. 7, 8, 9). The body, including the odontoid process, and allowing 0″·1 for the missing epiphysis, measures 2″·7 in antero-posterior length. The width from side to side across the anterior articular processes is 2″·6, and the length of the spine is also 2″·6; the neural canal is 1″·1 in diameter. The width from side to side at the posterior articular facets is nearly 2″·3. The width of the body at the narrowest part is 2″·0, and the entire height of the bone 2″·1.

8. The proximal half, or rather more, of the left ulna (Pl. V. fig. 1) of an old and apparently very muscular individual. The olecranon, measured in the antero-posterior direction from the upper point of the greater sigmoid cavity, is 2″·6 wide, and the distance from the same point to the point of the coronoid process 2″·0. The length of the lesser sigmoid cavity is 1″·8.

The corresponding measurements in an ulna of *U. horribilis* (*ferox*), Baird, from California, are 2″·7, 2″·0, 1″·8, or as nearly as possible the same. In another specimen of the smaller variety of the Grizzly Bear (*U. richardsoni*, Baird), the dimensions are 2″·5, 1″·9, 1″·5.

9. The corresponding part of a second right ulna of a younger and less robust animal, but otherwise agreeing with the above.

10. The proximal end of the right radius, which fits to the last-mentioned ulna, and no doubt belonged to the same skeleton. Its proximal articular head measures 1″·7 × 1″·25, and the least circumference of the shaft is 2″·6.

11. One of the most remarkable among the ursine remains consists of the nearly entire right tibia, with the upper end of the fibula attached above, by bony ankylosis,

to the side of the head of the tibia, and at about the middle of its length to the shaft of that bone by a very thick mass of callus. The bones, which are comparatively of small size (the distal end of the tibia measuring 1″·5 × 2″·7), appear to have suffered compound fracture some time before the death of the animal, and to have become reunited in a very irregular though firm fashion. The consequent distortion is so great, that the transverse axis of the distal articular surface is twisted round about a quarter of a circle; and as the lower fragments of both bones override the upper to a considerable extent, the limb must have been shortened as well as distorted.

It is not easy to understand how a wild predaceous animal could have contrived to maintain the struggle for existence during the long period required to effect even such an imperfect cure, or even afterwards, in such a mutilated condition. The instance would certainly seem to show, at any rate, that sometimes "*sævis inter se convenit ursis.*"

12. Besides the above, there are several metacarpal and one metatarsal bone, belonging to perhaps four individuals, differing a good deal, as it would seem, in size and age. These are represented in Pl. VI. figs. 1, 2, 3, 4, and 5 (fig 10 is the fifth metacarpal of *Felis pardus*). These bones will be afterwards more particularly referred to.

Notwithstanding the number of these ursine remains, they hardly supply sufficient materials for the determination, with certainty, of the species to which they belong, which must, I fear, in the absence of further evidence, be left in considerable doubt.

Some of the more important characters by which the existing and fossil species of Bears are distinguished are afforded by the skull and face. No portion of either, with the exception of a fragmentary maxillary, is contained in the Gibraltar collection; and as the remaining parts of most diagnostic value, as the lower jaw and teeth, exhibit characters intermediate, as it were, between *U. fossilis* sive *ferox* and *U. arctos*, it appears to me impossible to decide whether the Gibraltar Bear should be referred to the one or the other of those species or, it may be, to a third distinct from either.

That these remains have no relation whatever to *U. spelæus* is sufficiently obvious from the dimensions and other characters of the teeth, and notably of the fourth lower premolar and last molar ($\overline{\text{pm. 4}}$ and $\overline{\text{m. 3}}$), together with the presence of an open alveolus of the first premolar in all three specimens of the mandible, and also from the size and proportions of the other bones, more especially of the metacarpals, metatarsal, and phalanges, which, of all the bones of the skeleton, are perhaps most characteristic of *U. spelæus*. The Great Cave-Bear may therefore at once be dismissed from consideration; and we may proceed to inquire which of the other known existing or fossilized specimens afford the nearest points of resemblance.

These species are but few in number, and may, I think, at any rate for paleontological purposes, be included under the following specific types:—

1. Ursus fossilis, Goldfuss.

U. priscus, Cuv.
U. ferox fossilis, mihi.
U. bourguignati, Lartet.

2. Ursus ferox, Richardson.

U. horribilis, horridus, richardsoni, Baird.
U. cinereus, Gray.
U. piscator.

3. Ursus arctos, Linn.

U. fuscus, niger, Alb. Magn.; Goldf.
U. norvegicus, pyrenaicus, collaris, &c., F. Cuv.
U. isabellinus, Horsfield.
U. syriacus, Hempr. & Ehr.
U. cadaverinus, formicarius, longirostris, Eversm.

4. Ursus lartetianus.
5. Ursus faidherbianus.
6. Ursus letourneuxianus.
7. Ursus rouvieri.

} Bourguignat.

1. Ursus fossilis, Goldf.

From the time of Goldfuss[1] all paleontogists, except Blumenbach and De Blainville, have recognized at least two distinct specific forms amongst the Ursine remains found in caverns. To one of these, basing his description upon a perfect cranium, with the lower jaw, found in the deepest part of the Gailenreuth cavern, Goldfuss applied the term *U. fossilis*[2]. This form has appeared to me to coincide so very closely with the existing *U. ferox*, or *horribilis*, of North America, that I was induced some years since to suggest that they might be regarded as specifically the same, so far as cranial and dental characters are concerned. Regarding, therefore, this second species of Cave-Bear as undistinguishable by dental and osteological characters from the Grizzly Bear and its varieties, what is here said of the one, in comparing it with *U. arctos*, will apply to the other.

I have already observed that some of the most important distinctive characters between these very closely allied forms are found in the cranium and face, parts which are not afforded in the the Gibraltar collection; the comparison, therefore, can be only very incomplete and inconclusive. The parts upon which I have been compelled principally to rely for the means of diagnosis are the horizontal ramus of the lower jaw, the dentition, and to some extent the axis vertebra. With respect to the other bones of the skeleton, my own observation leads me quite to agree with A. Wagner[3], who remarks that after twenty years' study of bears, fossil and recent, he considers that no characters can be drawn from any of the bones of the skeleton except the skull and teeth. The only differences, he says, may be regarded as individual, except as respects the metacarpals and metatarsals, and, he might have added, the phalanges.

[1] Goldfuss, Ac. Cæs. Leop. Nova Acta, x. 1821, p. 449.

[2] Cuvier (*op. cit.* vii. p. 242) says that Goldfuss had given the name of *U. priscus* to this skull, but upon what authority I am not aware. The term employed by Goldfuss is *U. fossilis.*

[3] Wiegm. Archiv, 1843, i. pp. 24–42.

As regards the lower jaw, of which we have little more than the horizontal ramus, the only difference that I can perceive between it and the corresponding portion in three mandibles of *U. fossilis* from the Gower caves consists in the greater thickness of the interior border, which is very much thinner in the Welsh specimens, the jaws otherwise corresponding exactly in dimensions as to vertical diameter and thickness. The important differential character afforded by the angular "crochet," which is thicker and more incurved in *U. fossilis* and *ferox* than in *U. arctos*, is unfortunately absent in the Gibraltar bone, as are also those derivable from the ascending ramus, coronoid process[1], &c.

The two remaining teeth in this mandible are rather smaller than in the Gower specimens, but very slightly so; and the most important of them in a comparative point of view, the $\overline{\text{pm. 4}}$, is wanting, having been shed during life, and the alveolus wholly obliterated. This tooth, however, exists quite entire in one of the other specimens, and corresponds in all respects much more closely with that tooth in *U. arctos* than with that of *U. fossilis*. The important characters afforded by the $\overline{\text{pm. 4}}$ in *U. spelæus* are very well known; and, to a less decided extent, it seems to me to afford one of the most important means of diagnosing *U. arctos* from its most closely allied congener.

In studying the dental characteristics of different species of Bears, we have to regard, first, their size and proportions to each other, and, secondly, any differences of pattern they may present. With regard to the former of these points, as will be obvious from the odontograms (Pl. XXVII. nos. 6–10), no conclusions could in the present case be drawn, except that the teeth in the Gibraltar specimens are, with perhaps one exception, fully as large as those of the existing *U. ferox* (No. 7), or even of *U. fossilis* (No. 6), and, on the whole, somewhat larger than the largest known to me of *U. arctos* (No. 10). As regards the second point, it may be observed that, unfortunately, the general resemblance of most of the teeth in all the larger carnivorous Bears, as regards form and pattern, is so close, and moreover so liable, within certain limits, to vary very considerably, that but few of them are practically available for the purpose of drawing specific distinctions. From the circumstance, also, that a very moderate amount of wear destroys the more minute particularities of sculpturing, characters of that kind can seldom be employed with any advantage.

For these reasons, it will generally be found sufficient to advert only to those teeth which afford the most marked and least readily effaceable features. These appear to be the second or last upper molar ($\underline{\text{m. 2}}$), and the first and last molars of the lower jaw ($\overline{\text{pm. 4}}$ and $\overline{\text{m. 3}}$).

The last upper molar in *U. spelæus*, besides its much greater size, is usually distinguished by its more or less oblong form, the sides being nearly parallel, and the hinder

[1] Professor Owen (Brit. Fossil Mamm. p. 83) adduces the greater breadth and height of the coronoid process as a point of difference between *U. priscus* and *U. arctos*.

end not much narrower than the middle, and never, or scarcely ever, at all pointed. The grinding-surface also, in the perfectly unworn condition, is characterized by its comparative flatness or expansion transversely. On the outer border there are three cusps, the hindmost of which, however, is very low and soon worn off. Of the two larger conical cusps the anterior is stronger than the posterior, which latter presents no trace of an accessory intermediate tubercle in front.

In *U. ferox* and *U. fossilis* the tooth is more contracted behind than in *U. spelæus*, but less so than is usually the case in *U. arctos*, and the attenuation may be said to commence further back. The grinding-surface in the unworn tooth is also much less compressed from side to side than it is in *U. arctos*, though more so than in *U. spelæus*. Of the three outer cusps, the anterior two are more nearly of equal size than they are in *U. spelæus*, and there is no appearance of an accessory intermediate tubercle on the hinder of the two; the third or posterior cusp is sometimes entirely wanting, and always of insignificant size, and soon worn away.

In *U. arctos* the crown in the perfectly unworn or germ condition is much more compressed, the two sides falling in, as it were, so as to leave merely a wide furrow between them. There are only two cusps on the outer border, of which the anterior is considerably the larger, and the hinder in most cases has a small portion in front constricted off so as to form a small accessory tubercle intermediate between the two cusps; and in this species the internal basal cingulum would appear to be usually less developed than in the others.

The third lower molar ($\overline{\text{m. 3}}$) in *U. spelæus* is in most cases readily distinguishable by its peculiar form, which is also, from what I have observed, tolerably constant. The form of the tooth corresponds, in fact, as might be expected, with that of the expanded upper molar to which it is opposed. The form of the tooth may be described as oblong or subquadrangular, usually with an angle posteriorly. The outer border is divided into two distinct though low cusps by a deep sulcus a little behind the middle of its length. The grinding-surface is very minutely and richly tuberculated or, as it may be said, granulated. The anterior and internal cusp is comparatively little developed.

In *U. fossilis* the much smaller tooth is usually of a subtriangular form and generally rounded behind. Sometimes it is more elongated; but even then it is readily distinguishable from that of *U. spelæus* by its greater attenuation posteriorly (corresponding with the upper molar) and other characters. In the typical triangular form there is no sulcus on the outer border, or but a very faint one close to the hinder end; and this is soon destroyed, if it ever existed, by slight wear. When the tooth is more elongated the outer side presents a shallow sinus, subdividing the border, as in *U. spelæus*, into two unequal low cusps. The anterior and inner angle of the tooth is raised into a strong conical cusp. The grinding-surface is coarsely plicated or ridged, and rarely tuberculated or granulated in the interstices of the ridges [1].

[1] In the figure of the mandibular dentition of *U. priscus*, in Brit. Foss. Mamm. (fig. 35 B) the $\overline{\text{m. 3}}$

In *U. arctos* the tooth is also triangular in form, but usually more angular behind, in accordance with the more pointed shape of the corresponding upper molar. It has usually no constriction on the outer border; and the anterior and inner cusp is generally but little developed. The grinding-surface presents only a few coarse folds or rugæ, and is never, so far as I have seen, tuberculated or granulated in the slightest degree.

The fourth lower premolar ($\overline{\text{pm. 4}}$) is in some respects the most characteristic of all the teeth; and were its characters rather less liable to vary by defect in *U. fossilis* and *U. ferox*, it might almost by itself be considered sufficient to give assurance of the species. Its distinctive characters in *U. spelæus* are well known; and when fully developed and unworn it seems to me to afford excellent distinctive characters also between *U. ferox* and *U. arctos*.

In *Ursus spelæus*, besides the principal cone, there are usually on the inner side two, and always one, smaller cusps, of which one is *anterior* in position to the principal cusp. In all other Bears this tooth has either a single conical cusp, or at most a single small internal tubercle *posterior* in position to the principal cusp, and corresponding to the hinder of the two internal cusps in *U. spelæus*.

In all the large carnivorous Bears this tooth presents several common characters, the differences exhibited in various species depending solely, as it would seem, upon the degree of development or suppression of minute parts.

In all cases the tooth presents a large conical cusp, which is placed nearer the anterior than the posterior border of the crown. An acute ridge or keel, in perfectly unworn teeth, descends from the point of the cusp in front to the anterior end of the crown, where it terminates after making a slight curve inwards, in a more or less distinct though always very minute tubercle. Two similar but more strongly marked ridges descend from the apex of the cone towards the hinder border of the tooth.

In fully developed and perfectly unworn teeth in *U. fossilis*, *ferox*, and *maritimus* (and, I have no doubt, also in *U. arctos*, though I have seen no tooth of that species young enough to show it), these hinder ridges are more or less distinctly serrated, especially the outer one, which is always continued to the hinder border of the tooth, whilst the internal ridge rarely reaches more than halfway between the base of the cone and the hinder border. Now the differences in the fourth lower premolar, as between *U. fossilis*, *ferox*, and *arctos*, consist solely in the varying degree of development of these minute parts. In well-marked teeth of *U. fossilis* taken in the germ-condition, the anterior *carina* and the tubercle at its base are strongly developed. The outer of the two hinder *carinæ*, which is deeply serrated, terminates at the posterior border of the crown in a small tubercle, on the inner side of which is placed a second tubercle of equal size; so that the hinder extremity of the crown (or the talon, as it may be termed) might in

appears to be deeply sinuated on the outer border; but this appears to have arisen from the circumstance that the figure has been taken from Goldfuss's specimen in the British Museum, in which the tooth has a piece chipped off at that spot.

well-marked instances be described as bifid. Sometimes, instead of two distinct tubercles, there is a row of several smaller ones; and it not unfrequently happens that, owing to pressure against the next tooth, the appearance of any tubercles in that situation is destroyed. The inner of the two posterior ridges, after descending a short way, ends in a distinct and sometimes considerable-sized somewhat pointed denticle or accessory cusp, which is that above referred to, and is that noticed by Prof. Owen in speaking of *U. priscus*[1]. In a specimen of *U. ferox* (No. 1137 *b*, B.M.), although the two divaricating posterior ridges are quite distinct, there is no appearance whatever of the inner tubercle or cusp; nor is there any indication of its having been worn off; and the hinder tubercles, if ever present, have been removed by pressure. But in a second specimen of an older animal (No. 1137 *a*, B.M.), in which the tooth is much worn, the site of the internal tubercle is still quite visible, as well as the presence of the bifid posterior talon; and in a specimen, also a good deal worn, of the same species in the College of Surgeons, the same appearances are distinctly shown. In the typical specimen of *U. priscus* (*fossilis*) in the British Museum, whose teeth are also much worn, the inner tubercle is very faintly indicated, nor is the bifid talon distinctly discernible. In general characters, therefore, the tooth exactly resembles that of *U. ferox* (No. 1137 *b*, B.M.).

In *U. arctos* the $\overline{\text{pm. 4}}$ is distinguished, besides its usually much smaller dimensions, by the extremely minute size or total absence of the inner tubercle, which in this species, so far as I have seen, rarely exceeds a large pin's head in size, and is often wholly wanting. The posterior talon sometimes exhibits a very minute tubercle, but is more usually quite smooth, and never distinctly bifid as in *U. ferox*.

On applying these observations on the teeth to the diagnosis of the Gibraltar Bear, it appears to me that that form occupies a position intermediate, as it were, between *U. arctos* and *U. ferox*.

1. As regards the second upper molar. In the Gibraltar jaw this tooth resembles that of *U. ferox*, besides its size, in its comparatively slight attenuation behind, and that of *U. arctos* in the apparent falling inwards of the side, though to what extent this reached cannot be determined in the present worn condition of the tooth.

2. The third lower molar also resembles that of *U. ferox* much more nearly than that of *U. arctos* in its greater dimensions and more oblong form, corresponding with the larger and longer upper molar; but there is no appearance whatever of a sulcus in the outer border, such as would most probably have been seen in a tooth of the same size in *U. fossilis* or *U. ferox*.

3. The fourth lower premolar, on the other hand, in its comparatively small dimensions, the diminutive size of the inner denticle, which is not bigger than a pin's head, and the perfectly simple non-tuberculated inner border, more nearly resembles, in fact quite agrees with, the same tooth in *U. arctos*.

[1] Brit. Foss. Mammals, p. 81.

The evidence, therefore, as to species afforded by the dentition of the Gibraltar Bear, is not very satisfactory, and leaves it doubtful whether it should be referred to *U. fossilis* or to a large form of *U. arctos*.

Another specimen in which we may seek for further evidence is the axis vertebra, which seems to present some distinctive characters from that of *U. ferox*; but these are perhaps not very marked, nor probably of much intrinsic importance. And it must be remembered that the Gibraltar bone is of a young animal, and that with which it was compared of fully mature age. The comparative dimensions of these bones are given in the following table.

Comparative Dimensions of Axis of *Ursus ferox* and *U.* ——, Gibraltar.

	Total length.	Width of body at middle.	Width across anterior articular process.	Width across posterior articular process.	Length of spine.	Diameter of neural canal.
	in.	in.	in.		in.	in.
1. Gibraltar specimen	2·7	2·0	2·7	..	2·6	1·0
2. *U. ferox*, R.C.S.	2·8	1·9	2·4	..	3·3	0·9
3. *U. arctos*, 218 *c*, B.M.	..	..	..	..	2·35	..
4. *U. isabellinus*	..	1·7	2·3	..	2·65	0·6

From these figures it will be seen that the main differences as regards dimensions are in the greater width across the anterior articular processes, which would indicate of course a longer atlas and skull, and probably, therefore, a larger animal, which is quite in accordance with the comparative dimensions of the teeth in the two cases. The neural canal also is larger in the Gibraltar bone, which is an indication in the same direction, whilst, on the other hand, the total length is slightly less, and that of the spine considerably so—both of which differences may reasonably be assigned to the different ages of the individuals.

In other respects it is to be observed that in the axis of *U. ferox* the posterior articular facets are larger and rounder, the transverse processes much larger, the neural laminæ thicker, and the odontoid process smaller—all of which differences may also be fairly referred to age and stature.

The spine in *U. ferox* is produced backwards some way behind the level of the posterior articular processes, whilst in the Gibraltar bone it is on a level with them; and in the former it is much hollowed posteriorly: but these characters may also perhaps be referred to difference of age.

I have also compared the axis with that of *U. arctos* (var. *isabellinus*[1]). The latter is of about the same general size, but differs from the former in several particulars, some of which, but not all, can also be regarded as due to age.

[1] I may mention that in this specimen of *U. isabellinus* in the British Museum there are six sacral vertebræ.

1. The spine, which is of the same length, is 1″·3 instead of 1″·0, and much more rounded at both ends on the upper edge, and much deeper in front (exactly the reverse of *U. spelæus*). But viewed from above it is thinner and much more constricted above the posterior articulating processes. It is also deeply hollowed behind (as in *U. ferox*).

2. The body is much narrower in the middle.

3. The anterior articular processes are smaller and more rounded or convex.

4. The odontoid process is smaller.

5. But the most remarkable difference is in the size of the neural canal, which in *U. isabellinus* is little more than half the greatest diameter of that in the Gibraltar bone.

6. The form of the posterior surface of the centrum is quite different; but as the epiphysis is wanting in the Gibraltar specimen, the difference may perhaps be thus in some measure accounted for. The other, as I have observed, can hardly be assigned to age, nor, as it would seem, to the circumstance that the Isabelline Bear was of smaller size than the Gibraltar one.

Hence, again, then, we are brought to the conclusion that the Gibraltar Bear approached more nearly to *U. fossilis* or *U. ferox* than to *U. arctos* (var. *isabellinus*).

As regards the metacarpals, I need only remark that, having carefully compared them with those of *U. ferox*, of which a good specimen has lately been acquired by the Royal College of Surgeons, I can perceive scarcely any difference worthy of note between them. So far as dimensions are concerned, this will be obvious from the accompanying Table (see Appendix, opposite).

It will be seen, from this Table, that the Gibraltar metacarpals must have belonged to four individuals, and that the largest of these most nearly coincides with the specimen of *U. ferox* in the College Museum, which, it is to be remarked, is of small size for that species, and, to judge from the wear of the teeth, rather old.

In the *fifth* metacarpal of *U. ferox* the crescentic tuberosity on the outer side of the head is more pronounced, whilst in the Gibraltar bone it is wider just above the lower capitulum. But the muscular impression[1], or tuberosity, on the outer side below is more pronounced in *U. ferox*. The perimetral index is slightly greater in the Gibraltar bone; and its shaft very slightly more compressed.

In the *second* metacarpal, of which there are two specimens in the Gibraltar collection, one considerably smaller than the other, though quite mature, rather more difference is perceptible. In the first place, the proximal end is more produced behind than in *U. ferox*, and the shaft in the smaller specimen very much more compressed; but in the larger of the two this compression is not observable. The distal articular head in both is smaller, and less rounded than in *U. ferox*.

[1] For insertion of the *peronæus brevis*?

APPENDIX.

Table showing Comparative Dimensions of Metacarpals of specimens of *Ursus*.

To face page 70.

	Mc. 1.					Mc. 2.					Mc. 3.					Mc. 4					Mc. 5.					
	Length.	px.	dx.	l. c.	p. i.	Length	px.	dx	l. c.	p. i.	Length	px.	dx.	l. c.	p. i.	Length.	px	dx.	l. c	p. i.	Length.	px	dx.	l. c.	p. i.	
Gibraltar 1			..											.	.	3·2	95×70	75×81	1·6	·500	3·4	100×95	65×80	1·7	·500	
„ 2			..													.		.	..		3·5	120×90	70×100	1·9	·545	older.
„ 3..	..			.	.	2·9	90×53	60×70	1·4	·489																
„ 4				.		3·1	90×60	70×75	1·6	·516																
Swedish [young] (Engibouli ..	..			..		2·85	90×55	60×70	1·15	·403	2·85	85×55	60×70	1·1	·386	3·0	90×60	60×70	1·2	·400	2·9	90×80	60×75	1·2	413	
U. spelæus, 43740, B.M. .	2·85	85×120	74×90	1·8	·631	3·5	130×93	90×115	2·35	·671	3·6	110×96	100×102	2·5	·694	3·7	140×100	100×140	2·8	·756	3·7	145×130	82×85	2·8	·756	
U. ferox, Paris	3·2	.				3·1			.		3·1			.		3·3					3·6					
„ R.C.S.	2·9	65×90	60×70	1·4	·482	2·9	100×90	70×75	1·6	·551	3·05	96×65	65×70	1·5	·491	3·05	95×70	75×85	1·5	·491	3·3	100×100	70×90	1·8	·545	
U. bourguignat			.						.					..							3·8	100×	×100			
U. arctos, Sweden, 218 *c* or 1182*a*, B.M.	2·62	51×66	40×50	,,		2·9	75×40	52×56	1·1	·345	3·0	80×50	50×55	1·1	·366	3·1	80×50	50×60	1·3	·419	3·1	75×75	50×70	1·3	·419	
U. isabellinus, 1010 *g*, B.M. .	2·7	80×90	60×70	1·2	·444	2·9	1·0×80	60×80	1·4	·483	3·0	90×70	65×70	1·4	·466	3·1	90×70	70×90	1·5	·483	3·2	100×90	65×80	1·6	·500	
U. arctos, 218 *h*, B.M. ...	3·2	90×110	60×70	1·4	·437	3·6	110×80	65×80	1·7	·472	3·7	110×70	70×70	1·55	418	3·8	110×70	70×90	1·7	·447	3·9	120×130	70×90	1·9	·487	

Explanation of Symbols.

px = proximal extremity. dx = distal extremity. l. c. = least circumference. p. i. = perimetral index.

