XIV. *Report on the Exploration of Brixham Cave, conducted by a Committee of the Geological Society, and under the superintendence of* Wm. Pengelly, *Esq., F.R.S., aided by a local Committee; with Descriptions of the Animal Remains by* George Busk, *Esq., F.R.S., and of the Flint Implements by* John Evans, *Esq., F.R.S. By* Joseph Prestwich, *F.R.S., F.G.S., &c., Reporter.*

Received May 16,—Read June 20, 1872.

Contents.

I. *Preliminary Observations.*

This Cave, or rather series of enlarged fissures in the Devonian Limestone, was discovered in January 1858 whilst quarrying the rock on the slope of the hill which rises above the small fishing-town of Brixham, near Torquay, in Devonshire. The owner of the quarry had the excavation carried sufficiently far to show that the cave had several branches, and contained bones both on the surface of the stalagmite and in the red loam beneath it. Mr. Pengelly visited the cave soon after its discovery, and, believing it likely to prove of much interest, opened negotiations with the proprietor, with a view to secure the right of exploration. There were, however, obstacles which then prevented this object being carried into execution. Shortly afterwards the late Dr. Falconer, while on a visit to Torquay, was informed of the discovery, and, after a careful inspection of the cave, he was so impressed with the opportunity here afforded of working out completely a new and untouched bone-cavern, that on his return to London he addressed the following letter to the Geological Society. This letter is given at length, as showing the state of the cave question at that period, and the objects to be attained by the exploration of the Brixham Cave.

"31 Sackville Street, W., 10th May, 1858.

"*To the Secretary of the Geological Society.*

"Sir,—I solicit the favour of your bringing the subject of this letter under the consideration of the Council.

"It is well known that a great and popular impulse was given to Geology in this country by the well-directed and eminently successful researches of the late Dr. BUCKLAND on the ossiferous caves of England. After the publication of the 'Reliquiæ Diluvianæ,' the subject in its general bearings was regarded as pretty well exhausted, so far at least as concerned the uniformity of character in the fossil remains found in the caverns, and their being referable to a single geological period. Since 1823 the interest in the subject has gradually fallen off; and it is probably not overstating the fact to say that there is hardly a general geological question in which the majority of geologists in this country take less interest at present than in what relates to the ossiferous caves. The subject has not advanced 'pari passu' with the progress in the investigation of the Upper Pliocene and Postpliocene deposits.

"It was understood that Dr. BUCKLAND before the close of his valuable life had intended to bring out a second edition of the 'Reliquiæ Diluvianæ,' in which some of the questionable views so earnestly advocated in the original work would have been greatly modified; but unfortunately the design remained unaccomplished, and the popular opinions in the cave-districts where collections were amassed have been mainly regulated by the doctrines embodied in the work as published in 1823.

"The consequences have been thus:—the Tunnel caves like 'Kirkdale,' which were haunts of predaceous carnivora, and the Fissure caves like 'Oreston,' that were filled from above, have been popularly regarded as containing the *débris* of the same mammalian fauna, and as having been overlaid with their ochreous loam by the same common agency at the same period. The contents of the different caverns were thus considered as being in great measure duplicates of one another; and the exceptional presence of certain forms in one case and their absence in another were regarded more in the light of local accidents than as significant of any general source of difference. Hence it followed that more attention was paid to the extrication of the bones and to securing good specimens, than to a record of their relative association and the order of succession in which they occurred. The remains have been, in some instances, huddled together in provincial collections—the contents of five or six distinct caves without a discriminative mark to indicate out of which particular cavern they came. Another consequence has been that, being regarded in the light of duplicates, the contents of some of the most important and classical English caverns have been dispersed piecemeal, and, so far as regards them, the evil is now beyond remedy.

"My object in this communication is to bring to the notice of the Council an interesting case of a newly discovered and intact cavern, where the mischief done elsewhere may be partly retrieved, and probably much effected, by combined action well directed.