The only difference in the *fourth* metacarpal is the greater compression of the shaft in the Gibraltar bone.

The *first* metatarsal is of exactly the same length as that of *U. ferox*; and the only difference between the two is that in the Gibraltar bone the proximal articular surface is broader and less produced at the inner and posterior angle.

As regards *U. arctos*, as the only metacarpals belonging to that species that I have been able to compare with the Gibraltar bones and those of *U. ferox* are from a young individual, and in which the epiphyses are not fully completely united, though nearly so, I am not able to say more, making allowance for their much smaller size, than that they appear in the compression of the shaft of the *fourth* and *fifth*, and in the comparatively small size of the distal capitulum, to bear a very close resemblance to the Gibraltar bones [1].

Doubt being thus left as to which, if either, of the two generally recognized forms above noticed the Gibraltar species should be referred to, it will be interesting to recall the circumstance of the discovery, about the year 1866 or 1867, by M. Bourguignat, in a cavern at Djebel-Thaya, in the province of Constantine, in Algeria, of abundant ursine remains, which were considered by him to belong to four distinct species, differing considerably, as it would appear, not only in size, but also in the relative proportions of the bones of the extremities, the teeth, &c.

The first published notice of this discovery appeared in 1867 [2], in which a brief description is given of a form upon which M. Bourguignat has bestowed the name of *U. faidherbianus*, founding his diagnosis, however, solely upon the lower teeth. In the next year he published the discovery, in the same cavern, of three more forms, to which he assigns the rank of species, viz. *U. lartetianus*, *letourneuxianus*, and *rouvieri* [3]. M. Bourguignat was led to conclude, upon evidence which he has not, so far as I am aware, yet published, that these different forms belonged to different epochs, which nevertheless appear to have overlapped each other.

The oldest form, to which he assigns as its latest date 8500 B.C., is *U. lartetianus*; the next in point of antiquity is *U. letourneuxianus*, which came down from about 8000 to 3500 B.C.; whilst the other two (*U. rouvieri* and *U. faidherbianus*) are traced to quite a recent epoch, and even, according to M. Bourguignat, may be still existing or have but very recently become extinct.

It is much to be regretted that M. Bourguignat has not as yet given more detailed

[1] It is much to be regretted that neither in the British Museum nor in the Royal College of Surgeons are there any satisfactory materials for studying the osteology of the Common European Brown Bear in the wild state. The bones of long-caged animals are so generally deformed, and especially in the Bear, which seems to peculiarly liable to chronic rheumatic arthritis, as to be wholly useless for any purpose of palæontological comparison.

[2] Notice sur un *Ursus* nouveau. Paris, 1867.

[3] Notice prodromique sur quelques Ursidæ d'Algérie. Paris, 1868.

particulars of these supposed species, since those contained in the short notices above cited are insufficient to allow us fairly to judge of the correctness or not of his determinations, and especially in a case in which we are required to accept the extraordinary discovery of four entirely new specific forms in such a limited locality. And I am obliged to confess that, having been allowed, through M. Bourguignat's extreme kindness and liberality, to study his collection of Ursine remains from the Thaya cavern, they hardly appeared to me to present characters which I should have thought sufficient (considering the extreme variability of all Bears) to justify the distinctions he has set up. As an instance, I may mention that M. Bourguignat divides his four species into two groups, one of which, consisting of the two ancient forms *U. lartetianus* and *U. rouvieri*, is characterized by the presence of a perforation at the bottom of the olecranon-fossa, which he regards as a special character distinctive of certain African Ursidæ, as contradistinguished from those without a perforation, which he considers to belong to a European type. Leaving on one side the evidence upon which M. Bourguignat may rest in attributing this or any other character to African Bears, I would merely remark that more extended observation has perhaps since convinced him that such a character is of no value whatever, as it may occasionally be observed, certainly in *U. spelæus*, and probably in all Bears, as it is also in Man and many other mammals.

But as regards the Gibraltar Bear, it is matter of considerable interest to inquire whether it may not have an intimate relationship with one or other of these ancient Algerian forms. Probability is highly in favour of such a supposition. And the question then arises, What is or what are the known species to which M. Bourguignat's Bears most closely assimilate?

Our means of judging with respect to this are at present very limited; but, to judge from the lower dentition of *U. faidherbianus* (Odontogram 9 *a*, Pl. XXVII.), there is nothing opposed to the supposition that it represents *U. arctos*, or a small form of the *ferox* type, from the comparative width of the fourth premolar, which is greater in *U. fossilis* and *U. ferox* than it usually is in *U. arctos*[1].

The only other of M. Bourguignat's forms of which I have any data is *U. letourneuxianus*, of which the maxillary dentition is shown in Odontogram No. 9, Pl. XXVII.; and from this it would seem to have been a Bear with teeth in size fully above the mean of *U. spelæus*, and with a second upper molar much larger than in any *U. fossilis* or *U. ferox* that has come under my observation. The presence, however, of the first and third premolars shows that it did not belong to *U. spelæus*.

But one of the most interesting points connected with M. Bourguignat's discovery of Ursine remains in the Algerian cavern is the establishment, beyond doubt, of the

[1] In *U. arctos* I have not as yet met with an instance in which the thickness of $\overline{\text{pm. 4}}$ reached 0″·3, it being usually 0″·25; whilst in *U. ferox* it is always at least 0″·3 thick, and sometimes 0″·35.

existence of a large Bear on the African continent from the period when it was still continuous with Europe down to a comparatively recent period, if not to the present day, although zoologists seem disposed to dispute its present existence in the north of Africa.

M. Bourguignat, in his Notice &c. (1867, p. 4), gives a very interesting summary of the evidence afforded by various writers on the subject of the former and present existence of the Bear in North Africa, which appears to have been disputed as far back as by Pliny, who nevertheless cites historical evidence to the contrary. With respect to the present or very recent existence of a Bear resembling the European Brown Bear, the authority of L'Abbé Poiret[1] is quoted, who asserts that in the Atlas Mountains the brown Bear is found, and is very carnivorous. During his stay at Mazoule an Arab brought him the skin of a Bear which he had killed.

In 1841 Mr. Edward Blyth[2] related the capture in 1834 of a couple of Bears near Tetuan, from particulars furnished to him by Mr. Crowther, an officer of the 63rd Regiment. On these particulars was founded by Schinz[3] a new species, *U. crowtheri*, which was adopted by Pucheran[4], and by Gray[5]. Lastly, according to Capt. Loche[6], author of several works on the mammalogy of Algeria, the Brown Bear (*U. arctos*) would appear to exist in the Atlantic chain of mountains in Morocco, whence it often invaded the French provinces. And the same writer states that he had seen at Marseilles, seven or eight years before, a Brown Bear which had been sent by the Emperor of Morocco.

In addition, however, to this evidence, M. Bourguignat adduces that of M. Letourneux, a councillor of Algiers, who states that whilst he was "procureur impérial" at Bone he learned from the Arabs of the Edough that formerly, according to tradition, Bears had abounded in that country, which committed great ravages in the vineyards. On another occasion he was informed by the Arabs of Ouled-sidi-Bekri that Bears had infested their mountains within fifty years; and a man related that one of the last Bears had been killed by his father. According to these people, the Bears in question were small, thick-set, of a brown colour, with a white spot under the throat, very fond of honey and fruit, and when fighting raised themselves on the hind legs. The Caid Boa-Roabi of Zardeza, whose district reached almost to Thaya, assured M. Letourneux that he had often seen traces and heard cries of the Bear in the moun-

[1] Voyage en Barbarie, ou Lettres écrites de l'ancienne Numidie pendant les années 1785 et 1786. Tom. i. p. 238 (1789).

[2] Proc. Zool. Soc. 1841, pp. 64, 65.

[3] Synops. Mammal. p. 302. 1842.

[4] "Esquisse sur la mammalogie du continent Africain," Rev. et Mag. de Zool. 1855, p. 499.

[5] Proc. Zool. Soc. 1864, p. 698.

[6] Catalogue des Mamm. &c. de l'Algérie, p. 30. 1858. These characters, M. Bourguignat observes, closely correspond with those assigned by himself and M. Lartet to *U. faidherbianus*.

tains of Gherara Dhebhar; and another Scheik, living close to Heliopolis, stated to him that he had often seen the Bear, and followed it in the evening into the very mountain of Thaya.

In further confirmation of the very recent, if not present, existence of a Bear in the immediate neighbourhood of the cavern explored by M. Bourguignat, he relates that he himself, during his exploration of the cavern, noticed in the soft soil large foot-prints, as sharp and fresh as if they had not been made more than an hour or two. They were the footprints of a heavy animal, and excited great emotion amongst the Arabs who accompanied him, whose exclamations of Deb! Deb! the Arab word for Bear[1], showed, at any rate, that they were not only familiar with its name, but also not unprepared to witness its sudden appearance.

The existence of a fossil Bear in Algeria has, however, been long well known, a considerable portion of a cranium having been discovered so far back as 1835 by M. Milne-Edwards[2] in an ossiferous breccia fifty metres above the level of the sea, in a red calcareous tufa. M. Milne-Edwards, from what he was able to make out with regard to the size and shape of the cranium, was induced to think that, although of very large size, it presented more resemblance to that of *U. labiatus* than of any other living species.

I may now state the conclusions which, as it appears to me, may be drawn from the above evidence, about the Ursine remains from Genista cave.

1. That they belong exclusively to the more ancient fauna.

2. That they afford evidence of at least four individuals, varying in size and age very considerably, one of which has suffered compound fracture of the hind leg, from which it had recovered with great deformity of the limb.

3. That it was a species of large size, and probably equal to the largest existing Brown or Grizzly Bears, but not equal to *U. spelæus*.

4. That it differs essentially in dental and other osteological characters from *U. spelæus*.

5. That the preponderance of its characters is in favour of its being closely related to *U. fossilis* sive *priscus*, or to a form intermediate between that and *U. arctos*, var. *isabellinus*.

6. That it may have been also closely related to one or other of the fossilized Bears whose remains were discovered by M. Bourguignat in the Cavern of Thaya in Algeria.

[1] I have been lately informed, however, that by "Deb" the Arabs understand, not the Bear, but the Hyæna.

[2] Ann. d. Sc. Naturelles 2me sér. Zoologie, tom. vii. p. 216 (1837): "Note sur une brèche osseuse située entre Oran et Mers-el-Kebir."

IV. Hyæna.

The principal specimen belonging to the *Hyæna* yielded by the Genista cave is a fine cranium, in several pieces, but which, when placed together, constitute two portions, which respectively comprise the facial and occipital regions (Plates I. and II.), the intermediate connecting part having been broken or lost in the extraction from the hard matrix.

The facial segment presents half of the right orbit, part of the zygomatic arch, and the whole of the maxillary of the same side, together with all the molars *in situ*, with the exception of the small tubercular. It shows also part of the alveolus of the canine, the incisive border being wanting. On the left side only a small part of the maxillary is left, containing the three anterior premolars. The palate connects the two lines of teeth, and is complete on the right side almost to the extreme posterior verge, exhibiting the large digital fossa within the carnassial, and an indistinct indication of the alveolus of the apparently uniradicular molar.

The posterior portion of the cranium includes the whole of the occipital region, a part of both parietals, and the greater part of both temporals, with the auditory foramina and bullæ, together with the glenoid fossæ and occipital condyles, which are quite perfect. The right glenoid fossa is in a diseased condition; and what remains of the temporal zygomatic process appears to indicate that that process had been diseased, or perhaps the seat of an old ununited fracture. The sagittal crest is wanting; but the occipital area and spine are tolerably entire (fig. 4). The teeth are all much worn; and the general condition of the bones is also such as to prove that the animal was aged.

The specimen was found at a depth of 36 feet, in the upper chamber of the Genista Cave; but it is thoroughly fossilized, dense, and heavy. The cerebral cavity and all the hollows are occupied by a thick deposit of ochreous stalagmite, in a mass of which the whole was imbedded.

In the subjoined Table will be found the principal dimensions that the condition of the specimen will allow to be taken, contrasted with those obtained in *H. spelæa* (one example), *H. crocuta fera* (mean), *H. brunnea* (mean), *H. striata* (mean):—

TABLE showing Dimensions of the Cranium and Teeth in *Hyæna*.

	Gibraltar specimen.	*H. spelæa.*	*H. crocuta* (*fera*). (Mean.)	*H. brunnea.* (Mean.)	*H. striata.* (Mean.)
	inches.	inches.	inches.	inches.	inches.
1. Length from occipital crest to incisive border	10·6	10·8	10·7	10·1	9·0
2. „ „ condyles to incisive border	9·9	....	9·8	9·1	8·2
3. Width between outsides of condyles	2·1	2·2	2·0	2·0	1·6
4. Width of skull over auditory foramina	3·9	....	3·9	3·4	3·1
5. Width of base of occipital triangle	4·0				
6. Height of „ „	3·8				
7. Foramen magnum, vd. and trd.	1·0 × ·9				
8. Auditory bulla	·2 × ·1				
9. Molar series	3·4	3·7	3·34	3·12	2·7
10. Pm. 1	·30 × ·25	·33 × 32	·30 × ·27	·27 × ·25	·23 × ·22
11. Pm. 2	·72 × 51	·68 × ·43	·67 × ·50	·68 × ·46	·62 × 40
12. Pm. 3	1·05 × ·72	1·00 × ·73	·94 × ·70	·93 × ·85	·80 × 52
13. Pm. 4	1·50 × 80	1·60 × 87	1·46 × ·84	1·42 × ·63	1·17 × ·70
14. M. 1	·2 × —?	0	·2 × ·1	·51 × ·21	·50 × 21

The mere inspection of these numbers will be sufficient to show that the Gibraltar fossil *Hyæna* is in all essential particulars, as regards cranial and dental measurements, very closely in accord with *Hyæna crocuta* and *H. spelæa*, whilst at the same time it offers considerable differences from both *H. brunnea* and *H. striata*. Further examination only tends to prove that this similarity is real, and that the Hyena found in the Genista Cave is, in fact, identical with the Spotted Hyena of Southern and Western Africa, and quite distinct from the Striped Hyena of Western Asia and Northern Africa.

This conclusion is so contrary to what might have been expected, that when it was forced upon us it could not fail to excite the greatest surprise and interest; and Dr. Falconer went into the question of the specific identification of the specimen with his well-known acuteness and zeal. Unfortunately at that time there were no known materials in London for studying the cranial and dental characters of *Hyæna brunnea*, although there were two skulls erroneously assigned to that species in the British Museum [1].

The consequence was that Dr. Falconer had no means of determining differences between *H. crocuta* and *H. brunnea*, and was misled into the impression that the Gibraltar *Hyæna* was of the latter species. For the same reason he was induced to regard the *Hyæna fusca* of G. St.-Hilaire as distinct from *H. brunnea*, Thunb., and to adopt the notion that *H. maculata*, Kaup, was distinct from *H. crocuta*, Erxl. (sp.).

[1] A full account of the cause of this confusion will be found in my paper "On the Cranial and Dental Characters of the existing Species of Hyæna," published in the Linnean Society's Journal, Zoology, vol. ix. p. 59, 1866.

Since then, however, we have been furnished with abundant materials for the clearing up of what was to him necessarily obscure, and no difficulty now exists in distinguishing between the three existing species of *Hyæna* from their cranial and dental characters alone; and I may remark that any difficulty even at that time would have been removed, had Dr. Falconer been acquainted with Dr. Wagner's excellent paper "on the Specific Differences by which *H. brunnea* is distinguished from *H. striata* and *crocuta*, as manifested in the skull and dentition"[1]. In this memoir, with which I was wholly unacquainted at the time when I communicated my paper to the Linnean Society, nearly all that I have remarked was anticipated more than twenty-three years ago.

The principal cranial and dental characters by which the three existing species of *Hyæna* are distinguished may be briefly stated as under[2]:—

H. striata and *H. brunnea*, so far as regards cranial and dental characters, agree in so many particulars, as upon superficial inspection to be readily confounded. The chief points in which they agree are also those in which they both differ from *H. crocuta* and its fossil congeners.

1. In both species the upper tubercular molar is triradicular and tricuspid, and rarely less than 0″·5 in length by 0″·2 in its shortest diameter; while in *H. crocuta* and its allies this tooth is normally biradicular and bicuspid, though not unfrequently by abortion or fusion uniradicular or entirely absent, and it is never more than 0″·2 or 0″·21 in length by about 0″·1 in the shorter diameter.

2. In having the three lobes of the upper carnassial tooth (pm. 4) subequal in the antero-posterior direction.

3. In having a more or less distinct accessory point on the inner side of the hinder cusp of the lower carnassial (m. 1). It is true that a minute tubercle (or rudiment, rather, of a similar point) is not unfrequently seen in nearly the same situation in *H. crocuta*, and perhaps still more frequently in *H. spelæa*[3]; but in those species it never assumes any thing like the size it presents in *H. striata* and *H. brunnea*, though it is considerably less in the latter species than in the former. Some difference also may be noticed in the exact situation of the accessory point in *H. crocuta* and *spelæa*, in both which species it is usually situated as it were in a hollow beneath the base, at the inner and hinder border of the posterior cusp, whilst in *H. striata* and *brunnea* it rises distinctly on the inner surface of the cusp.

Other points of agreement between these two species may be noticed, as, for instance, the presence in both of a distinct anterior talon to the second premolar, and of a

[1] "Auseinandersetzung der specifischen Differenzen durch welche sich die *H. brunnea* von der *H. striata* und *crocuta* in der Beschaffenheit des Schädels und Gebisses unterscheidet, vom Prof. Dr. A. Wagner," Münch. Abhandl. iii. p. 609, 1843.

[2] Linn. Soc. Journal, ix. p. 65.

[3] In twelve lower carnassials of *H. spelæa*, from Kent's Cavern and Kirkdale, in the national collection, a small accessory point was noticed in five, whilst in seven there was merely a trace of one.

well-defined anterior talon to the first, second, and third premolar, which is larger, however, as, in fact, are all the talons, in *H. striata*. In *H. striata* and *H. brunnea* the second and third premolars are placed with their long axis oblique to the line of the alveolar border, and the third premolar is obliquely truncated behind, whilst in *H. crocuta* this tooth is square behind.

The opening of the nares is rounded in *H. crocuta*, and more or less pyriform in *H. striata* and *brunnea*, in which also the anterior palatine foramina are very much larger in proportion. Dr. Wagner further adduces the form and size of the auricular bulla as distinctive marks. In *H. crocuta* this part is much more developed than in *H. striata* (and to a less extent in *H. brunnea*); and its posterior wall is convex or flat, whilst in *H. striata* and *brunnea* it is more or less concave. The extremity also of the mastoid process is compressed in both those species and rounded in *H. crocuta*.

According to Dr. Wagner the occipital crest curves more backwards in *H. striata* and *brunnea* than it does in *H. crocuta*, in which it does not project beyond the level of the condyles.

In my paper above referred to, and also in that of Dr. Wagner, several other points in the conformation of the skull and face in which differences are observable are adverted to; but as these for the most part refer to parts that are deficient in the Gibraltar specimen, there is no occasion here to repeat them.

It will perhaps be simply necessary to indicate that in all the main points above noticed the Gibraltar cranium and teeth exhibit the characters of *H. crocuta* as distinguished from *H. striata* and *brunnea*.

1. The form of the upper carnassial, in which the posterior cusp forms about half the length of the tooth [1].

2. The minuteness, if not absence, of a tubercular molar.

3. The squareness of the hinder border of pm. 3.

4. The expansion of the auricular bulla, and the convexity of its hinder wall, and the roundness of the mastoid process.

5. The uprightness of the occipital plane and the wavy outline of the lateral ridges by which it is bounded.

6. And, as distinguishing it more particularly from *H. brunnea*, the rotundity and fulness of the parietal region of the skull.

These considerations, together with the comparative dimensions given in the Table, and those of the teeth, as shown in the odontograms (Pl. XXVII. Nos. 1–5) of the maxillary molar dentition of the Gibraltar *Hyæna* contrasted with those of *H. spelæa*, *H. crocuta*, *H. brunnea*, and *H. striata*, will sufficiently demonstrate the identity of the Gibraltar *Hyæna* with *H. crocuta* and *H. spelæa*, which may be regarded, perhaps, as specifically the same.

[1] This will be better seen in the figure, Plate I., than in the specimen itself in its present state, the tooth having suffered injury since the drawing was made, by which the greater part of the enamel has been detached.

This identification of the Gibraltar *Hyæna* with *H. crocuta* is perhaps one of the most interesting results of the exploration, as affording a strong confirmation of the probability that the Cave-Hyena found its way into Europe from Africa, at least in part, by way of Spain, through which country its track may, in fact, almost be followed, since a jaw, pronounced by Dr. Falconer to be that of *H. spelæa*, is described by Don Casiano de Prado as having been discovered in the Cavern of Pedraza, near Segovia, associated with very ancient objects[1]. It has also occurred in Sicily[2], where the specimen is described by Dr. Falconer as "certainly not of the Indian Striped Hyena, but of the *Hyæna crocuta*, or Spotted Hyena of the Cape," and at Mentone, where it seems to have been coeval with man.

It is also of interest here to remark that, so far as is at present known, no fossil remains referrible to *H. striata* have been discovered in Spain. The most southern known locality for that species appears to be the cavern of Lunel-Viel, in which the *H. intermedia* of Marcel de Serres undoubtedly represents *H. striata*. Nor does it seem to have occurred in the fossil state in Italy; so that in the present state of our knowledge it would appear to be not at all improbable that at the time when Europe and Africa were continuous by land the fauna of the latter continent did not include the Striped Hyena, whose centre of distribution, we may conclude, was probably in Asia.

The only other remains of *Hyæna* are numerous coprolites, to one of which is closely adherent a fragment of the atlas of an Ibex. These objects, of course, show that the animal must have lived at no great distance from the spot at which the remains were entombed.

V. Felis.

The fossil remains from the Genista Cave establish by very distinct evidence the existence in the ancient fauna of several species of *Felis*, varying in size from the Leopard to nearly that of the Wild Cat.

Of these the largest was a form undistinguishable from the existing F. pardus, or Panther, of the opposite African coast,

The specimens referrible to this animal, all of which, it is highly probable, belonged to one and the same individual, are:—

1. A portion of the left maxilla, containing the alveolus of the outer incisor, the canine broken off recently to the level of the alveolus, the empty alveolus occupied by stalagmite of the first premolar (pm. 2) and the entire second premolar (pm. 3). (Pl. III. fig. 2.)

2. The nearly entire right mandible, retaining the canine and three molars (pm. 3, pm. 4, m. 1), all perfect, and the socket of the outer incisor. (Pl. III. fig. 1.)

3. Half the left mandible pairing with the above, although they were found at some

[1] Descripcion fisica y geologica de la Provincia de Madrid, 1864, p. 216.

[2] Falconer, Pal. Mem. ii. p. 465.

distance apart, retaining the outer incisor, canine, and two anterior molars (pm. 3, pm. 4).