"Within the last month a new and undisturbed cave has been discovered on 'Windmill Hill,' overhanging Brixham, in the same tract of limestone in which the caverns of Kent's Hole, Anstis Cove, Chudleigh, and Berry Head are found. A brief notice of the discovery appeared in the Exeter 'Western Times' of the 10th ultimo. Mr. EVEREST and myself went to see it on the 17th ultimo.

"'Windmill Hill' rises immediately above Bolton Street, in Brixham. The limestone strata crop out on the N.E. side, where they are very cavernous. A vertical channel running up the hill marks the line of a fault (joint?), the walls being separated by a seam of about 2 inches of yellowish loam. Near its base, in quarrying out a foundation for cottages, a concealed cavern was discovered blocked up by loam, rubbish, and breccia—on removing which an open cavity was seen, low and narrow at the mouth, but expanding inwards, and presenting the usual characters of the Plymouth limestone caves; water percolates from above with a copious drip, and the vault and floor are irregularly coated with stalagmite. On a shelving stalagmitic terrace in the interior we saw from a distance a pair of large Cervine horns horizontally imbedded in the stalagmite; and I distinguished bones of *Hyæna*, *Bear*, *Bos*, *Deer*, and *Horse* which had been picked out of the breccia. The interior of the cavern is blocked up by stalagmitic deposit; but from the hollow sound yielded on percussion, it would appear that there are undervaultings as in Kent's Hole. In another direction the stalagmite flooring descends suddenly in a chasm of undetermined depth. There are two external openings nearly at the same level, a considerable distance apart, which would seem to communicate with the same interior hollow; and it is probable that, like Kent's Hole, the Brixham Cave is of great extent with irregular ramifications. As in other similar cases, the principal deposit of fossil bones may be looked for under the stalagmitic floor not yet touched.

"Taking into account the vast richness of Kent's Hole in fossil remains, the dispersion of Mr. McEnery's collections, and the grievous fate of the MS. labours of about twenty years of his life*, it is submitted to the Council whether there is not a prospect of equal wealth in this promising and adjoining cave of Brixham, and whether the case is not one deserving of a combined effort among geologists to organize operations for having it satisfactorily explored before mischief is done by untutored zeal and desultory work.

"The importance of following up a case of this description has been forced upon my attention by some of the results of an examination of the cave-bone collections both in England and abroad, in connexion with the investigation of the distribution of the extinct Proboscidea in the European Upper-Tertiary deposits. I have during the last twelve months been more or less occupied with the conditions under which Elephant remains occur in the caves; and having lately returned from a tour in company with my friend the Rev. Robert Everest, during which we had made a *reconnaissance* survey of the caves in, or cave-collections from, the neighbourhood of Bristol, the Mendips, Devonshire, South Wales, Kirkdale, and Cefn, some of the results have appeared of sufficient interest to justify my trespassing on the attention of the Council with this communication. Of these I may mention the following:—

* This manuscript was fortunately recovered by Mr. E. Vivian, of Torquay, who, in 1859, published part of it together with seventeen of the original plates; the whole manuscript has since been edited by Mr. Pengelly and published in the Transactions of the Devonshire Association for the Advancement of Science, Literature, and Art for 1869.

"1st. The detection, in considerable abundance in certain of the caves, of the remains of a species of Rhinoceros, equally distinct from the *tichorhine* species of Siberia and of the Glacial period generally, and from the *leptorhine* Rhinoceros of CUVIER, of the subapennine Elephant-bed and Lacustrine deposits of the Norfolk coast. I have seen nearly the entire series of the upper and lower teeth *in situ* in the jaws, and from one of the caves a considerable portion of the skeleton associated with teeth and cranial fragments. The characters distinctive of the form from the species above referred to are so pronounced and so constant, and the material so abundant, that I have no doubts on the subject. I have designated the species provisionally *Rh. hemitœchus priscus**. The interest of the case is enhanced by its presumable relations to some important late investigations of M. LARTET, to which I shall refer in the sequel.