4. The proximal extremities of the right and left ulnas, each with the olecranon broken, and probably gnawed off; all the fractured surfaces are covered with stalagmite.

5. An entire right tibia.

6. A portion of the shaft of the corresponding left tibia.

1. The mandible measures from the incisive border to the angular process 6″. Its height at the middle of its length about 1″·3; the length of the diasteme is ·7, of the symphysis 2″·0, and of the molar series 2″·1. The incisor series or the space between the canines inside measures about 0″·8. The canine is ·6×·5, pm. 3 ·6×·3, pm. 4 ·78×·40, and m. 1 (carnassial) ·80×40. The jaw is very thick and massive, its width immediately behind the canines being 1″·6 nearly. In the mandible of an African *F. pardus* (No. 4540, C. S.), the length from the incisor border to the angle is 6″·3, the height at the middle 1″·3, the length of the diasteme ·8, of symphysis 2″·0, of the molar series 2″·1, of incisor series ·8, the canine ·65×·50, pm. 3 ·50×25, pm. 4 ·80×·35 m. 1 ·75×·37.

2. The tibia measures 9″·9 in length, the proximal end 2″·1×2″·25, the distal 1″·0×1″·6; the least circumference is 2″·9, and the perimetral index ·291. The tibia of an African Leopard in the Royal College of Surgeons is 9″·8 long, the proximal end 2″·4×2″·8, the distal 1″·0×1″·55, the least circumference 2″·8, and the perimetral index ·285.

The same close resemblance is exhibited in the dentition, as will be seen by inspection of the odontograms Nos. 21 and 22 (Pl. XXVII.), of which the former represents that of the Gibraltar Leopard, and the latter that of *F. pardus* (No. 4544, R. C. S.).

Under the appellation of *F. antiqua*, Cuvier [1] notices the occurrence of a very similar form in the ossiferous breccia at Nice, associated with the Lion and several cervine ruminants. It was also met with in the cavern of Gailenreuth; and it is also recorded by M. Marcel de Serres as occurring in the cavern of Lunel-Viel. M. Lartet [2] met with it in the Cavern of Mars, in the maritime Alps, and M. Gervais [3] in the Cave of Mialet. Lastly, Messrs. Boyd Dawkins and Sanford [4] enumerate it amongst the species met with at Banwell, and at Bleadon Hill and Hutton Cave in the Mendip Hills.

The latter writers remark (p. 179) "that the remains from the pliocene beds of Mont Perrier, in Auvergne, ascribed by MM. Croizet and Jobert to *Felis antiqua*, are too large to have belonged to the largest Leopard, though M. de Blainville believes that *F. pardinensis* and *F. arvernensis* are identical with the Panther." They also justly remark that the *F. pardoides* of Prof. Owen [5] differs from the Panther in the lowness of the crown of the last [lower] molar," to which might be added that the Crag tooth also

[1] *Op. cit.* t. vi. p. 383.

[2] Ann. d. Sc. Nat. 5me sér. viii. p. 170.

[3] Anim. Vertéb. vivants et fossiles, 1867–1869, p. 68, pl. xv.

[4] Brit. Pleistocene Mamm. part iv. p. 177, 1872.

[5] Brit. Foss. Mamm. p. 169.

differs from that of the existing Leopard, if we may judge from the figure, in the excavation of the anterior part of the anterior cusp on the inner face, on which aspect, in the Gibraltar specimen and the existing Panther, the surface is uniformly convex.

In conclusion, it may be remarked that the size of the lower true molar in the Bleadon-Hill Leopard, ·8 × ·4, exactly corresponds with that of the same tooth in the Gibraltar specimen; and this is a character in which these two specimens appear to exceed any recent Leopard with which I have had an opportunity of making comparison. In the figure of the lower jaw of *Felis pardus*, however, given by M. de Blainville [1], the antero-posterior length of the tooth appears to be the same as in the two fossil instances.

I would observe, however, that, although in the Gibraltar Leopard the lower carnassial is so unusually long, the penultimate is of exactly the same length, and the next but very slightly longer.

2. Felis pardina, Oken.

The true Lynxes (excluding the Caracal) constitute a peculiar well-defined subgeneric group of Cats, characterized, so far as external features are concerned, by long legs, short tails, and usually tufted ears, to which, as more intrinsic characters, may be added the almost invariable absence at all ages of the foremost small upper premolar (pm. 2), which is generally present in almost all other felines—and, according to Keyserling and Blasius [2], by the circumstance that the nasals are separated from the maxillaries by the intervention of the descending process of the frontal meeting the premaxillary) Blasius adds, as another character of the Lynx Cats, that the lower carnassial (m. 1). is tricuspid. But in this he is manifestly in error, since that condition obtains only in one of the four or five species constituting the group; it is in fact confined, so far as my observation extends, exclusively to the northern Lynx of Europe and Asia.

Of the group thus characterized, several European forms have been described under different specific names; but at present I believe zoologists are tolerably unanimous in considering that there are in the Old World only two specifically distinct forms. The larger, best-known, and more widely distributed of these is *Felis lynx*, Linnæus and Pallas, under which are included:—

F. cervaria, Temminck, Nilsson, Cuv.

F. lupulina, Thunb.

F. lyncula, virgata, Nilss.

F. lynx, Schreber, Temminck, Bechst., Keyserling and Blasius, Blasius, Schinz, Blainville, &c.

[1] Ostéographie, pl. xxxvi. (*Felis*, pl. viii.). *Vid.* also jaw of the fossil Leopard from Lunel-Viel, pl. xliv. (*Felis*, xvi.).

[2] Dr. Gray made the same observation, and applies it to "all the species of Lynx both from the Eastern and Western Hemispheres," apparently unaware that he had been anticipated by Keyserling and Blasius. Proc. Zool. Society, 1867, p. 259.

F. borealis (pars), Temminck, Thunberg.
Lyncus borealis, Gray.
L. lupulinus, Gray.

These various forms appear to differ from each other merely in certain details of coloration and size; and I have been unable to find any mention of more important dental or osteological characters, which, in a palæontological point of view, at any rate, are alone available.

The range of this Lynx appears to be very extensive, reaching from the northern shores of Siberia, throughout the whole of Europe, to the southernmost part of Italy, and from the Caucasus to the extreme west, where its remains show that it was also a member of the quaternary fauna [1].

But, with this very extensive distribution, no evidence at present exists of the occurrence of *F. lynx* south of the Pyrenees, although it is said to have been killed in that range of mountains in 1833. In the south of Spain, at any rate, and in Portugal north of Lisbon, it is replaced by a distinct and somewhat smaller form, which in some parts even appears to be tolerably abundant. There is furthermore evidence of its having inhabited the peninsula at a very remote period, its remains, to judge from the figure of a lower jaw, having been discovered by M. Delgado [2] in the "Casa de Moura."

It is to this second European Lynx that the remains of a species of *Felis* considerably less than the Leopard found in the Genista Cave appear to belong.

They consist of a considerable part of the maxillaries of one individual and a portion of the right maxillary of a second, together with a large part of the lower jaw, the distal extremity of the left humerus, the proximal end of a corresponding ulna, and the distal end of a tibia.

One of the maxillary specimens is represented in Plate III. fig. 3, *a*, *b*, *c*, *d*, *e*. It consists of the nearly entire left maxillary with all the teeth and the lower or malar portion of the orbital border. The two molar teeth (pm. 3 and pm. 4) are quite perfect; but the canine is broken off close to the alveolus. On the right side only a small portion of the maxillary remains, containing the perfect canine; of the incisors four remain entire [3], and the two central alveoli are filled with stalagmite. There is no vestige whatever in either specimen of the anterior premolar (pm. 2).

The canine (fig. 3, *c*) shows two deeply defined grooves on the outer and hinder

[1] A jaw undistinguishable from that of *F. lynx* was discovered by Dr. Ransome in a fissure of the Magnesian Limestone at Pleasley Vale in Derbyshire, associated with bones of the Wolf, Fox, Roedeer, Vole, &c. (Brit. Assoc. Report of Sections, 1866, p. 16). It has been described and figured by Messrs. Boyd Dawkins and Sanford (Brit. Pleistocene Mammals, part iii. p. 172, 1868), who remark that the geological age of this relic cannot be determined with absolute certainty, though they think it may probably belong to the Post-glacial period.

[2] Commissão geologica de Portugal. Estudos Geologicos—Primeiro Opusculo—Noticia ácerca das Grutas da Césaréda, p. 92, pl. ii. figs. 4, 5, 6, 8, 9, 1867.

[3] Two have unfortunately been recently broken off.

aspect; and there is none on the inner face, which shows a very indistinct trace of a short ridge. The tooth is almost cylindrical. The length of the diasteme is not more than 0″·2. The characters presented by the other maxillary specimen, which is of an older animal, so far as they go, exactly agree with those of the former.

The mandibular specimen consists of the greater part of the left ramus, and about half of the right (Pl. III. fig. 4). A portion of the left ramus, corresponding to the second tooth, is wanting; but the lower carnassial on that side remains entire, and the fangs of the anterior premolar (pm. 4), recently broken off, are left in the alveoli. On the right side the canine is quite entire, as are the two anterior premolars (pm. 3 and pm. 4).

If the dimensions of this jaw are compared with those afforded by the specimens above referred to, and with those given by Messrs. Boyd-Dawkins and Sanford, the difference between the Gibraltar specimen and *F. pardina* and *F. lynx* will be seen to be but slight. The chief points to be remarked are the greater width of the diasteme in the Gibraltar specimen, and the less length of the molar series in both it and *F. pardina*, as compared with *F. lynx*. This is commensurate with the greater antero-posterior diameter of the carnassial in the latter species, as shown in the odontograms. In both these particulars, viz. the width of the diasteme and the comparative shortness of the molar series, the Gibraltar jaw agrees with that figured by M. Delgado.

As the condition of the Gibraltar specimens affords no means of judging of the cranial characters, it would be needless on this occasion to discuss them. It may be stated, however, that they are amply sufficient to prevent any confusion between the Northern and Southern Lynx, and with the Caracal, even in the fossil state.

The same may be said with respect to the dental characters, which are also alone sufficient for a satisfactory diagnosis. As, fortunately, the Gibraltar remains afford the complete dentition, I will proceed to point out the more salient characteristic differences, 1. between the true Lynx and the Caracal, and 2. between the Northern and the Southern European Lynx. It does not appear to be necessary to compare any other feline species. The two American Lynxes are so much smaller as to be out of the question altogether.

1. As to the dental differences between the Lynxes (proper) and the Caracal. (*a*) The Caracal almost invariably possesses an upper anterior molar, though usually of small size, and sometimes apparently deciduous at an early period. (*b*) Its canines are in almost all cases smooth or ungrooved; its premolars are much more compressed; and the inner anterior tubercle of pm. 4 is smaller.[1]

[1] In a skull of *F. caracal* (No. 981 *a*, B. M.) the canines have, to use Dr. Falconer's expression, "the enamel smooth and ungrooved." And the same is markedly the case in a skull from Tangiers, $\frac{51}{4—23}$ B.M. The canines are also smooth in two Caracal's skulls in the Royal College of Surgeons, $\frac{11}{}$ one of which, No. 4587, from

2. As regards the dental distinctions between the Northern and Southern Lynx, we have to remark (*a*) that in *F. lynx* the teeth generally are larger, though of the same proportionate width, and (*b*) that the upper tubercular molar is very much larger, and triradiate (the middle root very small).

3. The lower carnassial is furnished with an additional small cusp behind[1], which is wanting, not only in *F. pardina*, but, so far as I am aware, in almost all other felines. The only cases in which I have noticed any thing of the kind is in *F. picta* (*Leopardus pictus*, Gray) (No. 1495*a* B. M.), from South Africa, and in *F. viverrinus*, Gray.

4. The pm. 3 is broader or squarer behind in *F. lynx*, whilst it tapers almost to a point in *F. pardina*, and the teeth generally are wider posteriorly.

3. Felis caligata, Temminck.

A third species of *Felis*, of smaller size than the Lynx, is represented by:—

1. An entire left mandible, with all the teeth except the incisors.
2. A fragment of a second left mandible retaining the carnassial tooth only.
3. An entire right humerus.
4. The distal end of the left humerus.
5. The proximal end of apparently the corresponding ulna.
6. The distal half of the right tibia.
7. Two metatarsal bones.

1. The entire mandible (Pl. III. fig. 6) measures 2″·8 from the incisor border to the condyle, and about the same to the extremity of the crochet. The coronoid process rises to the height of 1″·2; and the height of the ramus at the second tooth is 0″·5. The condyle is 0″·6 in length, and is rather slenderer than it appears in the figure, its greatest thickness being about 0″·15. The length of the three molars is 0″95, and of the diasteme about 0·″26. The dimensions and proportional sizes of the teeth are shown in the odontogram No. 15.

This beautiful specimen was extracted from a very hard ferruginous matrix. The bone is very dense, and almost black from manganesic infiltration, so that there can be no doubt that the animal belonged to the most ancient fauna of the rock. The teeth, with the exception of the carnassial (m. 1), which has lost the hinder cusp (by recent fracture), are nearly entire, the small anterior and posterior cusps in pm. 3 and pm. 4 having been either worn or broken off.

The canine, which is greatly worn behind, has a simple deep groove on the outer side;

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the Hunterian Collection, is named *F. lynx* in the Catalogue, though there can be no doubt of its belonging to "the Persian Lynx," *F. caracal*, and not to the true Lynx. But in a skull of a large Caracal from the Zoological Society's Collection, No. 981 *e*, B. M., a single fissure is obscurely evident on the outer side of the canines.

[1] The absence of this cusp in the Canadian Lynx is referred to by Messrs. Dawkins and Sanford.

and perhaps a second may have existed until worn away by the usure of the tooth. There is no distinct appearance of a groove on the inner aspect.

The coronoid process is as much reclined as in the Common Cat, and projects backwards to a vertical line, which would touch the condyle and angular crochet. The masseteric fossa is very deep, and its anterior margin much raised.

2. The fragment of the second mandible, so far as it goes, precisely corresponds with the former, except that it is scarcely stained with manganese, although it was imbedded in the same kind of matrix.

3. The entire humerus is 4″·3 long, the proximal end ·95×·70, the distal ·50×·85, the least circumference 1″·0, perimetral index ·232. This bone has a very recent aspect, and is obviously of much more recent age than the rest.

4. The fragment of a humerus has an ancient look, but corresponds in all respects with the above.

5. The portion of ulna, from the condition of the bone, would seem to belong to the opposite side of the same individual as No. 4; whilst

6. The tibia and metatarsals have the more recent aspect of the entire humerus. There can be no doubt, however, that all these bones belong to the same species.

Of the numerous existing species of Cats smaller than the Lynx, and varying in size from the Serval to *F. maniculata*, and in which the upper carnassial tooth never exceeds 0″·5 or 0″·55, and the lower 0″·4 or 0″·45 in length, the only ones with which it appears worth while to compare the Gibraltar form are:—

1. Felis serval, Schreber, Gray.

Felis capensis, Forst.
—— *galeopardus*, Desmarest.
—— *senegalensis*, Lesson.
Chaus servalina, Gerrard, Blainv.
—— *serval*, Buffon.

2. Felis chaus, Güldenst, Temminck, Blainv.

Felis catolynx, Pallas.
—— *libyca*, Olivier.
—— *affinis*, Gray.
—— *dongolensis*, Hempr. and Ehr.
—— *jacquemontii*, I. Geoff. St.-Hil.
—— *rüppelli*, Brandt (non Schinz).
—— *servalis*, Blainv.
Chaus libycus, Gray.
—— *jacquemontii*, Gerrard.

3. Felis caligata, Temminck.

Felis caligata sive *bubastes*, Blainv.
—— *bubastes*, Ehr. & Hemp. (Symb. Phys.).
—— *cafra* sive *caffra*, Desmarest, Gray.
—— "*Caracal de Libye*," Buffon.
—— "*Booted Lynx*," Bruce.
Chaus caffer, Gray, B. M. Cat.

4. Felis maniculata, Rüppell.

Felis rüppelli, Schinz.

To which might perhaps be added:—

5. Felis catus (*fera*), Linn.

6. Felis catus magna, Schmerling.

As my comparison has been necessarily limited to the lower jaw and teeth, I will confine what I have to remark to these parts alone, which appear amply sufficient for the purpose of diagnosis.

Of the species above enumerated, that whose lower jaw most closely resembles the Gibraltar specimen is *F. caligata* s. *bubastes*, as represented in M. de Blainville's figure [1], which has been taken from a mummified specimen. Comparison of this figure with that of the Gibraltar specimen (Pl. III. fig. 6) will at once demonstrate their almost exact resemblance. It will be useful also to compare M. de Blainville's figures of the lower jaw of *F. servalis*, *F. chaus* (mummy) (which seem to me to belong to the same species), *F. maniculata fera*, and *F. catus fera*, together with Dr. Schmerling's figure of the jaw of *F. catus magna*, which, although the teeth are, or appear in the figure to be, rather smaller, seems to me to be identical with the Serval.

The several Odontograms of these Cats (Pl. XXVII.) will further serve to show the differences and resemblances amongst them as regards the dentition; whilst those of the recent and mummified *F. caligata*, compared with that of the Gibraltar specimen, will further demonstrate so far the identity of these three forms.

Besides this comparison with published figures, I have carefully contrasted the Gibraltar jaw with that of the so-termed *Chaus caffer*, Gray (857 a, B. M.) from the Cape of Good Hope.

The jaw and teeth are exactly of the same size. In fact there is no perceptible difference between them; and it is clear that whatever may be the species to which the Museum specimen (procured from M. Verreaux) belongs, the Gibraltar one is the same. The only difference worth noticing is the circumstance that the coronoid process is narrower at the bottom in the latter; but both have the same slope of the coronoid

[1] Ostéographie, Pl. xlvii. (*Felis*, xix.).

process in front, or very nearly so. In the pattern of the teeth the median cusp of pm. 2 is thicker in the Gibraltar specimen, though the tooth is of exactly the same length at the base. In neither is there any distinct trace of a hinder cusp or even of the anterior, though there has probably been a small one in both. They both differ altogether from *Chaus servalinus* (133 *a*, B. M.) from Senegal, in which the teeth are not only much larger, but the pm. 3 and pm. 4 have a large anterior and two small hinder cusps, as in most of the Felidæ.

In *Chaus libycus* (1172 *b*, B. M.), whose mandible is of the same size, the coronoid process is less reclined, and the teeth, except pm. 3, longer, with a much more strongly marked cingulum behind.

Another strong point of resemblance between the Cape and the Gibraltar specimens consists in the configuration of the masseteric fossa, which is very deep, and has an abrupt narrow elevated ridge bounding it below; whilst in *Chaus libycus* the fossa is much shallower, and the ridge less elevated. In the Cape and Gibraltar jaws the "crochet" is much incurved, but scarcely at all so in *Chaus libycus*. The distance also from the lower border of the "crochet" to the under surface of the condyle is the same in the Cape and Gibraltar specimens, and considerably greater than in *Ch. libycus*. There can be no doubt, therefore, that the Gibraltar and Cape species are one and the same; nor can there, I think, be any doubt that the Indian form named *Chaus libycus* in the British-Museum Catalogue is distinct.

The parietal width in *C. libycus* is 1″·9; in *C. caffer* 1″·95, or nearly the same; so that the animals are probably of nearly equal bulk. But the orbit in *C. caffer* is 2″·3 in its vertical diameter, and that of *C. libycus* only 1″·9. The bony orbit is almost complete in *C. caffer*, and much less complete in *C. libycus*, in which also the infra-orbital foramen is smaller and more elliptical, and larger and rounder in *C. caffer*. In *Chaus caffer*, again, the nasals are equal with the maxillaries, whilst in *C. libycus* they exceed the maxillaries, as in the Lion. In *C. libycus* the lacrymo-maxillary suture is in front of the edge of the orbit, and in *C. caffer* coincident with or rather behind it.

In the narrowness and reclination of the coronoid process the Gibraltar jaw resembles (among the species above named), besides *F. bubastes*, *F. maniculata* and *Felis catus ferus*, and, it may be added, the Domestic Cat also; but it is distinguished from the three latter, not only by its greater size, but also by the far greater thinness of the inferior boundary of the masseteric fossa; and from *F. maniculata* by the less abrupt or defined termination of the fossa anteriorly. In *F. maniculata* also the "crochet" does not project so far backwards, though this may probably be an uncertain character.

From these considerations there appears to be every reason for believing that the smaller fossil Cat of Gibraltar is *F. caligata*, a species which appears to have a very extensive range from one end of Africa to the other, and to have formed one of the three feline species which were regarded as sacred by the ancient Egyptians, and were

frequently converted into mummies, the other two being *F. chaus* and, in all probability, *F. maniculata*, which was apparently the domestic cat of the period.

4. Felis domestica.

Numerous remains of the common domestic Cat were met with in the more recent deposits in the caves and fissures, and may be often picked up on the surface. But I have not yet met with any really fossilized Cat smaller than *F. caligata*.

VI. Canis, Herpestes, Meles.

No other remains of Carnivora have been met with in the Gibraltar collection belonging to the more ancient fauna. The jaw of a Fox (Pl. III. fig. 7), incrusted with red stalagmite from the upper part of the Genista Cave, is the only instance of any great apparent antiquity. Numerous specimens belonging to the same species, undistinguishable in the bones and teeth from the common Fox, have occurred in other fissures and caverns, mixed with recent bones and human rubbish, as might be expected, seeing that the Fox is at present a living inhabitant of the Rock.

In the same category of more recent specimens, it may be mentioned that in Genista Cave No 3 the skull, without the lower jaw, of a Mangoose (*Herpestes ichneumon*, Illig.) was found, of the present existence of which on the Rock I am not aware, but which occurs in the south of Spain. Under the same circumstances the skull, jaw, and bones of the Badger (*Meles taxus*) of different ages, have also occurred, although, what is perhaps rather remarkable, the remains of this most ancient, perhaps, of all existing quaternary mammals except the Lion, have not as yet been discovered in the true ossiferous breccia. Bones of the Dog are frequently found on the surface; but no trace of the Wolf has been noticed.

VII. Equus.

Of the genus *Equus*, the materials, although not numerous, are amply sufficient to establish the identity of the species with *E. caballus*.

The principal specimens are:—

1. A large fragment of the cranium (Pl. VIII. fig. 1), comprising the greater part of the left side of the face, from the posterior border of the orbit to the incisive extremity of the diasteme. It shows the whole of the maxillary and lachrymal bones, together with part of the frontal; and about two thirds of the circuit of the orbit are left. The nasals are wanting. The specimen is slightly cracked behind; and a crack runs across the frontal and through the orbit.

It would appear that the specimen had originally been much more perfect, and that a considerable portion was lost in its extraction from the matrix. The dental series

consists of the empty pit of the small caducous first, and the three following milk-molars in full wear, together with the first true molar in germ imbedded in the jaw. In the dimensions and pattern of the teeth, and the other characters of this specimen, it will be seen to exhibit nothing to distinguish it from the corresponding parts of an ordinary colt or filly.

The specimen, which bears no marks of gnawing, was procured from beneath two thick floors of stalagmite; and it was imbedded in a hard calcareous ochreous matrix, from which it had to be chiselled out.

Two other maxillary fragments, each containing two milk-molars, were found at a greater depth. And besides these, two other detached milk-molars, upper and lower, were also met with. It may be presumed that all these specimens, though found at different depths and widely apart, may in all probability have belonged to the same individual. The crowns of the teeth are slightly sun-cracked, indicating exposure to the atmosphere before their entombment in the cave.

2. Another specimen, also possibly belonging to the same animal, is a proximal phalanx (Pl. VII. fig. 3), from which the proximal epiphysis has been detached. It is rather slender in form.

3. A large portion of a scapula of a mature animal (Pl. VIII.). The glenoid cavity measures $3''{\cdot}25 \times 2''{\cdot}5$, which denotes a horse of considerable size.

4. Corresponding with the scapula is the entire proximal extremity of the right humerus (Pl. IX. fig. 1).

5. An entire left calcaneum (fig. 3).

6. The distal epiphysis of the left femur (Pl. IX. fig. 2). This portion of the femur appears to have been detached at the epiphysial junction before interment, as the entire surface was covered with a thick layer of ochreous crystalline deposit.

7. Besides the above, there are in the collection several portions of upper and lower jaws, and a few detached teeth. With the exception of one or two old and much-worn teeth of the permanent series and of large size, nearly all the specimens would appear to belong to young or immature animals. It is to be remarked that none of the equine remains exhibit any evidence of gnawing, or of human agency—although, from the circumstance that by far the greater part of the collection consists of the remains of young or quite immature individuals, one might be almost inclined to suppose that they were the relics of animals that had been used for food.

1. *Head.*

All the specimens described or referred to above are strongly mineralized, and, as has been already said, are in that respect in exactly the same condition as the bones of *Rhinoceros*, *Cervus*, *Ibex*, &c., which are indubitably fossil. There can be little doubt that the Horse was a member of the contemporary fauna.

In Genista Cave No. 2 a couple of distal phalanges were met with, which appear to

belong to the ass and its foal. But as their condition plainly shows that they belong to a very recent period, they do not come within the scope of this account[1].

Another equine specimen, also found in the east fissure, presents some very curious characters. It is the greater part of the horizontal ramus of the right mandible, containing five teeth in an uninterrupted series, but apparently in a very irregular mode of growth. The two anterior ones are first and second deciduous molars, with a level disk of wear, exhibiting the enamel-flexures clearly: but the teeth, so far as can be judged, are apparently as long as the true molars; for the second projects in a curious manner straight out of the alveolus to the height of rather more than two inches, without showing any indication of division into fangs, and it is very deeply sulcated on the dorsum or outer surface. Its enamel-flexures are shown in Pl. IX. fig. 4, plainly indicating that it, and the one in front of it of similar pattern, are truly deciduous teeth. The third tooth is in germ and just emerging from the alveolus; so that its pattern cannot be ascertained; the two hinder teeth, however, are distinctly permanent molars.

VIII. Rhinoceros.

The genus *Rhinoceros* is represented by a considerable number of specimens, which were procured at various depths in the Genista Cave and east fissure. Though some few are stated to have been met with in the dark-coloured cave-earth in which the human relics &c. occurred, yet as these specimens, as regards mineral condition (that is to say, infiltration with calcareous matter, and incrustation with the ferruginous crystalline stalagmitic deposit, &c.), differ in no respect from those which occurred at the greatest depths, and since there is every reason to believe that the bones found in the highest level formed part of the same skeleton as that to which some of the deeper ones belonged, it must be concluded that their presence in the black earth was in some way accidental.

The principal specimens to which it is needful to call attention may be arranged as belonging to:—I. Head; II. Trunk; III. Anterior extremity; IV. Posterior extremity.

I. Specimens belonging to the Head are:—

1. A right upper fourth premolar (pm. 4, d). Pl. X. figs. 1–3.
2. A right upper molar (m. 1, d). Pl. X. figs. 4, 5.

[1] In the excavation of the east fissure the entire skeleton of a Horse was met with, at a few feet only below the surface. In general condition the bones presented very much the same character as many of the fossil bones from a greater depth, and had been deprived of the greater part of the animal matter. At first Captain Brome thought he had come upon the remains of a fossil Horse; but, to his surprise, when the foot-bones were exhumed, the shoes with which the animal had been shod were found *in situ*; and it was ascertained that the bones, much altered as they were, had belonged to a favourite Arab charger, which had been buried at the spot about twenty-five years before. The instance is a very striking one, in showing the fallacious nature of evidence derived merely from the mineral condition of buried bones when exposed to free percolation of water in a calcareous bed.

3. A left upper molar (m. 1, s). Pl. X. figs. 6, 7.
4. A left upper second premolar (pm. 2, s). Pl. X. fig. 8.

II. To the Trunk:—

5. A nearly entire atlas. Pl. XVIII. figs. 1, 2.

III. To the Anterior Extremity:—

6. An entire naturally detached proximal epiphysis of the left humerus. Pl. XI. fig. 1.
7. The head and a considerable part of the shaft of the right humerus of a fully mature animal.
8. A fragment of the shaft of the opposite humerus, fully adult.
9. A nearly entire left radius. Pl. XIV. figs. 1, 2.
10. A perfect right os lunare. Pl. XV. figs. 4–8.
11. The distal extremity of the third metacarpal. Pl. XVII. figs. 6–8.
12–15. The distal extremities of four metacarpals differing somewhat in size.
16. A second phalanx. Pl. XVI. fig. 9.

IV. To the Hinder Extremity:—

17. The nearly entire head and upper portion of the shaft of the right femur. Pls. XII., XIII.
18. A detached right third trochanter, probably of the same femur.
19. A nearly perfect right tibia of an immature animal, with the epiphyses ununited. Pl. XIV. figs. 3, 4.
20. A crushed fragment of the middle of the shaft of a tibia.
21, 22. Two right astragali, one of which is figured in Pl. XV. figs. 1–3.
23, 24. An entire third right metatarsal with the proximal end of the corresponding fourth metatarsal in natural apposition. Pl. XVI. figs. 1–4.
25, 26. The proximal half, or nearly so, of another third right metatarsal, and the corresponding entire fourth metatarsal apparently fitting to it; the latter is figured in Pl. VII. figs. 1–5.

I. *Head.*

As most of the more important of these specimens are represented of the natural size in the Plates accompanying the paper, it will be unnecessary to enter at any length into detailed descriptions of them. For the diagnosis of the species, however, to which they belong, it will be requisite to notice more particularly those which may be regarded as affording the best characters. Amongst these are, in the first place, the teeth.

1. The most perfect is the right upper fourth premolar. (Pl. X. figs. 1–3.)

The tooth, which is very little worn, measures 1″·8 in the antero-posterior direction,

and 2″·2 in the transverse (1″·8 × 2″·2) taken at the base of the crown. The extreme height of the crown in its present state is 2″·5; and it probably never exceeded 2″·6 when quite unworn.

On the dorsal or outer surface the second, fourth, and fifth costæ are very prominent, the second, as usual, being the most so. The first or anterior costa is rounded off; and the third is faintly indicated, though distinct enough throughout the whole length of the crown; at the base there is a rather deep sulcus between the second and fourth costæ. The anterior vallum, "bourrelet," or "guard," which is well developed, is nearly horizontal when the tooth is held in its natural position. It terminates at the inner and anterior angle, and does not extend at all on the inner face of the anterior colline. The posterior vallum ("posterior collis," B. Dawk.) is deeply notched in the middle and without a median cusp. It is prolonged into a strongly developed ridge, or "bourrelet," which crosses the inner face of the posterior colline obliquely from above downwards, nearly to the base of the crown, and terminates in the median sulcus in a very minute cusp, as shown in fig. 2.

The collines are slender and tapering. The anterior valley is wide, and traversed by a strong crista (combing-plate), which arises from the angle of junction of the hinder colline with the dorsal lamina. The uncus ("crochet") is represented by a very thin projecting plate, which appears, in the deeper part of the valley, to meet the crista so as to circumscribe a small pit. The posterior valley is much expanded, and, owing to the depth and width of the notch in the posterior vallum, very open. A small posterior crista or "combing-plate" projects into this valley from the inner wall of the dorsal lamina.

The surface of the enamel, which is about 0″·06 thick where it is unworn, is marked with very fine parallel sulci, and, in parts, with equally delicate transverse rugæ.

2. The tooth represented in figs. 4 and 5 appears to be the first right upper molar. It is much more worn than the preceding; and, in addition to this, the posterior vallum is entirely broken away. It measures about 2″ in either direction; and what remains of the crown is about 2″ in height. The second dorsal costa is very prominent, whilst the others are represented only by low rounded elevations. The uncus ("crochet") comes off at a right angle with the hinder colline, and curves slightly outwards, reaching nearly across the anterior valley. In thickness and sculpture of the surface the enamel of this tooth corresponds with that of the premolar above described.

3. The tooth represented in figs. 6 and 7 appears to be the corresponding molar of the opposite side. It is more imperfect than the last; but from what remains of it its character would seem to be identically the same.

In both these teeth the posterior vallum is too much broken to afford any evidence either for against the existence of a median cusp.

4. The small molar represented in fig. 8 has lost nearly the whole of the dorsal lamina. From the dimensions of the remaining portion, however, it may be concluded

that it is a second premolar of the left side (pm. 2, s). That it is not a milk-molar is shown by the circumstance that the opening of the median sulcus does not extend nearly to the bottom of the crown. The existence of an oblique descending ridge on the inner face of the hinder colline seems clearly to indicate its relation with the pm. 4 d described above.

Besides these more perfect teeth, there is (1) a broken fragment of a much-worn upper molar of small size, which, so far as can be judged, probably belonged to the deciduous series; (2) a mere chip from the inner face of a small much-worn premolar.

Judging from the apparently different ages or states of wear of these teeth, it is highly probable that they must have belonged to at least two individuals, one of which was much older than the other.

With respect to the specific characters afforded by the teeth, it may be stated that they seem to correspond in every particular with Dr. Falconer's description of those of *Rhinoceros hemitœchus*, as will be seen on reference to his account of that species in 'Palæontological Memoirs,' vol. ii. Without going into needless detail, I may quote what he says on the distinctive characters of the premolars and molar teeth of this species [1].

He remarks that the premolars of *R. hemitœchus* may be characterized:—

1. By the absence of an internal basal "bourrelet;"
2. By there being only two fossettes in the worn crown;
3. By the middle valley being traversed by the processes of a bifid crochet emitted from the posterior barrel, and by a parallel combing-plate given off by the outer or longitudinal ridge;
4. By being invested like the true molars with a very thick coat of cement.

He proceeds to remark that the absence of a basal "bourrelet," besides other characters, distinguishes the premolars of *R. hemitœchus* from *R. leptorhinus* and *R. megarhinus*. Since *R. leptorhinus* of Cuvier is synonymous with *R. megarhinus* of Christol, and *R. leptorhinus* of Owen with *R. hemitœchus*, Falc., it is not quite clear what his meaning is in the expression just quoted. But, as partly explanatory of it, I may cite a note of his, made in the British Museum in June 1864, with reference to a tooth numbered 36770, which runs thus:—"A true right from Peckham, exactly in the same stage of wear of crochet and outer ridge as the Gibraltar molar; and the termination of the transverse valley, as in it, is a triangular fissure without complication. It has no basal 'bourrelet.' It is probably m. 1, like the Gibraltar tooth; and the two are of nearly the same size. It has no combing-plate." Dr. Falconer, in a side-note, says that this tooth "ought to be figured with the Gibraltar bone," thus marking emphatically, what I know was his opinion, that the two teeth were specifically identical; and his recommendation as to the giving of a figure of the Peckham tooth should have been obeyed, had the necessity for it not have been obviated by the

[1] *Op. cit.* p. 328, pls. xvi., xvii. &c.

publication of an excellent figure of the tooth in question by Professor Boyd Dawkins, in his paper on *R. leptorhinus* (*R. hemitœchus*)[1].

The above citation may suffice to show that in Dr. Falconer's opinion the Gibraltar tooth belonged to the same species as that figured by Prof. Boyd Dawkins, which is undoubtedly *R. hemitœchus*.

Again, with respect to the molars, Dr. Falconer observes (*op. cit.* p. 329) that the character which best distinguishes them from those of all other species lies in the peculiar form of the "crochet" or promontory, projected forwards from the posterior colline into the transverse valley. "In all species, fossil or recent," he says, "except *R. hemitœchus*, the 'crochet' forms a plate, which is emitted at a very open angle with the posterior colline, and directed more or less diagonally towards the anterior outer corner of the crown." Again (p. 331), "if the penultimate true molar in *R. hemitœchus* be examined, the crochet presents a thick massive body thrown straight forward, and forming an acute angle with the anterior margin of the posterior barrel. It is flat or concave above [externally] and convex below [internally], narrow at the base, and thickening to a blunt margin. In mass it bears a much larger proportion to the disc of the hind barrel than in most of the other species. In the corresponding molars of *R. megarhinus*, Christ. (pl. iii. fig. 5, of Christol's Mem., and pl. ii. fig. 5, Gervais's Paléontol. Franç.), besides the difference of alignment in its offset from the hind barrel the section of the crochet is wedge-shaped, thinning from a broad base to a sharp edge"[2].

But it is needless to say more with respect to the hemitœchine characters of the Gibraltar teeth, so far as Dr. Falconer's opinion respecting them is concerned. Besides the reference he himself gives to the specimen (B. M. No. 36770) figured by Prof. Boyd Dawkins, the exact correspondence between the figure of m. 2 of *R. hemitœchus* given in Paleontographical Memoirs, vol. ii. pl. xvi. fig. 1, with fig. 4, Pl. X. of this communication, cannot fail to satisfy us of the identity of the two forms, and of their distinction from that presented by *R. megarhinus*, Christ.

I have not thought it necessary to say any thing with respect to the points by which the Gibraltar teeth are distinguished from the corresponding ones in *R. tichorhinus*, the differences in all respects being too marked to require comment. Nor, having shown their apparent identity with those of *R. hemitœchus*, is it requisite to say much respecting their distinction from the molars of *R. etruscus*, which species would otherwise naturally have suggested itself as a very likely subject of comparison, nor respecting their relation to the teeth of *R. bicornis*, which, again, might have suggested itself as not unlikely to be found in company with *H. crocuta*.

As regards *R. etruscus*, the figures and descriptions of the Gibraltar teeth already

[1] Journal of the Geological Society, vol. xxiii. pl. x. fig. 5.

[2] I am inclined, from my own observations, to think that Dr. Falconer placed, perhaps, too much importance upon the characters afforded by the "crochet," which appear to be very variable.

given will be quite sufficient to show that they are *toto cælo* distinct; and the same may be said with respect to *R. bicornis*, and, I may add, to any other of the existing species with which I am acquainted.

2. *Trunk.*

The only bone belonging to this division of the skeleton, beyond a small fragment of a rib, in all probability rhinocerine, is the *atlas*, represented in Pl. XVIII. figs. 1 & 2.

The remains of this vertebra consist of nearly the entire left and a considerable portion of the right half of the bone.

When placed in their proper positions the two fragments have evidently formed parts of the same vertebra, which has been broken in the process of exhumation, or extraction from the hard stalagmite deposit in which it was imbedded. The bone is that of a mature animal. In its present condition it measures about 11″·0 in extreme breadth; and if it had any unossified epiphyses, it might, when entire, have measured perhaps 12″·0. The antero-posterior diameter of the transverse processes is about 4″, or a little more; and the extreme antero-posterior length of the bone, measured between the summits of the anterior and posterior articular processes, is about the same. The dorsal portion of the ring is absent; so that the configuration of that part, which would seem to differ a good deal in different species (at any rate it does so in *R. unicornis* and *R. bicornis*), cannot be ascertained. The posterior articular surfaces look obliquely inwards, their planes meeting at an angle of about 100° or 110°. The anterior articular cup, when the fragments were fixed in plaster of Paris in their proper position, fitted exactly upon the occipital condyles of a skull of *R. hemitœchus* in the British Museum. The only existing species with whose atlas I have had an opportunity of comparing the Gibraltar specimen are *R. unicornis* and *R. bicornis*, from both of which it differs so widely in many respects, that it appears to me needless to enter into any particular comparison.

I have not been able to compare the atlas with that of any fossil species; but Cuvier[1] notices and figures a fossil atlas of *Rhinoceros*, which was found in 1750 near Schartfels (Schwarzfels?), and first described by Hollman[2], which presents many characters in common with it, amongst which are:—(1) the comparatively small size, Hollman's specimen not being more than 13″·7 broad and about 5″·0 in the antero-posterior width of the transverse processes; (2) the incompleteness of the anterior arterial foramina, which in the Gibraltar bone are represented by wide notches; (3) the obliquity of the posterior articular surfaces, whose planes in Hollman's specimen, according to Cuvier, met at an angle of about 90°.

With respect to the last two particulars, Cuvier remarks that in a recent atlas (probably *R. unicornis*?) with which he instituted a comparison the arterial foramina were complete, and the posterior articular surfaces formed a right angle with the longitudinal plane of the bone.

[1] Ossemens Fossiles, ed. 4, t. iii. p. 143, pl. 46. figs. 6–8.

[2] Comment. Soc. Gotting. 1751, p. 251.

In the absence of other direct means of comparison, it is difficult to arrive at any positive determination; but, from the circumstance of the Gibraltar atlas fitting so exactly as it does upon the skull of *R. hemitœchus*, Falc., it is allowable to assume that it must have belonged to a species closely allied to, if not identical with that form.

3. *Anterior Extremity.*

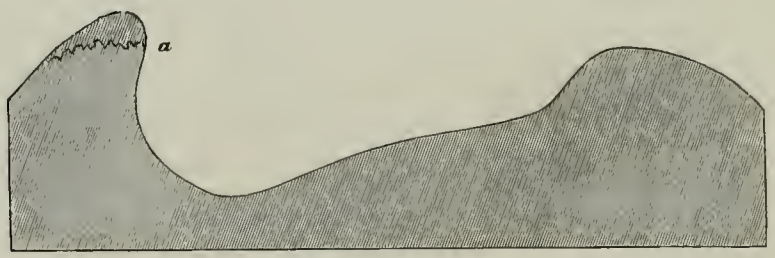
One of the best-marked specimens belonging to the anterior extremity is a perfect, naturally detached proximal epiphysis of the left humerus (Pl. XI. fig. 1). It includes the entire articular surface, the great tuberosity, and the occipital groove and ridges complete. The bone is dense and heavy, and is uniformly incrusted on all its surfaces with a thin layer of crystalline ferruginous stalagmite. The articular surface measures 4″·2 in the transverse, and about 5″·0 in the antero-posterior direction. The radius of the curve taken tranvsersely is about 2″·9, and in the antero-posterior direction about 2″·0. The occipital groove is three inches wide and about 1″·1 deep at the outer side.

I have not as yet met with the corresponding part of the humerus of any fossil form except that of *R. megarhinus* from Grays (No. 23111, British Museum), from which the Gibraltar specimen differs so widely, more especially in the form of the bicipital groove, that there can be no doubt of their specific distinction. I have also compared it with the same part in *R. bicornis* (*R. keitloa*), with the result that, as regards the form of the bicipital groove, it approaches that species more nearly than any other with which a comparison has been instituted. In order to illustrate the different and, as it seems to me, important characters that are afforded by the conformation of this groove in various species of *Rhinoceros*, I have subjoined ideal sections across it in

1. The Gibraltar *Rhinoceros*, fig. 2,
2. *R. megarhinus*, Grays, fig. 3,
3. *R. bicornis* (*R. keitloa*), fig. 4,

in all of which the letter (*a*) is placed on the outer side.

Fig. 2.

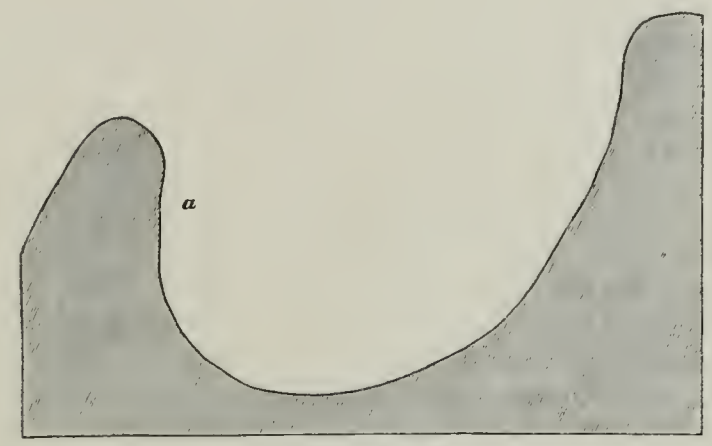


Rhinoceros of Gibraltar.

The specimen No. 7 consists of about the upper half of the left humerus of a fully mature, probably aged animal. It is unfortunately much mutilated, the bici-

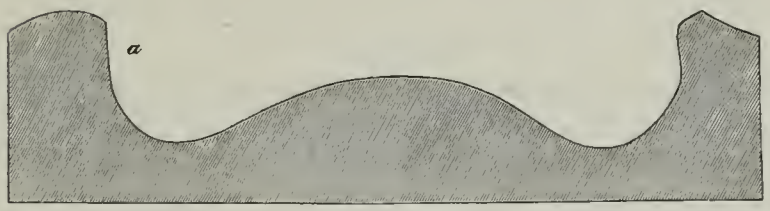
pital groove and ridges and the great tuberosity being lost. The part of the bone at which they were attached is crushed into numerous fragments, probably by the fall

Fig. 3.



Rhinoceros megarhinus.

Fig. 4.



Rhinoceros keitloa.

upon the bone of a heavy fragment of rock; the fragments, however, although much displaced, are solidly united by red calcareous stalagmite. The shaft is also broken across transversely about five inches below the summit of the articular head; and the two portions of the bone were found at a considerable distance apart. At the lower end the shaft is fractured very irregularly; but there is no appearance anywhere of the bone having been gnawed by the Hyena. There is a small incised mark close to the lower end; but this appears to be quite recent.

The fragment, as it is, is about 11 inches long; and the least circumference of the shaft, at the point where it is usually smallest, is about 8″·7. The proximal articular surface is very nearly entire. It measures about 4″·2 in the transverse, and about the same in the antero-posterior direction [1]. The radius of its curve is 2″·0.

The injured condition of the bone precludes the possibility of ascertaining very precisely any of its characters.

It may be remarked, however, in comparison with a humerus of *R. bicornis* (*R.*

[1] In *R. bicornis* the antero-posterior measure is 4″·6, and the transverse 3″·9 or 4″·0.

keitloa):—(1) that the two bones would appear to be of as nearly as possible the same size; (2) that on the anterior aspect of the shaft there is no appearance of the rounded bulging observable in the middle part of that aspect in the humerus of *R. bicornis*; (3) on the posterior aspect in *R. bicornis* there is a strongly marked semicircular ridge, or *linea aspera*, running upwards and inwards from the deltoid crest to the posterior border of the articular surface of the head, no trace of any thing like which is visible in the Gibraltar specimen; (4) the rough muscular impression on the inner side of the shaft is situated an inch lower down, and is larger in size in the Gibraltar bone.

With respect to *R. megarhinus*, comparison with a magnificent perfect specimen of the humerus of that species from Ilford (No. 23111, Brit. Mus.) shows that it was of larger size, or, at any rate, thicker, having a least circumference of 9″·9. But the articular surface of the head is of pretty nearly the same dimensions, viz. 5″·3 × 4″·2 in the antero-posterior and transverse directions. These dimensions, it should be remarked, are identical, or nearly so, with those of the detached epiphysis, and but very little different in the antero-posterior extent from those in the present specimen.

I have not as yet met with a humerus of the smaller Thames-valley species retaining the upper extremity. There is none, therefore, with which the present specimen could be compared, except as regards the least circumference of the shaft, which in *R. hemitœchus* is about 8″·8, or an inch less than in the larger species.

Another specimen is a small portion from about the middle of the shaft of a right humerus, and corresponding in all respects as to contour, condition, &c. with the same part in specimen No. 7, and doubtless belonging to the same individual. Like the bone just described, it appears to have been crushed and then recemented by calcareous infiltration.

Another important specimen is a nearly entire left radius, Pl. XIV. figs. 1, 2.

This bone is 15″·0 long; and the proximal end measures 2″·4 × 3″·8 in antero-posterior and transverse diameters, and the distal end 2″·6 × 3″·9, whilst the least circumference of the shaft (5 inches below the summit) is 5″·5. The perimetral index, therefore, of the bone is about ·360.