"2nd. Abundant evidence in all the cave-districts of two extinct species of Elephant, viz. *Elephas primigenius* (Mammoth) of the Glacial period, and *Elephas antiquus* of the subapennine period (Norwich Crag and the Astesan)—the former commonly associated in the English caves with the *tichorhine* Rhinoceros, the latter with *Rhinoceros priscus*. I have not observed among the cave-bones any indications of remains of *Elephas* (*Loxodon*) *meridionalis*, nor undoubted remains of *Elephas* (*Loxodon*) *priscus*.

"3rd. In one of the caves, where the evidence is tolerably conclusive that the bones were washed into a fissure about the same time, the following undoubted associations were seen:—

Elephas (*Euelephas*) *antiquus*,
Hippopotamus major,
Rhinoceros priscus,

without the admixture, so far as the collection went, of other species of the same genera.

"4th. In other caves *Elephas primigenius* and the *tichorhine Rhinoceros* were observed, without the admixture of *Elephas antiquus* and *Rhinoceros priscus*.

"5th. In one of the caverns the most important part of the skeleton of an *Elephas antiquus* was found together, supplying a desideratum of the European collections.

"6th. In none of the caves were any specimens observed referable to the *Rhinoceros leptorhinus* of CUVIER, as I regard that species to be limited.

"From what I have seen, I am strongly of the conviction that, with our present advanced knowledge, the thorough investigation of a well-filled virgin cave in England would materially aid in clearing up the mystery, either of the contemporaneity of the Pliocene mammalian fauna with the commencement of the Postpliocene fauna, or of the conditions and associations under which the former was replaced by the latter. M. LARTET, in a late communication to the French Academy, has thrown out a suggestion, the importance of which, if well founded, can hardly be overestimated, that the mixed

* "Having gone into a detailed examination of the remains, I find that the species *Rhinoceros hemitœchus priscus* is equally distinct from the existing African species and from *Rh. leptorhinus* and *Rh. tichorhinus*."—H. F. For Dr. FALCONER's later observations on the Rhinoceros, see his 'Palæontological Memoirs,' edited by Dr. MURCHISON, vol. ii. pp. 309–403.

mammalian fauna of the Glacial period has been made up of two distinct geographical elements—the one a northern division pushed southwards from Siberia and the north of Europe, consisting of the *Mammoth*, the *tichorhine Rhinoceros*, the *Irish Elk*, *Ursus spelæus*, *Bos primigenius*, &c.; the other a southern division projected northward from Mauritania through Spain and France, comprising the existing *African Elephant*, the existing two-horned *Rhinoceros* (*Rh. bicornis*), the *Lion*, *Panther*, two existing *Hyænæ*, *Hog*, *Antelope*, *Porcupine*, &c. M. LARTET affirms that Elephant remains from the Quaternary deposits of Spain which had been examined by him belong 'indubitablement à l'Éléphant actuel d'Afrique et au Rhinocéros bicorne vivant aujourd'hui dans la partie australe de ce même continent.'

"M. GERVAIS has described Rhinoceros remains from the cave of Lunel-viel under the name of *Rh. Lunellensis*, which he affirms are hardly distinguishable from those of the existing two-horned species, the agreement of the teeth being almost complete. M. LARTET states that certain Rhinoceros molars from Kirkdale exhibit the same line of resemblance.

"I have been induced by these circumstances to bring the case of the new Brixham Cavern to the notice of the Council.

"Ever your obedient Servant,

"HUGH FALCONER."

The Council of the Geological Society, not having at their disposal funds for undertaking such a work, addressed a letter to the President and Council of the Royal Society, by whom a grant of £100 was promptly made from the Donation Fund, on the understanding that any specimens obtained should be eventually deposited in the British Museum. This sum was afterwards increased by the liberal donation, through Mr. PENGELLY, of £50 from Baroness BURDETT COUTTS, £5 from Sir JAMES KAY SHUTTLEWORTH, £5 from R. ARTHLINGTON, Esq., and by a further grant of £100 from the Royal Society.