The principal, in fact the only difference of any importance between this radius and that of *R. hemitœchus* from Ilford, as represented in a perfect specimen of the latter in Sir Antonio Brady's magnificent collection, happily now in the British Museum (No. 45245), is that the former, with the same length, is rather the slenderer (in the proportion of 12 to 13), the least transverse diameter of the shaft being in it 1″·95 and in the Ilford specimen 2″·1. But the antero-posterior diameter is the same in both, viz. 1″·9. The least circumference in the Ilford specimen is 5″·7, and its length 14″·5, showing a perimetral index of ·393.

The proximal end of the Gibraltar bone measures 3″·75, and of the Ilford 3″·8. The distal end in the former is 2″·5 × 3″·9, whilst in the Ilford bone it measures 2″·6 × 4″·2. This difference, at first sight, is considerable, and might, justly perhaps, be regarded as

of importance, were it not explained by the circumstance that the lower end of the Ilford radius is diseased, presenting numerous large vascular openings and a general spongy condition, evidently due to what in surgical pathology would be termed chronic osteitis. This diseased condition is strongly manifested also in the radio-ulnar articular surface; and it is a curious circumstance that Sir Antonio Brady's collection of rhinocerine remains from the Ilford brickfields contains a right and a left tibia in precisely the same mineral condition, and corresponding in proportional size with the radius, one of which tibiæ is very extensively diseased at the distal end, exhibiting the consequences of chronic osteitis in a very advanced stage, being much enlarged and extremely spongy, whilst its fellow presents a similar disease at a less advanced degree. Bnt even in this bone the affection has advanced further than in the radius. It may therefore be fairly concluded that all these bones in the Ilford collection belonged to one and the same individual, and therefore that the enlarged condition of the distal extremity of the radius is abnormal. The shaft of the Gibraltar radius, besides its being a little slenderer than that of the other, is rather more curved in front, and the groove for the extensor tendons at the lower end is deeper and more pronounced than in the Ilford specimen. It is, however, well shown in the latter; and its depth is apparently diminished merely in consequence of the diseased condition of that end of the bone.

Now, as this extensor groove appears to be one of the most distinctive characteristics of the radius of *R. hemitœchus*, as compared with that of any other species, recent or fossil, with which I have had an opportunity of contrasting it, its existence and depth in the Gibraltar specimen appear to afford strong evidence in favour of that specimen belonging to the same species. On the dorsal aspect of the two bones I am unable to perceive any difference worthy of note, beyond the fact that all the muscular impressions are more strongly marked in the Ilford specimen. But this is a question of age or development; and in all other respects the bones appear to be identical.

The *os lunare* (Pl. XV. figs. 4–8) is absolutely perfect. In mineral condition it is extremely dense and heavy, and highly infiltrated with manganesic oxide. The only fossil bones with which I have been able to compare it are a right and left from Grays, Nos. 22038 and 22038 *b*, in the British Museum, and belonging in all probability to the same individual. These bones are considerably larger than the Gibraltar specimen, measuring:—

	Grays. in.	Gibraltar. in.
Length	2·95	2·6
Width	2·35	1·9
Antero-posterior diameter	2·3	2·1

The scaphoid facet (*a*, fig. 4) in the Gibraltar bone is 1″·8 long, and in that from Grays 2″·12; and the facet (*a*, fig. 6), which is triangular in the Gibraltar, is circular

in the Grays specimen. The *os lunare* from Grays, from its size, I should refer, at any rate provisionally, to the larger of the two species found there, viz. *R. leptorhinus* (*R. megarhinus*); but as I have not seen any specimen of the same bone belonging without doubt to *R. hemitœchus*, I can only employ the smaller dimensions of the Gibraltar bone as a doubtful argument in favour of its belonging to that species.

The other specimens appertaining to the anterior extremity are portions of five metacarpal bones. Unfortunately these are all fragments of the lower end of the bones only. They include the distal articulation, and in some nearly half of the shaft of two right second and two left second metacarpals, together with a similar fragment of the third right. To judge from their dimensions, these bones would appear to have belonged to two individuals, one considerably larger than the other; but, except in size, the corresponding bones do not appear to present any appreciable differences whatever. The following dimensions, giving the antero-posterior and transverse diameters of the distal articular end, will suffice to show their not inconsiderable difference in size:—

	in.
1. MC 2 (*d*)	15×14
2. MC 2 (*s*)	15×14
3. MC 2 (*d*)	17×15
4. MC 2 (*s*)	16×15
5. MC 3 (*d*)	17×19

In comparison with other species, it may be noted that the distal articular trochlea in *R. bicornis* (femur of same size) is 17×21, in *R. hemitœchus* (Ilford) (mean) 16×20, and in *R. megarhinus*, Grays, 2·1×2·5. These numbers afford additional evidence of the close similarity between the Gibraltar species and *R. hemitœchus*, and at the same time of its distinctness from *R. megarhinus*.

4. *Hinder Extremity.*

The only clearly recognizable specimens belonging to the femur are (1) a fragment consisting of about the upper third of the bone of the right side, and (2) a detached third trochanter, with a portion of the shaft from which it springs, and, without doubt, belonging to the same bone.

(1) The larger portion (Pls. XII. & XIII.) presents the head considerably abraded on the upper surface, the entire trochanter major and a portion of the shaft rather more than six inches long below the head; and on the inner border is the prominent trochanter minor, the lower point of which is at a distance of 5″·6 below the lower border of the articular head. On the anterior aspect (Pl. XII.) the bone is much excavated below the head and trochanter, which arches over it on the upper and outer part. A slightly elevated ridge runs directly downwards from the outer border of the arti-

cular surface, nearly in the middle. Besides this there are no particular marks. The posterior surface (Pl. XIII.) is very slightly excavated behind the trochanter major; and in that situation it is perforated by several large vascular foramina, and has a coarse reticulated sculpture, but no digital pit. Elsewhere it is smooth, and evenly and very slightly convex. The outer border of the bone, below the overhanging end of the trochanter major, is square or flattened, the flat surface about an inch below the projecting border of the trochanter being 1″·8 across; and the angles bounding it both before and behind are right angles, and both, but especially the anterior, quite sharp.

The articular head, which measures about 3″·4 in antero-posterior diameter, has lost its upper half, apparently by abrasion, the abraded surface being originally covered, like the rest of the bone, with a thick hard crystalline stalagmitic incrustation. The specimen was found broken into several fragments, some of which were met with at 11–14, and others at 26 feet below the stalagmite floor of the Genista cave. And it is memorable as being the first fossil bone discovered by Capt. Brome beneath the stalagmite. It is obvious, from its appearance, that the bone has been crushed.

(2) The detached third trochanter projects about 2″·6 from the border of the shaft, and is 2″·6 wide. It curves gently forwards. This fragment, incrusted all over with stalagmitic deposit, was found at a depth of 11 feet; but that it belongs to the same femur as the portion above described is manifest from its colour and condition, and also from the circumstance that it shows evidence of having suffered from the same crushing influence. As compared with the femur of *R. bicornis* of the same dimensions, the principal differences observable are:—

1. That the trochanter major stands out at a right angle, or nearly so, whilst in *R. bicornis* its upper border slopes gradually downwards.
2. That the onter border of the shaft below the trochanter major, in *R. bicornis*, slopes obliquely backwards, the anterior angle being very acute instead of rectangular.
3. That the raised ridge on the anterior surface is placed more internally.
4. That the third trochanter is more curved forwards.
5. That there is a deep circumscribed digital fossa behind the trochanter major.

With respect to the further determination of the species to which this interesting specimen should be referred, the only ones with which it is at all necessary to compare it are *R. hemitœchus* and *R. etruscus*.

I may mention that Dr. Falconer, who devoted much time and trouble to the comparison of the Gibraltar bone, was inclined to refer it to *R. etruscus*, considering it "the only one we cannot reconcile with the character of *R. leptorhinus*." He remarks that "the Gibraltar femur agrees so closely in form and proportions with a femur of [assigned to] *R. etruscus* presented to the national collection by Mr. Pentland, that had they been found in the same deposit they would have been referred without hesita-

tion to the same species. The correspondence holds in the contour of the articular head and large trochanter, and in the amount of uncination and expansion of the blade of the third trochanter, which yield distinctive characters of the femur in different species of *Rhinoceros*. The complete synostosis of the articular head, and strong tendinous ridges on the surface of the bone, prove that the Gibraltar femur is of an adult and even old animal. We have seen," he says, "no adult femur of *R. megarhinus* that would correspond with it in size."

The following Table shows the comparative dimensions of the Gibraltar bone and of *R. etruscus*, as taken by Dr. Falconer and myself, together with those of *R. hemitœchus* and *R. bicornis* &c.:—

Dimensions of Femur in various species of *Rhinoceros*.	Ap. d. of head.	Tr. d. of head and trochanter major.	Ap. d. of trochanter major.	Width of shaft 5 ins. below head.	Ap. d. of shaft at same point.	Width of third trochanter.
Gibraltar femur	3·3	7·4	3·2	4·3	2·5	2·7
R. etruscus, B.M.	3·5	7·9	3·1	4·8	1·7	3·0
R. bicornis (*R. keitloa*)	3·3	7·4	3·2	3·5	1·7	2·8
„ „ Saffron Walden	4·0	7·9				
R. hemitœchus (Brady)	3·6					

At the time when this study of the Gibraltar femur was made by Dr. Falconer and myself we were unable to find a fossil specimen that came so near to it in size and general characters as the femur of *R. etruscus* above referred to; but since then the specimens of the smaller Thames-valley femur in Sir A. Brady's collection afford sufficient ground for considering it not at all improbable that it may belong to the same species, or one closely allied to it. It may also be remarked that, if the proportions between the femur and humerus were the same in the extinct form as they are in the existing *R. bicornis*, the diameter of the articular head in the Gibraltar bone quite accords with that of the head of the adult humerus already described. They may therefore be safely regarded as belonging to the same species, and, as I should suppose from their both being crushed in the same way, in all probability to the same animal, which all the other evidence seems to show was undistinguishable from *R. hemitœchus*.

A third specimen is a nearly entire tibia, represented in Plate XIV. fig. 4.

This bone was found broken into numerous fragments, several of which were met with many feet apart; but I have been able to put them together in such a manner as to give a very fair representation of the bone in its entirety. It belongs to an immature animal, as both the proximal and distal epiphyses are naturally detached. It has therefore probably not reached its full size. Dr. Falconer and I compared it with

numerous fossil tibiæ in the British Museum, and especially with one from the Thames valley (No. 21884), termed *R. leptorhinus*, Owen. With this the Gibraltar bone agrees very closely in size, form, proportions, section of shaft, and contours of articular surfaces, whilst in all these respects it differs greatly from both *Rhinoceros etruscus* and *R. tichorhinus*. The tibia of the former, a Val-d'Arno specimen (No. 28805), while quite as long, is much slenderer in the shaft, with smaller articular surfaces; whilst in *R. tichorhinus* the tibia is thicker, shorter, and more massive in all its proportions.

The principal dimensions of the Gibraltar and Thames-valley specimens, together with those of the Val-d'Arno tibia are as under:—

Dimensions of Tibia in *Rhinoceros*.	Length.	Ap. d. and tr. d. of proximal end.	Ap. d. and tr. d. of distal end.	Least circumference.	Perimetral index.
Gibraltar specimen	15·0	5·1 × 4·9	3·0 × 3·8	·70	·466
Ilford. Brady's collection	14·6	5·2 × 4·9	3·0 × 3·7	·69	·472
Ditto ditto	15·5	× 5·1	× 3·7		
No. 21884, B.M.	14·5	5·1 × 4·8	2·7 × 3·9		
R. etruscus, Val d'Arno. No. 28805	14·1	4·3 × 3·8	2·4 × 3·4	6·2	·439
R. tichorhinus (Wirksworth)	15·9				
R. incisivus (Santan)	15·1	4·6 × 4·4	2·5 × 3·7	6·2	·410
R. unicornis	14·5	5·5 × 5·5	3·3 × 4·3	7·5	·517

From these figures will be seen the close correspondence, except perhaps in length, between the three Thames-valley specimens and that from Gibraltar, and the distinction between them and the Etruscan form.

5. *Astragalus.*

Of this important bone, the collection contains two specimens in excellent preservation; one, in fact, is quite perfect (Pl. XV. fig. 3), and the other very nearly so. They are both of the right side, and, as regards mineral condition and in all other respects, precisely alike. The more perfect one was found cemented into the same mass of breccia as the distal epiphysis of the tibia above described, into which, when cleaned, it fits exactly. There can be no doubt, therefore, that it belongs to the same individual.

The second astragalus was found in a different situation, viz. at 21 feet in the black earth of the Genista cave, or at the same level very nearly as a metatarsal bone to be presently described. But as all the rhinocerine bones are in the same state of mineralization, they all doubtless belong to the same period.

The principal dimensions of these astragali are given in the subjoined Table, together with those of the same bone in some other extinct and recent species:—

Dimensions of astragalus in *Rhinoceros*.	Extreme length.	Length at middle of trochlea.	Breadth of trochlear portion.	Width of trochlea between summits of ridges.	Length and height of inner side of bone.	Length and height of outer side.	Width and height of scapho-cuboid facet.
Gibraltar, No. 1	3·20	2·70	3·10	2·30	3·1 × 2·1	2·5 × 1·6	2·7 × 1·6
„ No. 2	3·20	2·65	3·15	2·37	× 2·1	× 1·6	2·7 × 1·7
R. hemitœchus, Ilford, No. 22010, B.M.	3·20	2·50	3·00	2·37	× 2·3	× 1·6	× 1·7
„ „ No. 20815, B.M.	3·20	..	3·30	..	× 2·35	× 1·7	
„ *megarhinus*, Grays, No. 21617, B.M.	3·65	2·9	3·60	3·00	× 2·5	× 1·9	3·4 × 2·6
„ „ No. 21278	3·50	..	3·50	..	× 2·5	× 1·7	3·3 × 2·1
„ *etruscus*, B.M.	2·95	..	2·90	..	× 2·0	× 1·5	2·8 × 1·7
„ „ Malaga	3·00	2·5	3.00	2·25	× 2·0	× 1·6	2·6 ×
„ *tichorhinus*, Brixham collection	2·90	2·5	3·1	2·5	2·9 × 2·0	....	2·9 × 1·9
„ *bicornis* (*R. keitloa*)	2·70	2·5	3·15	2·5	2·7 × 2·2	2·5 × 1·65	2·8 × 1·8
„ „ Saffron Waldron	2·70	..	3·1	..	....	....	2·9 × 1·9

The mere inspection of the figures in these columns will show how very closely the Gibraltar bones correspond in size and proportions with that of *R. hemitœchus*, or the smaller of the Thames-valley species, and at the same time how widely in the main they differ from any other of the species noticed. Had all the other characters been equally in accordance, there would have been no occasion for any further comparison; but since, notwithstanding the remarkable resemblance in dimensions, the Gibraltar astragalus offers some characters by which it would appear to differ not inconsiderably from either *R. hemitœchus* or *R. megarhinus* (the only two with which it is at all worth while to bring it into comparison), it will be necessary to add a few remarks. The astragalus of *R. megarhinus*, besides its much larger size, is distinguished from that of *R. hemitœchus* (from the Thames valley) by several peculiarities.

1. The anterior or scapho-cuboid facet is more convex, and the proportional widths transversely of the scaphoid and the cuboid segments different, the former being to the latter as 1·000 to ·405, whilst in *R. hemitœchus* the proportion is as 1·000 to ·437.

2. In *R. megarhinus* the outer calcaneal facet extends, with an even outline, quite to the posterior and outer edge of the bone, whilst in *R. hemitœchus* the posterior border of the facet is sinuous, a rough surface for the attachment of a strong ligament being left between the margin of the facet and the postero-external border.

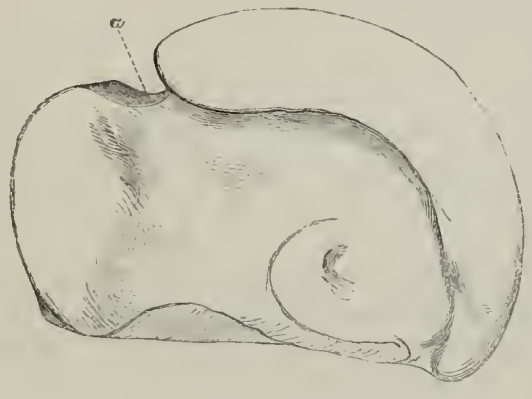
3. In the astragalus of *R. megarhinus* the outer ridge of the trochlea is more rounded or thicker than in *R. hemitœchus*.

4. In *R. hemitœchus* the crescentic internal malleolar facet is continued close up to the anterior border of the bone; and there is little or no constriction between its anterior termination and the scaphoid facet, whilst in *R. megarhinus* the crescentic facet terminates at a distance of nearly an inch behind the border of the bone; and, corresponding with this, the upper arched border of the facet measured along the arc

in *R. megarhinus* is 4″·2, whilst in the far smaller astragalus of *R. hemitœchus* the corresponding arc measures 4″·4.

The Gibraltar astragalus agrees with that of *R. hemitœchus* (1) almost exactly in size and proportions, (2) in the comparative flatness of the scapho-cuboid facet; and with that of *R. megarhinus* it agrees (1) in the form of the external calcaneal facet (vide Pl. XV. fig. 2), (2) in the termination of the crescentic internal malleolar facet at some distance behind the anterior border, as shown in the accompanying woodcut. But it differs from both in the greater proportional width of the cuboid

Fig. 5.



Astragalus of *Rhinoceros* from Gibraltar.

facet, which stands to that of the scaphoid as 660 to 1000, and in having a marked constriction (*a* in woodcut) in front of the anterior termination of the crescentic facet, in which respect, though to a much less extent, it bears some resemblance to *R. tichorhinus*, though differing very widely in all others. It does not appear necessary to consider the relations of the Gibraltar bone with the astragalus of *R. etruscus*, nor with that of *R. bicornis*, its difference from both being too obvious to require comment.

6. *Metatarsus.*

The bones belonging to this part of the skeleton are:—two right third metatarsals, one entire, and the other represented by the proximal half; and two right fourth metatarsals, one of which also is entire, and of the other only the proximal half remains.

The entire third and the broken fourth metatarsals fit so exactly to each other, and correspond so precisely in colour and condition generally, that there can be no doubt of their belonging to one and the same individual. The entire fourth metatarsal, and the broken third do not fit very exactly; but this may arise in part perhaps from the circumstance that the third is a good deal worn. The bones, however, differ somewhat in colour, and were apparently found a good way apart; so that the presumption would appear to be in favour of their belonging to distinct individuals.

As it was found in the dark cave-earth above the stalagmite floor of the Genista cave, in which one of the astragali was also discovered, it may be probable that the entire fourth metatarsal belonged to the same foot with that bone, although the depths at which they occurred were about 7 feet apart.

1. The entire third metatarsal (Pl. XVI. figs. 1–5) is 6″·7 long; the proximal end measures 1″·6×1″·9, and the distal the same. The transverse diameter of the shaft at the middle is 1″·8, and at the smallest part 1″·6; the least circumference is 4″·2, and the perimetral index ·626. The corresponding dimensions in a perfect third metatarsal in the Brady collection (of which an outline figure is given in Pl. XI. fig. 2) are almost identically the same—viz. length 6″·7, proximal end 1″·7×1″·9, and the distal 1″·6×1″·9. The width of the shaft at the middle is 1″·8, and at the smallest part 1″·6, the least circumference 4″·3, and the perimetral index ·642. Nor do the bones present any appreciable difference whatever in conformation.

The corresponding measurements in *R. megarhinus*, No. 19842, B. M., from Grays, are—length 8″·0, proximal end 2″·5×—?, distal 1″·9×2″·8, transverse diameter of shaft at middle 2″·3, and at the smallest part 2″·1, the least circumference 5″·2, and perimetral index ·650.

The following Table shows the relative dimensions of the third metatarsal in other instances of fossil and recent *Rhinoceros*; but the above will suffice to show the close resemblance between the Gibraltar metatarsal and that of *R. hemitœchus*, and at the same time its divergence from the megarhine type:—

Dimensions of third metatarsal in various species of *Rhinoceros*.	Length.	Ap. d. and tr. d. of proximal end.	Ap. d. and tr. d. of distal end.	Ap. d. and tr. d. of shaft at middle.	Least circumference.	Perimetral index.	Proportional tr. d. of shaft to ap. d. as 100.
Gibraltar, sp.	6·6	1·6 ×1·9	1·55×1·9	·8 ×1·75	4·2	·636	·218
R. hemitœchus, Ilford, No. 20245, B.M.	6·8	1·6 ×2·2	×2·0	·85×1·8	4·4	·647	·211
,, ,, Grays, No. 20267, B.M.	6·4	1·7 ×1·9	1·6 ×1·9	·8 ×1·6	3·9	·609	·200
,, ,, Sir A. Brady's collection	6·7	1·6 ×1·9	1·55×1·9	·9 ×1·8	4·2	·621	·200
,, ,, ,, ,,	6·3	1·6 ×1·9	1·4 ×1·8				
,, *megarhinus*, Grays, No. 19842, B.M.	8·0	×2·5	1·9 ×2·3	·9 ×2·1	5·2	·650	·233
,, ,, No. 23761, *g.* B.M.	7·75	1·9 ×2·4	1·85×2·3	·9 ×2·0	5·0	·657	·222
,, *tichorhinus*, Kent's Cavern	6·6	1·75×2·2	×2·2	1·0×2·0	5·0	·757	·200
,, *etruscus*, Val d'Arno, No. 28808, B.M.	6·85	1·8 ×2·0	1·5 ×1·7	·9 ×1·6	3·9	·567	·180
,, *incisivus*, No. 29646, B.M.	6·2	1·7 ×2·0	1·8 ×2·0	·9 ×1·6	4·1	·668	·180
,, *bicornis* (*R. keitloa*)	5·9	1·6 ×1·9	1·5 ×1·9	·8 ×1·65	4·2	·712	·206
,, *sumatrensis*, R.C.S.	6·3	×2·0	×2·0				
,, *unicornis*, R.C.S.	7·9	2·2 ×2·5	1·9 ×2·8	2·2×2·5			

2. The fourth metatarsal, represented in Pl. XVII. (figs. 1–5), is quite perfect, and of a fully mature animal, inasmuch as there is no trace whatever of the epiphysial suture.

The bone is 6″·2 long, the proximal end 1″·6×1″·75, the distal 1″·6×1″·4 the least circumference of the shaft 3″·4, and the perimetral index ·548. In the same bone from Ilford, No. 20816, B.M., the corresponding numbers are 6″·0, 1″·6×1″·5, 1″·8×1″·8, 3″·4, and ·566.

Taking this specimen as the type of the fourth metatarsal in *R. hemitœchus*, it would, so far as the above dimensions go, appear to be more robust in the shaft, and to have a thicker distal extremity than the Gibraltar specimen. Subjoined is a Table showing the relative dimensions of the bone in other species:—

Dimensions of the fourth metatarsal in *Rhinoceros*.	Length.	Proximal end.	Distal end.	Least circumference.	Perimetral index.
Gibraltar specimen	6·2	1·6×1·75	1·6×1·4	3·4	·548
R. hemitœchus, Grays, No. 20816	6·0	1·6×1·5	1·8×1·8	3·4	·566
R. bicornis (*R. keitloa*)	5·6	1·6×1·6	1·3×1·3	3·1	·553

From the foregoing account of the Rhinocerine remains it may be concluded:—

1. That they belong to at least three individuals, varying somewhat in size and, more particularly, in age.

2. That notwithstanding these differences, there is no reason for supposing that they represent more than one species, which was of about the same stature as, though somewhat slenderer in the extremities than the existing *R. bicornis*.

3. That in the dental and most of the osteological characters the Gibraltar *Rhinoceros*, if not identical with, more closely resembled the smaller of the two Thames-valley species (*R. hemitœchus*[1], Falc., *R. leptorhinus*, Owen, *R. merckii*, Lartet) than any other known extinct or recent form.

[1] With respect to the proper appellation of the smaller Thames-valley *Rhinoceros*, which was regarded by Dr. Falconer as identical with the species first distinguished by him in the Gower Caves and elsewhere under the name of *R. hemitœchus*, and also with that previously described by Prof. Owen from Clacton, notwithstanding all that has been written, some difference of opinion may well be entertained. Although in this account of the Gibraltar *Rhinoceros* I have employed the familiar term proposed by Dr. Falconer, I am by no means sure that it would not be better to retain the name given to the Clacton species by Prof Owen. It is quite true that *R. leptorhinus*, Owen, is not *R. leptorhinus* of Cuvier, which, though it appears to have included *R. megarhinus*, Christol, and *R. etruscus*, Falc., does not seem to have embraced *R. hemitœchus*; but, for the reason that Cuvier's term is of uncertain application, has been pretty generally superseded by *R. megarhinus*, and that the

4. That, although in general the osteological characters are nearly identical with those of *R. hemitœchus*, there are some differences, more especially in the astragalus, which it appears difficult to account for.

5. That, whether identical or not with *R. hemitœchus*, it cannot possibly be referred to *R. megarhinus*, Christol, *R. etruscus*, Falc., or *R. bicornis*, the only other species about which there could be any question.

IX. Cervus.

Cervine remains abound in the breccia of Gibraltar. The predominance of ruminants was observed by John Hunter[1] in such of the specimens as were examined by him; and among the few which passed under his hand Cuvier identified two species of *Cervus*—one resembling the Fallow Deer, the other a larger form, which he regarded as being unknown in the existing European fauna[2].

Some of the paleontologists who have described the contents of the Bone-caves of the south of France have extravagantly multiplied the species of extinct Deer upon the most trifling grounds. Amongst these M. Marcel de Serres was preeminent; of the cervine remains occurring in the caves of Lunel-Viel and Bize he has contrived to distinguish no less than ten extinct forms, to eight of which he gave specific names that merely serve to cumber the records of paleontology, since the majority of them appear to belong merely to varieties of the common or the Barbary Stag, or the Reindeer[3].

The Genista cave and fissure have yielded a considerable number of cervine bones derived from nearly all parts of the skeleton. But of the antlers there are only a few

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name of *leptorhinus*, Ow., has gained very extensive adoption, is employed in the British Museum, and has, moreover, been accepted, as I conceive, with fair reason, by Prof. Boyd Dawkins (Quart. Journ. Geol. Soc. xxiii. 1867, p. 217), it seems to me that it would be convenient and proper if palæontologists could agree upon its definitive adoption. A further reason might also now be given for the rejection of Dr. Falconer's appellation, in the circumstance that it is anatomically incorrect, since it has been fully shown by Mr. W. Davies, in his excellent description of the Brady Collection (Catalogue of Pleistocene Vertebrata from the neighbourhood of Ilford, 1874, p. 30), that the smaller *Rhinoceros* of the Thames-valley had in all probability as complete an osseous septum as *R. tichorhinus* itself.

Nowithstanding my great respect, or even veneration, for any opinion of the lamented M. Lartet, I am unable to accept *R. merckii*, Kaup, as the equivalent of *R. hemitœchus*, seeing, if for no other reason, that the typical specimens of the teeth of *R. merckii* procured from Dr. Kaup himself are in the British Museum, and are indisputably those of *R. megarhinus*, Christol. Dr. Kaup, in fact, must have confounded more than one species under the term *R. merckii*.

[1] Phil. Trans. 1794, p. 408.

[2] *L. c.* vol. iv. p. 173.

[3] 'Cavernes de Lunel-Viel,' 1839, p. 173; and 'Cavernes de l'Aude,' 1839, p. 103.

imperfect fragments. These bones occurred mostly at considerable depths, and they are in the same state of fossilization as the bones of *Rhinoceros*; whilst others, which were found in the upper part of the cavern, exhibit comparatively modern characters, and were probably contemporaneous with man. But no distinction otherwise can be perceived between the more ancient and the comparatively recent bones. The species, therefore, would seem to have enjoyed a continued existence on the Rock from the earliest times to the present epoch.

It would be tedious and superfluous to particularize all the specimens belonging to this *Cervus*, which is probably the larger one mentioned by Cuvier; but amongst them may be noticed the following:—

1. *Cranium.*

Of this part of the skeleton there are two fragments which afford good characters.

The larger of these specimens exhibits the greater part of the skull from the occiput to the anterior border of the frontal, including a portion of the right orbit. From the absence of any indications of an antler it may be regarded as belonging to a female; and it corresponds very clearly in form with the skull of a female *Cervus elaphus* with which it was compared, and with that of a Barbary Deer. The following dimensions are given in proof of this:—

	Gibraltar skull.	*C. elaphus* ♀.	*C. barbarus* ♂.
	inches.	inches.	inches.
Width at temporal ridge above auditory foramen	4·2	4·1	3·9
Length of skull from occipital crest to coronal suture.....	3·1	2·9	2·7
Greatest width of skull (parietal)	3·75	3·5	3·3

2. *Vertebræ.*

Although numerous vertebræ may be perceived disseminated through the breccia, from which it is almost impossible to extract them, very few have been procured in such a condition as to admit of accurate determination.

One, an *axis*, is represented in Plate XV. fig. 2. Its length is about 4″, and width 2″, at the anterior or atlanteal articulation. It presents, as will be obvious, all the characters of the same bone in *C. elaphus* of rather small size, and probably of the variety *C. barbarus*.

3. *Sacrum.*

The upper portion of a sacrum measures 4″·8 in transverse diameter at the base; and the articular surface of the centrum measures 2″·0 × 0″·9. This specimen occurred at a depth of thirty feet below the stalagmite floor of the cave; and it is heavy, dense, and

thoroughly fossilized. A second sacrum, of rather smaller size, but in the same condition, was found about two feet lower.

Of other parts of the pelvis all I have been able to make out are—portions of the right and left ischia, forming parts of the same skeleton, and a portion of the right os innominatum with the acetabulum complete. The diameter of the acetabulum (slightly worn down) is 1″·6.

4. *Scapula.*

Of this bone there are about eight specimens, all of which, except one, are broken so much in the same manner that it seems highly probable that they represent the remains left by a Dog or Fox.

The remaining portion in every case includes the glenoid cavity, sometimes with and sometimes without the coracoid tuberosity. In two instances (one of which is figured in Pl. XXI. fig. 5) a portion of the spine is left; but in most that process is broken off entirely. The size of the glenoid cavity varies in its longest diameter from 1″·6 to 1″·4. But the radius of the curve of the hollow only varies from 1″·0 to 0″·9, so that even the smaller might have sufficed for the reception of a head of the humerus not so much less than the others as might be supposed.

In a specimen of *C. elaphus* (689 *a*, B.M.) the longest diameter of the glenoid fossa is 1″·5, and in *C. barbarus* (No. 1043 *a*) 1″·4; so that the Gibraltar specimens are so far clearly within the limits of the same species.

5. *Humerus.*

The specimens of this bone, all fragmentary, are about six or seven in number. The antero-posterior diameter of the head is in two cases about 2″·7, whilst the distal articular extremity measures about 2″·0 × 2″·2. The least circumference of the shaft is in one case 3″·9, and in another 3″·4.

In *Cervus elaphus* (689 *n*, B.M.) the antero-posterior diameter of the head is 2″·9, and the distal end measures 2″·0 × 1″·9, and the least circumference of the shaft 3″·2.

In the specimen of *C. barbarus* (1043 *a*, B.M.) the length of the head is 2″·8, the size of the distal extremity 1″·7 × 1″·7, and the circumference of the shaft 3″·0.

6. *Radius.*

An entire radius, which exactly fits one of the humeri, is represented in Pl. XXI. fig. 3. It measures 10″·2 in length, the proximal end 2″·0 × 1″·0, and the distal 1″·3 × 1″·6; the least circumference of the shaft is 3″·0, and the perimetral index ·284.

A second specimen consists of only the proximal portion, 4″·0 long, of the left radius. The proximal articular end measures 1″·1 × 2″·1. The bone is sun-cracked, very dense and heavy, and it also fits to one of the humeri.

In the specimen of *C. elaphus* taken for comparison (above cited) the radius measures

10″·7 in length, the proximal end 1″×2″·9, and the distal 1″·0×1″·5, the least circumference of the shaft is 3″·0, and the perimetral index is ·280. In *C. barbarus* the length of the radius is 9″·2, the proximal end measures 0″·9×1″·8, and the distal 1″·2×1″·55, the least circumference of the shaft 2″·8, and the perimetral index ·304.

It is needless to point out the close similarity in the proportions of these bones.

7. *Metacarpal.*

Of the metacarpal several specimens occur, but none entire.

1. The lower half of the left metacarpal, about 4″·6 long, in which the distal articular end measures 1″·1×1″·6, and the least circumference is 2″·9.

2. A proximal portion, not improbably belonging to the same bone; the length of the fragment is about 3″·6, and the proximal extremity measures 1″·2×1″·6. To this metacarpal is attached the entire set of carpal bones, somewhat crushed and dislocated, but remaining in connexion with the corresponding radius.

3. In another specimen the proximal articular end measures 1″·2×1″·5.

4. We have the right and left metacarpals of a young Deer, the epiphyses being detached in both. The more perfect measures as it is (that is to say, from the summit to the epiphysial surface) 8″·2; the proximal end is 1″·0×1″·4, and the least circumference is 2″·6. If an inch be added for the epiphysis, the entire length of the bone would be about 9″·2, and the perimetral index ·283. These specimens, which were found at the depths of 20 and 30 feet in the black mould, must probably be referred to the human period. One is coated with a thin film of stalagmite; but the other is not; and neither of them is sun-cracked.

In the *C. elaphus* above cited the metacarpal is 9″·4 long, the proximal end measures 1″·0×1″·4, the least circumference 2″·3, and perimetral index is ·244. In *C. barbarus* the length of the metacarpal is 8″·4, the proximal extremity 1″·0×1″·4, the distal 0″·9 ×1″·4, the least circumference of the shaft 2″·1, and the perimetral index ·250.

These figures are sufficient to show that the Gibraltar metacarpals, like the other bones, accord very closely with those of *C. elaphus*, the only difference worthy of note being, perhaps, that they are a little thicker.

8. *Femur.*

The only distinctly recognizable specimens of this bone are:—

1. Two fragments of the upper end, one exhibiting the head and great trochanter entire; in the other the greater part of the latter process is wanting. One of the bones is of a larger form than the other; in it the proximal end (including head and trochanter) measures 1″·3×2″·2, the former number denoting the diameter of the articular head itself.

In the smaller specimen, which is nevertheless quite mature, the diameter of the head is 1″·2. In the strongly pronounced pyriform shape of the head and its size, in

the form of the trochanter and of the digital fossa behind it, these bones correspond exactly with the femur of *C. elaphus*, in which the diameter of the head is 1″·2; in *C. barbarus* 1″·1. Although found at a considerable depth in the Genista fissure, these two specimens, from their light porous condition and the complete absence of stalagmitic deposit, cannot be supposed to belong to the most ancient fauna, and are probably referrible to the human period. Not so with the few other remains of the femur, which consist of—

2. Three portions of the shaft, between five and six inches long, and all with a least circumference of between 3″·2 and 3″·4. That they are cervine, and do not belong to the gigantic form of *Ibex* met with in the breccia, is proved by the great extent and depth of the pit behind the inner condyle and the strong development of the linea aspera. The only other two specimens consist of the distal end, with the articular portion complete. The dimensions of this end in one case are 3″·5×2″·7, and in the other 3″·3×2″·4. In *C. elaphus* the corresponding dimensions are 3″·3×2″·5, and in *C. barbarus* 3″·1×2″·2.

All these specimens are thoroughly fossilized, and they were thickly incrusted with hard ferruginous stalagmite.

9. *Tibia.*

Portions of fourteen or fifteen tibiæ are preserved—some extracted from the hard breccia, others more or less free, but all coated to some extent with crystalline stalagmite. Six of the specimens consist of merely the shafts, without either articular end. One has the distal epiphysis detached; and, from the general character of the bone, it would appear to have belonged to the same animal as two of the metacarpals above described, to which also may perhaps be assigned a metatarsal of the same age and in the same condition. The least circumference of these shafts varies from 3″·5 to 2″·7, the younger-looking bones being, of course, the slenderer.

There are two fragments of the proximal end, in one of which the epiphysis has been detached, and the surface is covered with thick incrustation; in the other instance the proximal articular surface is entire, and measures 2″·7×2″·7.

Several examples of distal portions, with the trochlea, give the full characters of that part. As is the case with the other bones, these specimens, as regards the articular end, vary in size from 1″·3×1″·5 to 1″·5×1″·9, the intermediate forms being 1″·3×1″·8 and 1″·4×1″·9. Into the smallest of these specimens the astragalus of a Highland Stag fits so exactly that both might well have belonged to the same individual.

It is impossible to distinguish any of them from the tibia of *C. elaphus*. But besides the above there are two proximal fragments with the articular surface entire, which measures only 2″·1×2″·5, and which would seem to be referrible to *C. barbarus*, in which the surface in question measures 2″·4×2″·5. Both of these specimens are in the same mineral condition as the rest, although one is said to have been found above the stalagmite floor of Genista Cave, and the other at a considerable depth in the East Fissure.

10. *Metatarsal.*

The metatarsal is represented by two very perfect specimens, although one of them is without the epiphysis, in this respect corresponding with the two metacarpals above described; and all these bones doubtless belong to the same individual. The entire bone is 10″·3 long, the proximal end 1″·5 × 1″·3, the distal 1″·0 × 1″·45, the least circumference 2″·9, and the perimetral index ·281. In the *C. elaphus* taken for comparison the metatarsal affords the following measurements—length 10″·7, proximal end 1″·4 × 1″·2, distal end 1″·0 × 1″·5, least circumference 2″·4, and perimetral index ·223. It is thus considerably slenderer and longer than the Gibraltar bone; but in other respects they are very nearly alike. In *C. barbarus* the length of the metatarsal is 9″·25, proximal end 1″·3 × 1″·2, distal 0″·9 × 1″·4, least circumference 2″·1, perimetral index ·237; so that the Gibraltar metatarsal must be regarded as very robust.

The younger bone, if it had the epiphysis, would be about 10″·1 long, or nearly as long as the mature one; its proximal end measures 1″·3 × 1″·2, the least circumference 2″·5, and perimetral index ·249, showing still a considerable preponderance in thickness (even in this young bone) over the *C. elaphus* and *C. barbarus* with which comparison was made; but in a specimen of the metatarsal of *C. elaphus* from the peat in Lancashire the proportions are still more robust than in the Gibraltar bone.

11. *Astragalus.*

About twelve specimens of the astragalus occur, ten of which have been disengaged from the breccia and are more or less coated with stalagmite, whilst two seem to belong to the recent period. The latter are rather smaller than the others, according exactly in size with the astragalus of a Highland Deer; whilst the rest are of somewhat larger size, but with the samep roportions and form; so that there can be no doubt of their all belonging to one and the same species, the more ancient being, like the corresponding metatarsal, of larger size than the more recent.

12. *Calcaneum.*

Only two specimens of this bone are preserved, which accord with the larger astragali, and exactly resemble the same bone in *C. elaphus*.

13. *Phalanges.*

There are also several phalanges, including the ungual of the fore and hind feet, which agree in all respects with those of *C. elaphus*.

14. *Antlers.*

The only disengaged specimen of deer's antler shows the naturally detached base and burr, about $2\frac{1}{4}$ inches in diameter, with a brow-antler coming off immediately above the

burr, and slightly ascending for about four inches, where it is broken off. So far as can be judged from such a fragment, it resembles that of *C. elaphus* of the same dimensions.

15. *Jaws and Dentition.*

The number of detached teeth and more or less fragmentary jaws of the large *Cervus* collected in the Genista Cave and East Fissure was very great; but it is remarkable that a very small proportion of them belong to the upper jaw. My study of the teeth, therefore, has been mostly directed to those of the mandible.

As in all large collections of similar remains, specimens from animals varying a good deal in size occur. Instances of this are shown in Pl. XXI. figs. 1 & 2. But upon a survey of the entire collection it becomes obvious that no definite distinction, even as to size, can be traced; whilst in all other respects the close similarity of the jaws and teeth proves that they all belong to one and the same species, the differences being due in all probability solely to age, sex, or individual peculiarity, Although the smaller form is perhaps more abundant in the upper or more recent deposits above the stalagmite floor, and belonging, it may be assumed, to the human period, nevertheless even amongst the specimens from this situation are several of quite as large size as, and otherwise identical with those from the deepest recesses of the Genista fissure.

The remains indicate animals of all ages, from that at which the third milk-molar is retained, up to extreme old age, when the teeth are worn down to mere stumps.

In dimensions, proportions, and sculpture the teeth are identical with those of *C. elaphus*. So far as the dimensions and proportions are concerned, this will be seen at a glance at the odontograms Nos. 24, 25, & 35 (Pl. XXVII.), the first showing the mean size and relative proportions of the Gibraltar mandibular teeth, the second those of the Deer which occurs so abundantly in the Thames-valley deposits, and the third of a Highland Stag. The close similarity between these diagrams is so obvious as to require no comment.

In other respects, also, the Gibraltar teeth correspond with those of *C. elaphus*. It appears therefore to be evident that the larger Gibraltar *Cervus* is undistinguishable from that which accompanied *R. hemitœchus* in the valley of the Thames, and which, there is no reason to doubt, is represented at the present day by the Red Deer.

It may be remarked also that as among the remains referred to *C. elaphus* in the Genista-Cave collection there are some of rather smaller size than the rest, which Dr. Falconer and myself were inclined to look upon as belonging to *C. barbarus*, so, in the ancient forms of the Thames, two forms, very distinct in size not only of the bones but of the teeth, are to be distinguished, but otherwise both possessing the characters of *C. elaphus*. The dental characters of the smaller of these forms is shown in the odontogram No. 36.

16. *Cervus dama.*

One of the most interesting specimens in the Gibraltar collections is represented in

Plate XIX. It consists of a mass of breccia containing numerous bones, all obviously of the same skeleton and belonging to a Deer of the size and in all other respects undistinguishable from *C. dama*. These bones (some entire, others broken) are, or rather were, completely imbedded in an extremely hard red breccia, from which they were sculptured with considerable difficulty. This interesting specimen formed part of a large quantity of ossiferous breccia kindly forwarded by General Frome, and which was obtained in the excavations for some new works at Poco Roco, a point towards the northern end of the Rock, and in the line of the "northern quebrada." The bones distinctly visible in this block as it stands are:—

1. A large part of the lower jaw, containing five of the molar teeth, whose dimensions &c. will be seen in the odontogram No. 33.

2. A nearly entire left femur, whose proximal end measures $1''{\cdot}0 \times 2''{\cdot}3$, or nearly that.

3. A portion of the distal articular extremity of the right femur, which measures in the antero-posterior direction $2''{\cdot}7$, and precisely resembles, so far as it goes, the articular end of a small femur from the Genista Cave.

4. An astragalus, about $1''{\cdot}5$ long by about $0''{\cdot}9$ wide, and $0''{\cdot}85$ high on the outer side.

The astragalus of a Fallow Deer measures in the same directions $1''{\cdot}5$, $0''{\cdot}95$, and $0''{\cdot}85$, or identically the same; whilst comparison of the odontogram No. 33 with No. 34, which represents the mandibular dentition of *C. dama*, will show how closely the Poco-Roco Deer corresponds with the Fallow Deer.

X. Capra.

Of all the ruminants, the remains of a large caprine species are by far the most abundant in the Genista and other caverns of Gibraltar. They occur in deposits of all ages, apparently associated in the upper chambers &c. with human bones, and in the lower passages with those of the most ancient forms. They include:—skulls, tolerably perfect except in the facial portion; numerous detached horn-cores; upper and lower jaws, and innumerable detached teeth; together with a large number of bones of the extremities and pelvis, with several vertebræ, including the axis &c. Many of these are in perfect preservation.

As will be shown, we have been induced to refer all these remains, though differing a good deal in size and belonging to widely remote periods, to one and the same species, which still exists in considerable abundance in the mountainous sierras of Spain, from north to south, if not even on the southern slopes of the Pyrenees—the *Capra hispanica* of Schimper.

The genus *Capra*, according to Dr. Falconer, coexisted with species of *Chalicotherium*, *Hipparion*, *Hexaprotodon*, and other forms regarded as of Miocene age, in the Sevalik

hills; but no representative of the genus has as yet been discovered in any of the European Miocene faunas. Nor was it known as belonging even to the Pliocene period until 1859, when Dr. Falconer described the left frontal and horn-core of a large species of Ibex[1] found in the White Marl overlying the Tejares Blue Clays of the valley of Guadalmedina, near Malaga, determined by Professor Ansted to be of Pliocene age. And it is of interest to remark, with reference to the Gibraltar *Ibex*, that in the same deposit the upper jaw of a *Rhinoceros*, regarded by Dr. Falconer as *R. etruscus*, also occurred; and subsequently other specimens of both the *Ibex* and *Rhinoceros* have occurred in the same locality.

In 1844 M. Pomel communicated to the Academy of Sciences a notice of a supposed species of *Capra* (*Ibex*, Gervais) from the ancient alluvium of Malbattu (Puy-de-Dôme), which he provisionally named *Capra roseti*. The principal specimen was an ambiguous upper jaw of large size, containing four of the molars; and it seems doubtful, in the absence of further evidence, whether M. Pomel's species may not be an Antelope rather than a Goat. M. Félix Robert, in 1829, published, under the name of Antelope, a figure of a metatarsal found, along with extinct Deer and other mammals of Pliocene age, at Cassac near Le Puy[2]; but Dr. Falconer, having examined all these specimens, agreed with M. Gervais that the metatarsal in question was that of a Goat, probably *Ibex*, and not of an Antelope.

It appears, therefore, that we have certain evidence of a Pliocene *Capra* from Malaga, and probable evidence of an allied species from Central France.

As regards quaternary and later European forms, M. Marcel de Serres, in 1839, described certain remains from the ossiferous cavern of Bize, consisting of upper and lower jaws, which he assigned to *C. ægagrus*; but the evidence upon which this identification was made is not given.

In 1847 M. Gervais communicated to the Academy of Sciences a short notice of certain fossil remains, some of which had been previously attributed to a species of Antelope from the cavern of Mialet, in the Gard, under the name of *Capra* (*Ibex*) *cebennarum*; and in a subsequent more detailed account[3] he endeavours to show that they belonged to a true *Ibex*, at the same time admitting that he was unable to affirm that the species differed from the existing *Ibex* of the Pyrenees.

More recently M. Lartet has discovered numerous remains of *Ibex*, mingled with the crushed bones of the Horse, Aurochs, Reindeer, Chamois, Saiga Antelope, &c., in the Dordogne Caves. But in all these instances the skull has been fractured, seemingly for the extraction of the brain, and only mutilated pieces of horn-cores have been met with, together with fragments of jaws and other bones. M. Lartet simply

[1] Quart. Journ. Geol. Soc. vol. xv. 1860, p. 602.

[2] Ann. de la Soc. Agricult. Sci. &c. du Puy, 1839, p. 85, pl. ix. fig. 6.

[3] Comptes Rendus, 1847, tom. xxiv. p. 691.

cites the form as a "Bouquetin;" and there are no good grounds to believe, more than in the case of the Chamois, Saiga, Reindeer, Horse, &c., that it differs specifically from the living form or forms now inhabiting the Alps and Pyrenees.

Having thus traced in one form or another the existence of a large form of Goat back to a very remote period, it remains to inquire to which of these the Gibraltar remains belong.

The remains of two well-marked caprine ruminants abound in the collections from Windmill Hill—one of much larger size than the other, and whose remains are more numerous even than those of *Cervus*, and a smaller one, whose remains occur but very very sparingly, and, as it would seem, not among the most ancient forms.