A Committee* of the Geological Society of London—consisting of Dr. FALCONER, F.R.S., F.G.S., *Chairman and Secretary*; Mr. J. PRESTWICH, F.R.S., F.G.S., *Treasurer*; Mr. WM. PENGELLY, F.R.S., F.G.S.; Professor RAMSAY, F.R.S., F.G.S.; Sir CHARLES LYELL, F.R.S., F.G.S.; Mr. R. C. GODWIN-AUSTEN, F.R.S., F.G.S.; Mr. GEORGE BUSK, F.R.S., F.G.S.; Dr. PERCY, F.R.S., F.G.S.; Professor OWEN, F.R.S., F.G.S.; Rev. R. EVEREST, F.G.S.; Mr. BECKLES, F.R.S., F.G.S., and the President and Secretaries of the Geological Society—was appointed to direct the general operations; whilst a Torquay local sub-committee, consisting of Mr. PENGELLY, Mr. EDWARD VIVIAN, Mr. STEWART, Colonel THORESBY, Mr. SHEPPARD, and Mr. HOGG, were deputed by the London Committee to cooperate with them and superintend the actual working of the cave. It is, however, to Mr. PENGELLY that the Committee are indebted for the active and constant superintendence of the work and for the record of each day's proceedings. This gentleman, in fact, saw personally to the execution of the whole work, noted all the physical features,

* Several of the members elected were, however, unable to attend; and only a limited number of the Committee, whose names are attached to this Report, were able to take part in the prolonged proceedings.

and arranged and tabulated all the specimens found in the Cave, devoting to the investigation an amount of care and time without which it would have been impossible for the London Committee to have obtained the exact record which is now submitted to the Society.

A satisfactory lease of the Cave having been obtained, the services of Mr. KEEPING, the experienced fossil collector of the Isle of Wight, were secured, and the work commenced on the 14th July, 1858. The plan of operations laid down by the Committee was progressively to break up and examine the stalagmite floor throughout, and to explore successively and separately each bed beneath it. In this manner it was considered that the succession of beds and the precise position and association of the organic remains would be best determined.

In the course of the summer the cave was visited by several members of the London Committee, and in September 1858 the work had so far advanced that the following Report was drawn up by Dr. FALCONER, in conjunction with Professor RAMSAY and Mr. PENGELLY.

"*Report of Progress in the Cave.*

"Having lately made a joint inspection of the 'Windmill Hill Cavern' at Brixham, we think it may be of interest to the London Committee to know our opinion of the progress already made in the excavations, and of the probable prospective results. We examined the cavern in company with Mr. PENGELLY, F.G.S., under whose zealous superintendence the operations are conducted, and of Dr. JOHN PERCY, F.R.S., who during his residence at Torquay has taken an active and lively interest in the exploration. Most of the points to be discussed in the sequel were freely discussed among us, and there was but little difference of opinion as to the bearing of the observations and the best plan of carrying on the work for the future.

[Then follows first an account of the extent and structure of the cave, so far as then explored, with a sketch ground-plan by Professor RAMSAY. The later surveys and fuller description render it unnecessary to repeat this preliminary description. See Palæontological Memoirs, vol. ii. p. 492.]

"Regarded in a general way, the Brixham Cave may be considered as partaking of the tunnel character of the Kirkdale Cave in the 'Flint-knife Gallery,' and of the fissure character of Kent's Hole and the Gower Caves in the 'Reindeer Gallery.' No vertical flues ascending towards the summit of the cliff have as yet been detected in the explored parts, such as were found in the Oreston Cave and in Paviland.

"2. *Workings.*—The conduct of the excavations was consigned by the London Committee to Mr. PRESTWICH and Mr. PENGELLY. The Committee, fully impressed with the probability of remains of different periods being met with at the different levels in the cavern floor, determined from the outset on working the upper deposits horizontally inwards, as far as might be practicable, on the same horizon, and then of working the lower deposits successively in the same manner. In this manner they considered that they would avoid the risk of confounding the remains of different levels, which is apt

to take place when excavating cave-bottoms vertically down to the rock floor, and which has vitiated the results obtained in many other cave-explorations, more especially in regard of the contested position of human industrial remains. The excavations were commenced on the 14th July by Mr. KEEPING, of the Isle of Wight, deputed by Mr. PRESTWICH for the purpose; and they have been conducted with such vigour and success that within six weeks the stalagmite floor of the 'Reindeer Gallery,' together with the ochreous cave-earth deposits below it, was entirely broken up, and the floor of the 'Flint-knife Gallery' explored from its interior termination to the external 'central entrance.' The 'Pen Gallery' was also laid open from its commencement on to the 'Big (south) Chamber,' and on a rough estimate about 1500 bones were exhumed between the 14th July and the 23rd August.

"3. *Successive floor deposits.*—We are able to enter on this part of the subject only in a general way, having taken no precise measurements of the incomplete sections at different intervals in the galleries. Where all the deposits are present, the following section was yielded:—

1. Layer of stalagmite of irregular thickness.
2. Cave-earth (ochreous), with limestone breccia.
3. Ochreous cave-earth, with comminuted shale.
4. Rounded gravel, depth undetermined.

"Occasional water-worn pebbles were found mingled with the organic remains in the upper deposit of cave-earth No. 2. The drip from the roof in wet weather is copious in all the fissure galleries, and the floor in these cases is covered with a cake of stalagmite; while in the intersecting Tunnel Gallery there is little or no drip from the roof, and the surface of the cave-earth is uncovered.

"4. *Organic Remains.*—Mr. PENGELLY estimates that about 1500 bones had been exhumed during the first six weeks of the workings. A large number of these, however, belong to skeletons of small animals, like the Rabbit and Fox, found near the surface; we consider that the great harvest of remains will be found in the low-level deposits which have not yet been penetrated. Remains of the following animals were identified by Dr. FALCONER:—

"*Rhinoceros tichorhinus.*—Detached upper and lower molars, in considerable numbers, of young and old animals; an astragalus bearing distinct marks of superficial gnawing, dug up in our presence.

"*Bos.*—Species undetermined; teeth, jaws, and other bones.

"*Horse.*—Species undetermined; a few remains.

"*Cervus tarandus.*—The cranial box of the skull found near the surface by the owner on the first discovery of the cave, and a very fine entire antler imbedded superficially in the stalagmite near the intersection of the galleries E E and F F (Reindeer and Flint-knife Galleries) over the Ebur chasm*.

* Formed by a thin crust of stalagmite stretching across a cavity in the cave-earth.

"Fragments of antlers of other Deer; species undetermined.

"*Ursus spelæus.*—Lower jaws of young and old individuals with numerous detached canines and other teeth in fine preservation. A superb specimen of a left hind leg, comprising the femur, tibia, and fibula folded together, with the patella and astragalus *in situ*. These were found near the 'Ebur chasm;' and the other parts of the skeleton may be looked for when that portion of the cavern is dug up.

"*Hyæna spelæa.*—Teeth, fragments of the skull, lower jaws, and other bones.

"The above is nothing like a complete list of the animal remains found in the cave; but, considering that the workings have hitherto been restricted to the least productive and superficial deposits, it will suffice to show that the anticipations formed of the cavern were not too sanguine, and that the excavations are well worthy of being followed up vigorously; some of the results already arrived at are of great general interest.