Although there can be no doubt of its belonging to the subgenus *Ibex* of some authors, some difficulty has been experienced, and some doubt perhaps may still be entertained, with respect to the exact identification of the larger of these caprine species. This difficulty in the main arises from the circumstance that we at present are not in possession of sufficiently minute and accurate knowledge of the osteological differences between the supposed distinct European species of *Ibex*, which have been defined chiefly from external characters alone, included among which are the form and direction of growth of the horns.

As in the case of the fossil or subfossilized form we have little or no information on these points, the principal means of comparison, as things at present stand, are wanting. It is true that, as regards the important character afforded by the horns, some little information may be gathered from the horn-cores. This is less than might at first sight be expected; for the shape of the horn, so far as my observation has extended, can be only very distantly surmised from that of its core. In the case of a fully developed male, there is no doubt that we may trace characteristic features in the cores, more especially as to the presence or absence of a spiral twist; but in that of the cores belonging to female skulls I apprehend that very close similarity will be found to exist between the two marked varieties or species of European *Ibex*. Unfortunately, so far as I can perceive, all the horn-cores that have been procured in the Gibraltar collection are of the small size and, as it may be termed, featureless character belonging to those of the female.

As, however, it will be seen that I have endeavoured to arrive at some distinctive characters from other particulars in the bones, I would say a few words with respect to the still perhaps not altogether settled point concerning the number of so-termed European species belonging to the *Ibex* group.

Whilst some writers, as Blasius, appear inclined to regard the Alpine and Pyrenean *Ibex* as merely varieties, distinguished mainly by the curvature of the horns and the presence or absence of a beard, and to look at *Capra hispanica* of Schimper as a subvariety of the Pyrenean, by others these three forms have been considered specifically distinct.

The three forms in question are:—

1. Capra ibex, Linn. *C. alpina*, Girt.

Distinguished by its tuberculated, crescentic, divergent, subquadrangular horns, compressed towards the apex, and in the female smaller and more even on the surface. The male is altogether beardless.

Though formerly more widely distributed, I believe this species is restricted at present to one or two Alpine valleys on the southern or Italian side of Monte Rosa.

2. Capra pyrenaica, Bruch.

With the habit of the Alpine Ibex, but with a strong black beard. The horns are thick, rounded in front and on the outer side, internally flattened, and behind compressed into an acute angle, whence the transverse section is pyriform. They diverge at first abruptly, and afterwards are twisted spirally inwards and downwards; so that eventually the inner surface comes to look outwards, and the anterior inwards and downwards. In the female the horns are short and simply curved, flattened before and behind. It is found only on the Spanish side of the Pyrenees.

3. Capra hispanica, Schimper[1].

Distinguished from the Alpine Ibex by its large thick horns (in the male), which almost coalesce at the base, and are rounded and irregularly tuberculated in front, with an acute angle on the inner side. They rise at first parallel to each other, and then suddenly diverge, curving backwards, and again bending inwards towards the point (lyrate). In the female the horns are small and compressed. The male is furnished with a short, truncated, black beard.

This species is found, apparently in considerable abundance, in several of the mountainous sierras of Southern Spain, such as the Sierra Nevada, Sierra de Ronda, De Gredos, &c.

From the above descriptions it will be seen that, whilst the Alpine Ibex is obviously very distinct in external characters from either of the Spanish forms, the two latter agree so closely with each other that it is impossible to regard them as more than very closely allied varieties. I believe that Professor Schimper is himself now of this opinion.

For all practical purposes, however, on the present occasion, I shall assume that there are two distinct species, or at least well-marked permanent varieties, of Ibex found in the European area—one peculiar to the Alpine chain of mountains and perhaps found on the northern side of the Pyrenees, and the other confined to the mountainous regions of the Spanish peninsula.

[1] Comptes Rendus, 1848; Rev. Zool. 1848, p. 90.

Unfortunately, as I have before observed, we possess at present but little available material for osteological comparison between these two forms, except as regards the skull.

In the British Museum there is a specimen (No. 777 *a*) of the skull of a female Pyrenean Ibex, of which the stuffed skin is also in the collection; and there is another skull of an Alpine Ibex, which though young is quite mature, and its horn-cores are of the same size as those of the Pyrenean skull. The two specimens therefore admit of fair comparison.

The relative dimensions of a few corresponding parts in these two skulls are as under:—

	Circumference of horn-core at base.	Nasals.		Length and extreme breadth of lacrymals.	Length of malar.	Diameter of orbit.	Length of frontal in mesial line.	Length of parietals in mesial line.	Width of skull at coronal suture.
		Length.	Breadth at base.	Breadth at middle.					
Capra pyrenaica ♀. No. 777 *a*.....	3·6	3·6	1·3	1·0	2·2×·5	3·0	1·7	3·6	1·5	3·5
Capra ibex, Alps. No. 650 *f*.....	3·6	3·3	1·1	·9	1·9×·7	3·3	1·5	3·9	1·4	3·3

From these figures it will be seen that, so far as mere dimensions go, there is no marked difference observable between the two, except in the greater length of the malar bone in the Alpine Ibex, which is owing to the greater backward prolongation of the zygomatic process, and in the greater length of the frontal longitudinal arc, which, as compared with the somewhat greater length of the parietal, is worthy of notice. In other respects the following points may be adverted to:—

1. That in both forms the lower border of the lacrymal does not run parallel with the lacrymal ridge of the malar, but forms a triangle with it below.

2. That in the Alpine Ibex there is a deep depression or fossa around and in front of the infraorbitary foramen, which is almost absent in the Pyrenean.

3. That the premaxillaries are slender in both.

4. That the forehead is rather more *bombé* in the Pyrenean specimen, or more hollowed above the root of the nasals.

5. That the form of the ascending ramus of the mandible and the curvature of the coronal process are alike in both.

6. The horns have the same curve, and in both are angular on the inner side in front, in the same way but not so marked as in *Capra hircus*, and that in the Pyrenean specimen the horn is slightly hollowed on the inner face, as in the *C. hispanica* from the Sierra de Ronda. The Pyrenean horn is very closely and coarsely annulated in the

lower third, more faintly above. In the Alpine the annulation is finer throughout, corresponding perhaps with its younger age.

7. In both, the cores diverge from the base, and the sulcation of the surface shows no indication of a twist; but, in both, the points of the horns themselves show a tendency to turn in, as in *C. hispanica*, but less markedly.

The transverse section of the horn-cores is exactly alike in both, although that of the horns themselves differs considerably.

In the Royal College of Surgeons there are several skulls of both the Alpine and Spanish Ibex:—

Two from the Sierra de Gredos, presented by Señor Graells, Director of the Museum of Natural History of Madrid, and a magnificent specimen, with the horns, of a fine young male, which was shot in the Sierra de Ronda by Capt. Austruther, of the Rifle Brigade, who was stationed at the time of our visit at Gibraltar, and took the greatest interest in the investigation of the animal remains of the breccia. He kindly took the trouble to procure the above specimen for the purpose of facilitating our inquiry, but was unfortunately not able to convey the entire skeleton—preserving, however, the fore and hind feet.

Of the Alpine Ibex the College possesses a skull from the north of Italy, presented to the College by Sir James Hudson (3742 c) with one or two others, amongst which I have used one numbered 3742 A.

The comparative dimensions of certain parts of two of these Spanish and two Alpine Ibexes are given in the following Table:—

	Length of cores.	Circumference at base.	Circumference at middle.	Nasals.			Length and breadth of lacrymals.	Length and breadth of malar.	Diameter of orbit.	Frontal longitudinal arc.	Parietal longitudinal arc.	Occipital longitudinal arc.	Breadth at coronal suture.	Width of condyles.
				Length.	Breadth at base.	Breadth at middle.								
♂	..	750			372									
Alpine Ibex, 3742 c (R.C.S.)..	9·0	6·75	5·2	3·5	1·3	1·0	2·0	3·7 × 1·3	1·7					
		714			394									
C. hispanica (Sierra de Gredos)	7·0	5·0	..	3·3	1·3	1·1	2·0	3·0 × 1·1	1·8	..	1			
		551			449									
C. hispanica (Sierra de Ronda), 3743 c (R.C.S.).	9·5	5·3	..	3·7	1·6	1·1	2·1 × ·6	3·3	..	3·9	1·5	2·4	3·8	2·5
		603			483									
Alpine Ibex, 3742 A (R.C.S.)	13·0	7·9	..	3·8	1·8	0·9	2.1 × ?	..	1·6	4·5	1·5	2·7	3·7	2.3

These figures may suffice to give a correct idea of the characters of the two forms.

1. From the figures it will be seen that the proportion between the basal circumference and the length of the horn-core affords no distinctive character.

2. That the proportion of the width to the length of the nasals is very nearly the same in both, though it is rather less in the Alpine form in the middle.

3. That the lacrymals are of the same length.

4. That the malar is considerably longer in the Alpine Ibex, as before remarked.

5. That the diameter of the orbit is somewhat greater in the Spanish Ibex.

6. That in the other dimensions given there is no marked difference between the two forms.

If we proceed to compare the two forms in other respects, it will be found that

1. In the Alpine Ibex the horn-cores are very slightly flattened on the inside, and subangular though rounded behind; that they diverge from their base, so that the distance between the bases (at their centres) in front being three inches the points diverge eight inches, and that they exhibit no sign whatever of torsion. In the Spanish Ibex from the Sierra de Gredos the cores are slightly angular on the inner side behind and not at all flattened, and they have a decided indication of torsion. Also they rise more parallel to each other at first, and then diverge, so that the interval between their respective centres at the base being 3″·3 the tips are 6″·8 apart. The difference in their shape is very distinct and marked.

2. In the Alpine Ibex the inner or lower border of the lacrymal is more curved, owing to its running parallel (or being, in fact, almost coincident) with the malar suborbital ridge, whilst in the Spanish Ibex the border is straighter, and there is left inferiorly a triangular interval between it and the malar ridge in question.

3. In the Alpine Ibex there is a wide and deep depression around and in front of the infraorbitary foramen in the maxillary, which is almost entirely absent in the Spanish Ibex from Sierra de Gredos (R.C.S.), and much smaller though deep in 3743 c.

4. The forehead is rather more *bombé* in the Alpine Ibex.

5. The zygomatic process of the malar is much more produced in the Alpine Ibex.

6. The mandible is perhaps slenderer in the Spanish Ibex, and the coronoid process less recurved.

7. The diameter of the orbit is rather greater in the Spanish form.

8. The premaxillaries are thicker, especially towards the apex.

9. The fronto-nasal suture in the Spanish Ibex is a uniform semicircle, whilst in the Alpine it forms three sides of a hexagon.

On our return from Gibraltar Dr. Falconer and myself examined a specimen of *Capra hispanica* in the Museum at Cordova, stated to belong to a young male. In this the horn-core was 8 inches long, and had a basal circumference of 6″·2, so that it was of enormous proportional thickness. It had a well-marked angle on the inner side, which began at the posterior border of the base, and, gradually advancing in front, was lost about two thirds up. On October 25, 1865, Dr. Falconer, after I had left him in the south of France, compared at Montauban three skulls of what was styled *Capra pyrenaica*, from the Museum of Toulouse, with some of the bones brought by us from Gibraltar, and found, except for difference in size and age, that they agreed in the closest manner.

One of these Pyrenean specimens came from the Valle d'Osso, south of Pau, in the Western Pyrenees, whilst two others, with the skin still upon them, were procured in the neighbourhood of Luchon, in the Central Pyrenees. M. Lartet assisted in the comparison. The following dimensions are those given in Dr. Falconer's notes:—

		in.
No. 1.	Least width between the orbits at the lacrymal sulcus	4·5
	Distance between outer rims	6·3
	Length of the molar series	2·88
	Width of maxillaries in front of orbit	3·35
	Greatest width of palate	2·15
	Length of horn	24·0
	Distance between the tips	13·0
	„ at middle	16·5
	„ at base	0·25

The horns nearly touched at the base, and then gracefully diverged outwards, and then approached at the tips in an elegant twisted lyrate form. They were broad in front, angular behind and on the inner side. The posterior internal angle by the twist became gradually anterior near the apex. The horn-cores, Dr. Falconer observes, "exactly correspond with those of our young male" (Gibraltar fossil). The female from Toulouse was larger and older than the Gibraltar specimen, but otherwise alike. The mandible of the large male Pyrenean Ibex was 8 inches long and 3″·95 high at the coronoid process. The malar series measured 3″·05. The talon (or third column) of $\overline{\text{m. 3}}$ very large and rounded (as in our form A[1]), and it had no step. "The *Capra hispanica*, therefore," says Dr. Falconer, "ranges from the Pyrenees to the southern mountains of Spain, and it is very different from the true Pyrenean Ibex." The explanation of the last phrase is, that Dr. Falconer had been informed at Toulouse that the true Alpine Ibex also occurred in the Pyrenees—a fact, however, which is, I believe, denied by M. Lartet[2].

[1] The elder jaws we termed "form A."

[2] That some confusion exists with respect to the species or varieties of *Ibex* at present inhabiting the Pyrenees is plain; and it might in some degree, perhaps, be cleared up by the supposition that Ibexes with crescentic and with lyrate horns both occurred in different parts of the chain. I find it stated in Dr. Falconer's memoranda that M. Lartet had a notion, also conjecturally entertained by Cuvier, that there was a fertile cross between the common Goat and the Ibex, which might have given rise to the form with lyrate horns; but this is too extravagant a speculation to be entertained for a moment. Dr. Falconer also mentions that he had been told by M. Filhol, than whom a more acute, careful, excellent observer does not exist, that he had seen skulls of a true Pyrenean Ibex with horns of the ægocerine type (that is to say, curved backwards and parallel as in the Alpine Ibex) and quite different from the tragocerine horns of *Capra pyrenaica* or *hispanica*. But M. Lartet, than whom no one could be better acquainted with the Pyrenean fauna, had never heard of such an animal, and was always under the impression, with Cuvier, Roulin, and other French naturalists, that there was only one Pyrenean Ibex, and that with lyrate horns.

From what he writes, however, it will be seen that that experienced and acute observer fully recognized the similarity between the Pyrenean Ibex with lyrate horns and that which occurs in the south of Spain, and consequently must have regarded *C. pyrenaica* of Bruch and *C. hispanica*, Schimp., as synonyms.

With these preliminary remarks I will proceed to make a few observations on the bones of the fossil Ibex, and endeavour to point out its relation to the existing Spanish form.

Of all the mammalian remains collected by Capt. Brome in the Windmill-Hill caverns and fissures, those of the Ibex are, as I have said, by far the most abundant. They occurred at all depths, and apparently of all periods and of all ages, young and old, associated in the upper chambers of the Genista Cavern with human bones and works of art, and abundantly in the lower passages with the remains of the most ancient forms.

The specimens, of which cartloads were collected, include almost every part of the skeleton—skulls, horn-cores, vertebræ, limb-bones in profusion, and innumerable isolated teeth, of which bushels were met with, together with an immense number of lower and upper jaws &c.

The bones belong to animals of all ages; and amongst them are very many jaws with the milk-dentition. Most were more or less thickly incrusted with stalagmite, usually of the red colour; and the substance in the majority of cases was strongly infiltrated with manganese.

Selected characteristic specimens are represented in Plates XX. and XXII.–XXVI.

The inspection of these figures, and more especially of those showing the metacarpals and metatarsals in Plate XXVI., will alone suffice to show that very considerable diversity of size existed amongst the individuals. In fact, so striking was this difference upon first sight, especially in the mandibles, as to induce us to imagine that they must have belonged to more than one species or subspecies, at any rate. Further investigation, however, has led me to the conclusion that the differences we noticed are due simply to individual variation, or dependent upon sex, and, with regard to the mandibles, to age.

The mandibles present two very distinct varieties, one much slenderer than the other. But it will be found that the thicker form and greater depth of one of these varieties is simply owing to the circumstance that the teeth are more deeply immersed and, having been in use for a shorter time, descend more deeply into the ramus of the jaw. For the same reason, also, the usually shorter antero-posterior length of the last molar tooth is accounted for. This tooth in the Ibex is more or less contracted in its length towards the summit; so that the further it is protruded from the alveolus, as it wears down, the longer does it appear to be. But if the tooth in one of the thicker jaws be extracted from the socket, or its root exposed by removal of one side of the alveolus, it will be found to be of the same dimensions as in the other form at the same height.

The mere differences in size of the other bones, as exemplified in the metacarpals and metatarsals, shown in Plate XXVI., is also sufficiently explained by individual variation. The general form of the articular surfaces will be seen to correspond; and although the perimetral index shows considerable differences, this is not more than can probably be accounted for by age and sex.

On the whole, therefore, there appears to be no reason to consider that more than one species of Ibex is represented in the Gibraltar remains.

1. *Skull.*—Several more or less perfect skulls have afforded material for comparison of this important part of the skeleton.

The one figured in Plate XXII. fig. 1, exhibits the entire upper surface of the cranium, including the bases of the horn-cores in front and the entire occipital condyles behind. Unfortunately, neither in this nor in any of the other specimens are there any remains of the facial bones, except of the upper and lower jaws.

A second skull, in a very fragile condition, but still very perfect when repaired, is equally if not more complete, inasmuch as it preserves a considerable portion of the base. It shows half of the right horn-core divided vertically and transversely, and the right auditory foramen, a small part of the right orbit, with the whole of the temporo-parietal region on the same side. From the state of the sutures the skulls must have belonged to mature animals, which, from the inconsiderable size of the bases of the horn-cores, were most probably females.

A third specimen shows the left frontal with a part of the orbit, and an entire horn-core (fig. 7) of inconsiderable size, and therefore also probably female.

A fourth specimen gives a very complete view of the frontal region, with a portion of the left horn-core still attached.

Besides these are numerous fragmentary portions of the cranium, all obviously of the same character.

Numerous detached horn-cores, besides those already enumerated, have been noticed, all, with the exception of that figured in fig. 7, Pl. XXII., of the same general form and character; and from their size, and comparison with those of the existing Spanish and Alpine Ibex, I should conclude that they have all belonged to females.

The exceptional form shown in fig. 7 is peculiar by its rapid acumination towards the summit; but this would appear to be due to some accidental interruption to its development.

The wide cavernous structure of the interior of the horn-cores, and the peculiar radiate arrangement of the cancelli which is seen in numerous instances, are shown in fig. 2, Pl. XXII.

2. *Trunk.*—Bones belonging to the trunk are extremely rare in the collection, none having been met with, except of the pelvis, beyond a few more or less entire vertebræ.

One of the most characteristic of these is an almost perfect axis (figs. 4–6, Pl. XX.), distinguished from the corresponding bone in *Cervus barbarus* (fig. 3) by its shortness.

A second specimen, with the odontoid process, of smaller size, is shown in figs. 7 & 8; and several other fragments were met with in the collection.

The contrast between this vertebra in the Ibex and that of *Cervus barbarus* will be seen at a glance; whilst in the side view, fig. 6, the characteristically strong neural spine of the atlas in Ibex will be seen, commensurate, no doubt, with the enormous weight of the horns in the male of that species.

The selected collection from which this account is drawn up, affords, of other parts of the spine, only a small fragment of the upper part of the sacrum. Of the pelvic bones, there are several specimens of the os innominatum with the acetabulum, which do not appear to call for any remark.

3. *Anterior extremity.*—Some, though but few, instances of portions of the scapula have been noticed; but of the other large bones of the extremity very large numbers in all degrees of proportion have come under observation.

(1) *Humerus.*—Innumerable instances of this bone occur, varying only in size.

(2) *Forearm.*—As the radius and ulna of *Ibex* present some peculiarities characteristic of that division of *Capra*, it is worth while to point them out. In the first place, both in the Alpine and Spanish Ibex, it will be seen that the process of the ulna against which the head of the radius abuts is, on the outer side, prolonged rather beyond the level of the outer border of that bone, as at *a*, figs. 1 & 2, Pl. XXIV., thus affording, as it were, an additional strength to the articulation between the two bones. Neither in the Goat and Sheep, nor in any other ruminant that I have examined, is the outer alar process of the ulna, as it may be termed, produced beyond the inner edge of the radial head[1]. A second peculiarity of the Ibex, as contrasted, at any rate, with the Goat, Sheep, Deer, and any other of the more common ruminants, consists in the circumstance that, when the forearm is viewed in its front aspect, the ulna, instead of being concealed altogether behind the radius, is plainly visible beyond its outer border (fig. 4, Pl. XXIV.).

XI. Bos.

A large number of loose teeth of the common Ox were met with in the more superficial parts of the upper or human chamber of the Genista cave, intermixed with human bones and works of art &c. But the only indications of a bovine animal below the stalagmitic floors, in the deep passages and in the East Fissure, are limited to five or six teeth, and the distal extremity of a metatarsal or metacarpal, apparently gnawed by *Hyæna*[2]. This latter is thoroughly mineralized, deeply stained with manganesic deposit, and it was imbedded in hard ferruginous stalagmite. The teeth also present unmistakable marks of antiquity, though very slightly dendritic, and they were all thickly incrusted. There can be no doubt, therefore, that these remains belong to the ancient fauna. Two of the teeth are represented in Pl. XVIII. figs. 4, 5, from which

[1] In the Goat it is very nearly level with it.

[2] Dr. Falconer inclined to the belief that these bovine specimens belonged to *Bison priscus*.

it will be seen that they are of very large size and furnished with a very strong and prominent simple columella. I am unable to distinguish between these teeth and those of *Bos primigenius*, with which they agree in all particulars.

The portion of cannon bone, which consists merely of the articular end, measures $1''{\cdot}8 \times 3''{\cdot}5$, and is therefore of a size commensurate with the teeth.

It is, of course, impossible from such scanty materials to come to any definite opinion as to the species; but it is clear from these relics that an Ox equal to *Bos primigenius* in size formed part of the fauna of the Rock at a time when its bones were exposed to the gnawing of the Hyena.

XII. Sus.

The upper chamber of the Genista cave afforded numerous relics of a small Pig, consisting for the most part of fragments of the skull and jaws, and more especially of the lower jaw, intermixed with those of man, fragments of pottery, &c., and imbedded in the loose dark mould with which that chamber was occupied. But below the stalagmite floor, at the depth of 24 feet, a few remains were met with of a much larger form, consisting of portions of the right and left rami of the maudible of a young animal, and in which the third molar has not yet made its appearance. Both the other molars are *in situ*; having apparently just come into wear. The empty alveolus of the third deciduous molar is shown; and in front of it the second (?) permanent premolar is just making its appearance; and in front of that again are the fangs in the alveolus of the first deciduous molar ($\cdot 32 \times \cdot 2$). The dimensions of the two molars are:—

$\overline{\text{m. 1}}$	$\cdot 75 \times \cdot 48$.
$\overline{\text{m. 2}}$	$\cdot 9 \times \cdot 6$.

The vertical height of the ramus at the second molar is $1''{\cdot}3$, and its thickness $\cdot 9$.

The only other specimens from below the stalagmite in the Genista cave are:—

1. Portions of two canines incrusted with stalagmite, but not dendritic; the greatest diameter of the largest at about $3''{\cdot}5$ from the point is $\cdot 8$, and the radius of the curve $8''{\cdot}4$.

2. A detached lower third molar, or rather the crown portion in germ and quite perfect, measuring $1''{\cdot}5 \times \cdot 8$.

With respect to these relics it cannot be said with any certainty that they belong to the more ancient fauna of the Rock. Their appearance and mineral condition would rather lead to the supposition that they belong to a much more recent period, though perhaps, as it would seem, not immediately associated, like those of the smaller Pig, with man.

Evidence, therefore, was wanting in the Genista cave and fissure of the actual existence of a species of *Sus* in the true ancient breccia. But conclusive proof of this has been afforded from another part of the Rock, and which leaves no room for doubt that a species, to judge from the teeth, of the same size as that to which the larger Genista-cave remains belonged really did form part of the ancient fauna.

In masses of ossiferous breccia sent by General Frome from Poco Roco, and in some forwarded, I am not sure from what point, by Captain Luard, I found, completely imbedded in hard breccia, remains of a large Boar, in such a mineral condition as to leave no doubt of their contemporaneity with the most ancient species.

One of the specimens of this kind is a mass of breccia, which in a few cubic inches presents, much crushed, the greater part of the mandible, containing the canines and, taking the two sides together, most of the teeth, together with an apparently entire metatarsal and fragments of other bones.

In another mass of the same breccia I found, and have partially chiselled out, a fragment of the upper jaw, which may or may not correspond with the mandible, and containing the last premolar and the first and part of the second molars. And from the same breccia I have also exhumed the distal extremities of the third and fourth metatarsals, cemented together in their natural position by the hard matrix, and together with these and but a little way apart from them the two corresponding phalanges, of which one is almost entire. The conjoint width of the two metatarsals and of the proximal ends of the phalanges is 1″·5. The phalanx measures 1″·5 long.

The specimens forwarded by Captain Luard consist of portions of the upper and lower jaws of the same individual (to judge from the accuracy with which the teeth fit), and containing each the three molars, all entire except the third lower: those that remain are most of them worn, and especially the upper first molar. The teeth measure:—

	in.
$\frac{\text{m. 1}}{}$	·62×·60
$\frac{\text{m. 2}}{}$	·80×·65
$\frac{\text{m. 3}}{}$	1·30×·70
$\frac{}{\text{m. 1}}$	·60×·40
$\frac{}{\text{m. 2}}$	·80×·50
$\frac{}{\text{m. 3}}$	×·60

The vertical diameter of the lower jaw opposite the first molar is 1″·6, and its thickness ·95. The corresponding measurements in a specimen of an Italian Wild Boar in the College Museum are:—

	in.
$\frac{\text{m. 1}}{}$	·65×·55
$\frac{\text{m. 2}}{}$	·80×·65
$\frac{\text{m. 3}}{}$	1·15×·70
$\frac{}{\text{m. 1}}$	·60×·40
$\frac{}{\text{m. 2}}$	·75×·55
$\frac{}{\text{m. 3}}$	1·20×·55

So far as can be judged from such scanty materials, it would seem that a species of *Sus* having a dentition similar to that of the European Wild Boar existed on the

Rock from the earliest period of which we have any animal relics, down to a comparatively recent time, and not improbably into the human epoch, when it appears to have been replaced by the Domestic Pig. We have come to this conclusion from the size &c. of the metatarsals and phalanges, but more especially from the dentition; and the evidence afforded by the latter will be seen in the odontograms in Pl. XXVII., of which No. 1 represents the maxillary and mandibular dentition of the Gibraltar, No. 2 that of an Italian Wild Boar, No. 3 the maxillary dentition of a fossil Cave specimen at Montpellier, and No. 4 the average upper and lower dentition of *Sus domesticus*.

XIII. Lepus.

The only remains belonging to the class Rodentia are those of two species of *Lepus*. These are found in the oldest deposits, imbedded in the hard breccia in incredible quantities, or, more loose and not crusted with stalagmite, up to the most superficial parts of the caves and fissures and up to the present day, when the Rock swarms with Rabbits. Of the larger form only a few perfect bones, corresponding with those of Hare, have occurred. But specimens of the second smaller species are very numerous (in fact they were collected in bushels) in nearly all parts of the Genista cave and east fissure and other caves. They include perfect skulls with the dentition complete, innumerable lower jaws, and entire bones of the extremities. Some of the remains, thoroughly fossilized and imbedded in hard breccia, have been brought up from a depth of from 70 to 90 feet. The species was of the size of a small Rabbit, and is in no way distinguishable from the existing species.

It would thus seem that from the most remote period down to the present time the Rock of Gibraltar, like the rest of the Iberian peninsula and the Balearic Isles, has abounded with Rabbits, and well deserved the appellation of "cuniculosa" applied by Catullus to Celtiberia generally [1].

No trace has as yet appeared in the Windmill-Hill collections, nor in those from Poco Roco or elsewhere that have come under my observation, of the so-called *Lagomys* which Cuvier [2] describes and figures on the authority of Adrian Camper.

XIV. Elephas.

The only specimen of the remains of Elephant which, so far as I am aware, has ever been met with within the precincts of the Gibraltar promontory is a right upper last

[1] Although it is doubtful whether this term may not mean "abounding in mines," Diodorus Siculus nevertheless relates that the inhabitants of the Gymnesian Islands sent a deputation to Rome soliciting that a new land might be given to them, as they were quite driven out of their country by the Rabbits, and were no longer able to stand against their vast multitudes. These people were in the habit of hunting the *Leberides* by Wild Cats (γαλᾶς ἀγρίας) from Africa (iii. cap. 2. § 1).

According to Strabo, some supposed that Spalis, or Hispalis, and Spania, or Hispania, were derived from "Saphan," the Phœnician word for Rabbit.

[2] *Op. cit.* tom. iv. p. 174, pl. xiii. fig. 4.

molar of *Elephas antiquus*. It is very nearly perfect, wanting only about half of the foremost plate. In its present state it measures 7″ in length by 2″·8 in width at the thickest part. It presents ten plates and a half, which on the crown surface exhibit, in the disposition of the enamel, all the well-known characters of *Elephas antiquus*.

The tooth was found, as mentioned by Mr. Smith [1], in the process of scarping the ancient sea-cliff at Europa Point, in a raised beach about 70 feet above the present sea-level.

It is incrusted in parts with a fine comminuted shell breccia; and in many of the hollows of the surface numerous minute littoral shells (*Rissoa* &c.) and *Serpulæ* are lodged. But what is very remarkable, it does not appear to have been at all rolled, the angles of the old fractured surfaces being sharp, as are the edges of the machærides. There can be no doubt, therefore, that, although at one time it lay on the sea-shore, it could not have been brought by the action of the waves from any great distance. What its original position may have been or whence it was derived it is impossible to determine. But with respect to this it may be mentioned that a large tusk and other Elephantine remains were many years since found in association with those of Rhinoceros, in an alluvial calcareous formation at Tarifa [2]. And I believe similar remains have been met with in modern deposits near the south coast of Spain, towards the east.

XV. General Conclusions.

The foregoing enumeration completes the list of the principal mammals, of which remains have been identified, derived from the more ancient deposits in the Genista cave and elsewhere. The catalogue, however, cannot be considered as exhausting the ancient mammalian fauna of Gibraltar. Much, very much, yet remains to be done even in that single department of zoology; and it is to be hoped that some future Brome will arise to disinter the numerous forms that must yet lie concealed in the caves and fissures of the rock.

Where birds and small mammals such as the Rabbit abounded, there must, most probably, have existed corresponding predaceous carnivora of the Viverrine group—none of which have as yet been discovered in the ancient breccia, although the skull of *Herpestes ichneumon* was found in a recent condition in No. 3 Genista cave, which was only filled with human bones and rubbish and the remains of domestic animals. Although the Fox has been sparingly represented, the Wolf is as yet entirely wanting, and other forms that might be expected to turn up.

Amongst the most remarkable deficiencies in the ancient fauna made known up to the present time, however, should be noticed the entire absence of any trace of the Ape (*Macacus inuus*). Leaving on one side the disputed question whether the Barbary Ape ever was truly indigenous on the Rock of Gibraltar, there can be no doubt that during the last century or two it has there existed, at one time in considerable numbers, in a wild state. Many thousands of individuals, consequently, must have

[1] *Loc. cit.* p. 110.

[2] Pargeter, in Buckland's 'Reliquiæ Diluvianæ,' p. 159.

perished, and left their bones on the surface, all of which could scarcely have been completely devoured by the small Fox or the Weasel, which have long constituted the only predaceous mammals. If the Ape were one of the ancient fauna, the total absence of its bones in the breccia would be very remarkable; and even if, as is commonly supposed, it is a modern importation, it is equally surprising that none of its relics should have been met with on the surface or in the chinks and crannies into which they would be washed by the autumnal floods, in which situation the bones of Rabbits, Foxes, Cats, and Dogs abound [1].

I cannot better conclude these remarks than by copying from Dr. Falconer's notes (written ten or twelve years since) his statement of the points which at that time he thought were distinctly established, and which even now seem to me, as they did then, to include nearly all that can be said upon the subject in a general point of view:—

1. It has been argued, and, we think, with reason, that the fossil bones and other extraneous materials which occur in ossiferous breccia occupying fissures connected with the surface, furnish at the same time an accurate idea of the animal population of the land immediately subsequent to the disturbances which caused the rents, and a fairly approximative idea of the period when these disturbances took place; for the open crevices must have received the washings of the surface, swept in by atmospheric agencies, subsequently to their formation, and could have received no others.

It is not a little remarkable that, within that portion of the European area where caves and ossiferous fissures abound, not a single instance has been recorded on good authority of a Miocene mammalian form, either in cave-deposits or bone-breccia; and Dr. Falconer has endeavoured to show that, at any rate in England and Wales, the line of demarcation is so well defined that the caves were manifestly filled after the date of the Boulder-clay, none of the old Pliocene forms being ever yielded by them; and the same observation applies in a general manner to Germany, Belgium, France, and Italy.

2. The general aspect of the Gibraltar mammalian fauna is quaternary, one of the principal forms being *Rhinoceros hemitœchus*, which occurs so abundantly in the valley

[1] Most inquirers who have entertained the question have arrived at what appeared to us the correct opinion, that the few (not more than a dozen) [in 1864] Apes now found in the more inaccessible parts of the Rock are of quite recent importation, or the offspring of parents introduced within a few years from the opposite coast. Whatever may have been the case formerly, they may now be considered virtually extinct regarded as indigenous animals; and Captain Sayer states that he had traced an "old paper in the British Museum which makes mention of a large quantity of these Apes having been sent into the garrison in 1740, and refers to a poll tax to which they were subjected, like Jews, Moors, and other aliens," in the iron age of despotic rule in Gibraltar ('History of Gibraltar,' 1862, p. 444). It may nevertheless be readily conceived that when Calpe was as well clothed with forest as Abyla now is on the opposite coast, and the physical conditions admitted the Hyena, Leopard, and Rhinoceros to pass from Africa into Spain, these species might well have been accompanied by *Macacus inuus*. It is reserved for some future explorer of the ossiferous breccia to determine this interesting point.

of the Thames. But the forms are for the most part of southern or African affinities. Of the leading forms which characterize the northern division of the mammalian fauna of the Quaternary period, which ranged over Northern and Central Europe and the British Isles, and extended even to the shores of the Mediterranean in the south of France, not a vestige has been discovered in Gibraltar: *Rhinoceros tichorhinus*, *Ursus spelæus*, and the Reindeer are alike wanting.

3. The northern division of this Quaternary fauna as a whole appears to have been arrested by the Pyrenees. That the Reindeer existed in vast herds at the foot of the French slopes of the chain, and that it was accompanied by *Ursus spelæus*, *Rhinoceros tichorhinus*, *Ovibos moschatus* and the Mammoth, is well known. M. Lartet endeavoured to trace their Transpyrenean extension upon data furnished by Don Casiano de Prado, but was unsuccessful; and up to the present time not a single example of the Reindeer has yet been discovered in the Spanish peninsula, or, according to the same eminent authority, of *Elephas primigenius*[1]. It is interesting, however, to observe that the frequent companion of these animals in Northern Europe, the Cave-Hyena, has been found near Segovia, and, as we have seen, formerly existed on the Rock of Gibraltar.

4. It is of equal interest, on the other hand, to ascertain what was the northern limit of the other different forms ranged under the southern or African group, for which inquiry, however, satisfactory data are still wanting. M. Lartet and Don Casiano de Prado determined molars of the existing African Elephant at San Isidro, in the neighbourhood of Madrid. And it was conjectured that the African Rhinoceros (*R. bicornis*) had reached the neighbourhood of Montpellier, from remains discovered in the cave of Lunel-Viel; but Dr. Falconer ascertained that the specimen upon which this conjecture was founded is a jaw containing the milk-dentition of a young *R. hemitœchus*, agreeing in the closest manner with a corresponding fragment from one of the Gower caves.

The large Felidæ have a vast range of distribution, the Lion extending from India to Babylon, and within the historic period to Thrace on the one side, and on the other from the southernmost point of Africa to Mauritania, and, if it be the case (as there is every reason to believe) that the Cave-Lion is specifically identical, having extended in the Pleistocene period to the north of Britain. The Leopard, if we regard the African and Asiatic varieties as of one species, has also a wide range of distribution. As we have seen, it certainly occurs in the Gibraltar cave-fauna; and it appears to have ranged into Italy, France, Britain, and Central Europe, under the name of *Felis antiqua*, as a Quaternary form. *Hyæna crocuta*, under the name of *H. spelæa*, is still more generally spread; whilst, under the appellation of *H. intermedia*, we find the southern and eastern form of *H. striata* in the cavern of Lunel-Viel &c.

[1] Remains of the Mammoth, as I have been informed by Professor Leith Adams, have more lately been met with in the north of the peninsula.

DESCRIPTION OF THE PLATES.

PLATE I.

Fig. 1. Side view of skull and maxilla of *Hyæna crocuta.*
Fig. 2. View of basis cranii.

PLATE II.

Fig. 1. Palate of Hyena with molar teeth.
Fig. 2. Side view of maxilla (*bis*), right side.
Fig. 3. Portion of the corresponding left maxilla.
Fig. 4. Occipital area with foramen magnum and condyles.

PLATE III.

Fig. 1. Right ramus of mandible of *F. pardus.*
Fig. 2. Fragment of corresponding left maxilla.
Figs. 3*a*, *b*, *c*, *d*. Different views of under jaw of *F. pardina.*
Fig. 4. Anterior portion of right mandible of *F. pardina.*
Fig. 5. Posterior portion of left mandible of *F. pardina.*
Figs. 6*a*, *b*, *c*. Left mandible of *F. caligata* seu *bubastes.*
Fig. 7. Right mandible of *Canis vulpes.*
Fig. 8. Fragment of maxilla of *Meles taxus* (human period).
Fig. 9. Right mandible of young of *Meles taxus.*

PLATE IV.

Figs. 1, 2. Right mandible of *Ursus*?
Figs. 3, 4. Anterior part of right mandible, containing the fourth premolar.

PLATE V.

Fig. 1. Left ulna of *Ursus* —— ?
Fig. 2. Portion of right mandible of young *Ursus* —— ?
Fig. 3. Fragment of maxilla of same.
Figs. 4, 5. Hinder part of left mandible, containing the third molar *in situ.* Fig. 7 is the second molar of the same jaw.
Fig. 6. A detached canine.

PLATE VI.

Fig. 1. Second right metacarpal of *Ursus.*
Fig. 2. Fifth right metacarpal of *Ursus.*
Fig. 3. Fifth right metacarpal of *Ursus.*
Fig. 4. Second right metacarpal of *Ursus.*
Fig. 5. Fifth right metacarpal of *Ursus.*
Fig. 6. Fourth right metacarpal of *Ursus.*
Figs. 7–9. Different views of axis of *Ursus.*
Fig. 10. Fifth metacarpal of *Felis pardus.*

PLATE VII.

Fig. 1. Left maxilla &c. of young Horse. Fig. 2. Crown surface of deciduous teeth.
Fig. 3. A small first phalanx.

PLATE VIII.

Fig. 1. Portion of scapula of *Equus caballus*.
Fig. 2. The glenoid fossa.

PLATE IX.

Fig. 1. Head of humerus of *Equus caballus*.
Fig. 2. Distal articular surface of femur. Fig. 3. Portion of the calcaneum.
Fig. 4. Magnified view of a detached third deciduous upper molar.

PLATE X.

Figs. 1–3. Different views of upper molar of *Rhinoceros*.
Figs. 4, 5. Dorsal and crown aspects of right second upper molar.
Figs. 6, 7. Same views of corresponding (?) left upper molar.
Fig. 8. Upper molar, enamel detached.

PLATE XI.

Fig. 1. Proximal epiphyses of humerus of *Rhinoceros*, naturally detached.
Fig. 2. Outline sketch of third metacarpal of *R. hemitœchus*, from Ilford.

PLATE XII.

Upper portion of right femur of *Rhinoceros*, anterior view.

PLATE XIII.

The same, viewed from behind.

PLATE XIV.

Fig. 1. Right radius of *Rhinoceros*. Fig. 2. Proximal articular surface.
Fig. 3. Proximal articular surface of *R. hemitœchus*, from Ilford.
Fig. 4. Right tibia.

PLATE XV.

Figs. 1–3. Astragalus of *Rhinoceros*. Figs. 4–8. Os lunare of *Rhinoceros*.

PLATE XVI.

Fig. 1. The entire third and a portion of the fourth metatarsal, in natural apposition, of *Rhinoceros*.
Fig. 2. Posterior view of the third metatarsal.
Fig. 3. The proximal articular surfaces. Fig. 4. The distal articular surfaces.

PLATE XVII.

Figs. 1–5. Different views of the fourth metatarsal of *Rhinoceros*.
Figs. 6–8. The distal end of a third metatarsal.

PLATE XVIII.

Figs. 1, 2. Two fragments of the same atlas of *Rhinoceros hemitœchus*.
Fig. 3. Portion of pelvis with acetabulum of *Equus caballus*.
Figs. 4, 5. Bovine teeth.

PLATE XIX.

A mass of ossiferous breccia, containing bones and teeth of *Cervus dama*.

PLATE XX.

Fig. 1. Atlas of *Cervus elaphus* (var. *barbarus*?).
Fig. 2. Axis of same species.
Fig. 3. Atlas of *Ibex*.
Fig. 4. Axis of *Ibex* (front aspect).
Fig. 5. Axis of *Ibex* (anterior view).
Fig. 6. Axis of *Ibex* (side view).
Figs. 7, 8. Fragment of smaller axis of *Ibex*.

PLATE XXI.

Fig. 1. Right mandible of *Cervus elaphus*.
Fig. 2. Right mandible of *C. elaphus*, var. *barbarus*.
Fig. 3. Entire radius of *C. elaphus*.
Fig. 4. Distal extremity of tibia of *C. elaphus*.
Fig. 5. Portion of scapula.

PLATE XXII.

Fig. 1. Vertical view of skull of *Ibex*.
Fig. 2. Surface of attachment of horn-core (showing the peculiar arrangement of the cancelli).
Fig. 3. Front and side views of a deformed (?) female horn-core.
Fig. 4. Another female horn-core of normal shape.
Figs. 5–9. Sections to show the form of various horn-cores.

PLATE XXIII.

Figs. 1 and 1*a*. Portion of right maxilla of *Ibex*, containing all the molar teeth.
Figs. 2, 3. Internal and external views of a mandible of form A, or aged.
Fig. 4. Mandible of form B.

PLATE XXIV.

Fig. 1. Radius and ulna of *Ibex*: *a*, the peculiar internal expansion of the ulna.
Fig. 2. Radius and ulna, of larger size

Fig. 3. Portion of humerus, with the distal articular end entire.
Fig. 4. An entire radius, with the lower portion of the ulna *in situ*: *a*, proximal articular surface; *b*, distal articular surface.

PLATE XXV.

Fig. 1. Right femur of *Ibex*: *a*, head.
Fig. 2. A right femur of the largest size.
Fig. 3. A right tibia: *a*, proximal articular surface; *b*, distal articular surface.
Fig. 4. The distal end of a tibia of the largest size: *a*, distal articular surface.
Figs. 5 *a*, *b*, *c*. Different aspects of the astragalus.
Figs. 6 *a*, *b*, *c*. Different aspects of an ungual phalanx.

PLATE XXVI.

Figs. 1–4. Metacarpals of *Ibex*, of various sizes.
Figs. 5, 6. Metatarsals.

PLATE XXVII.

Odontograms.

Note.—The diagrammatic figures termed "Odontograms" (see Proc. Roy. Soc. vol. xviii. p. 544, 1870) are intended to supply the place of tables of measurements of the teeth, and at the same time to exhibit graphically their proportional dimensions in each case. The figures also serve to indicate which of the teeth of the typical series are absent or present. They are to be read thus:—

The squares in each transverse series contain the odontogram of the upper or lower (molar) dentition, or, in the case of the smaller animals, both, in which case the maxillary is marked *a*, and the mandibular *b*; and on the left-hand margin the name of the tooth with which each horizontal line throughout the series corresponds, is indicated. In the figures themselves each dark horizontal line corresponds with a single tooth, whose antero-posterior diameter, or length, is shown by the light shade, and transverse diameter or thickness by the dark shade. As the paper upon which the figures are laid down is divided into 20ths of an inch (0·05, =0·00126 metre), the dimensions of the teeth can be read off at once.

Fig. 1. Maxillary molar dentition of *Hyæna spelæa*.
Fig. 2. Maxillary molar dentition of *H. crocuta* (Gibraltar).
Fig. 3. Maxillary molar dentition of *H. crocuta*.
Fig. 4. Maxillary molar dentition of *H. brunnea*.
Fig. 5. Maxillary molar dentition of *H. striata*.
Figs. 6 and 6*a*. Maxillary and mandibular dentition of *Ursus ferox fossilis*.
Figs. 7 and 7*a*. Maxillary and mandibular dentition of *U. ferox* s. *horribilis*.
Figs. 8 and 8*a*. Maxillary and mandibular dentition of the Gibraltar *Ursus*.
Fig. 9. Maxillary dentition of *U. letourneuxianus*.
Fig. 9*a*. Mandibular dentition of *U. faidherbianus*.

Figs. 10 and 10*a*. Maxillary and mandibular dentition of *U. arctos*, var. *isabellinus*.
Fig. 11. Maxillary and mandibular dentition of *Felis pardina* (Gibraltar).
Fig. 12. Maxillary and mandibular dentition of *F. pardina* (R.C.S.).
Fig. 13. Maxillary and mandibular dentition of *F. lynx* (R.C.S.).
Fig. 14. Mandibular dentition of *F. bubastes*, from Blainville's figure.
Fig. 15. Mandibular dentition of *F. caligata* (Gibraltar).
Fig. 16. Mandibular dentition of *F. maniculata fera*, from Blainville's figure.
Fig. 17. Mandibular dentition of *F.* (*Chaus*) *caffra*, Gray.
Fig. 18. Mandibular dentition of *F. chaus*, from Blainville's figure (mummy).
Fig. 19. Mandibular dentition of *F. serval*, from Blainville's figure.
Fig. 20. Mandibular dentition of *F. domestica*.
Fig. 21. Maxillary and mandibular dentition of *F. pardus* (Gibraltar).
Fig. 22. Maxillary and mandibular dentition of *F. pardus* (R.C.S.).
Fig. 23. Maxillary and mandibular dentition of *F. antiqua*, from Gervais's figure.
Fig. 24. Mandibnlar dentition (mean) of *Cervus elaphus* (Gibraltar).
Fig. 25. Mandibular dentition (mean) of *C. elaphus* (Thames valley).
Figs. 26 *a*, *b*. Maxillary and mandibular dentition of *Capra hispanica*.
Figs. 27 *a*, *b*. Maxillary and mandibular dentition of *C. hispanica* (Gibraltar, A).
Figs. 28 *a*, *b*. Maxillary and mandibular dentition of *C. hispanica* (Gibraltar, B).
Figs. 29 *a*, *b*. Maxillary and mandibular dentition of *C. ibex* (Alpine).
Fig. 30. Mandibular dentition of *Sus scrofa* (Gibraltar).
Fig. 31. Mandibular dentition of German Wild Boar.
Fig. 32. Mandibular dentition of common Pig.
Fig. 33. Mandibular dentition of *Cervus dama* (Gibraltar).
Fig. 34. Mandibular dentition of *C. dama* (R.C.S.).
Fig. 35. Mandibular dentition of *C. elaphus* (Scotland).
Fig. 36. Mandibular dentition of *C. elaphus? minor* (Thames valley).