"5. *Human Industrial Remains* (?).—Several well-marked specimens of the objects called 'Flint Knives,' and generally accepted at the present day as the early products of rude Keltic or pre-Keltic industry, have been exhumed from different parts of the cavern, mixed in the ochreous earth indiscriminately with remains of *Rhinoceros*, *Hyæna*, and other extinct forms. One of these so-called 'Flint Knives' was brought up from the deposit No. 2 from a depth of 30 inches below the superficial stalagmite No. 1. We failed in detecting evidence that these so-called 'Flint Knives' were of a different age, as regards the period of their introduction, from the bones of the extinct animals occurring in the same stratum of cave-earth, or that they were introduced into the cavern by different agencies. SCHMERLING discovered, in the caves of Engis and Chokier, near Liége, well-marked flint knives and arrow-heads mingled, in the ochreous mud and gravel, with the bones of extinct mammalia, which he inferred had been washed in by the agency of running water; these included *Mammoth*, *Rhinoceros*, and *Hyæna*. DELPON and JOUANNET have made corresponding observations as to a similar mixture in the caves of Quercy and Périgord; MARCEL DE SERRES, DE CHRISTOL, TOURNAL, and DUMAS have inferred the same, in numerous caves in the south of France. The attention of Mr. PENGELLY has been closely directed to a careful and minute observation of the circumstances of the association in the Brixham cavern. The results of the exploration of each day are carefully put aside and labelled; and it may be anticipated that data will be arrived at for settling the disputed question of the contemporaneous introduction, or otherwise, of the supposed human industrial objects into the cavern along with the remains of the extinct mammalia.

"6. One result of great interest has already been brought out, namely, the superposition of undoubted remains of the Reindeer above the so-called 'Flint Knives,' from which the inference arises that the 'Reindeer' continued to be an inhabitant of Britain after the appearance of man in this island. A fine horn of a Reindeer, nearly perfect from the basal burr to the terminal branches of the beam, and presenting a bez-antler 17 inches long terminating in palmated snags, was discovered, superficially imbedded in the stalagmite, close to the 'Ebur chasm.' Near the same place a flint knife was brought up

from the ochreous earth 30 inches* below the stalagmite. Professor OWEN has noticed the occurrence of Reindeer remains in the 'Ash Hole' cavern of Berry Head, explored by the Rev. Mr. LYTE; Dr. FALCONER has identified skulls of the same species found in the Mendip caverns; and Major WOOD, of Stout Hall, has discovered skulls of it in the caves of Spritsail and Paviland, in Gower.

"In these instances there was no indication of their association with man; but in the Brixham cavern the evidence, so far as it goes, clearly tends to show that the antler in question was one of the latest introductions into the cavern before the (road) Entrance was blocked up by the rubbish, and long subsequent to the entombment of the objects called 'Flint Knives.'

"7. On the whole we consider the progress made to be highly satisfactory, and the promise of future results to be so encouraging as to merit the best efforts of the Committee to provide the means for following up the excavation. The grant from the Royal Society, together with Miss BURDETT COUTTS's liberal donation, however carefully husbanded, will not cover the very moderate scale of expenditure within which the operations are at present conducted beyond the month of December. A further grant may with some confidence be expected from the Royal Society next summer; but we invite the earnest attention of the Committee to devise ways and means to meet the expense of the excavation until then.

(Signed) "H. FALCONER, M.D.
"ANDREW RAMSAY.
"9*th September*, 1858." "WM. PENGELLY."

In November 1858, on the application of the Committee for assistance in making an exact plan of the cave, the Director-General of the Geological Survey, the late Sir RODERICK MURCHISON, obligingly instructed Mr. BRISTOW, F.R.S., a member of the Survey, to proceed to Brixham and carry out the objects the Committee had in view.

An excellent plan of the cave and various transverse sections were taken by Mr. BRISTOW, showing the form of the cave and the mode in which the cave-deposits were arranged.

At that period the whole of the stalagmite, the bed of breccia, the cave-earth, and part of the lower bed of gravel had been removed. After the removal of the whole of the latter bed, and the cave had been completely emptied, the Committee employed Mr. BOVEY, of Brixham, to complete the survey of those portions of the cave worked out subsequently to Mr. BRISTOW'S visit. The lower lines in the sections, and the central lines in the plan, form the additions made by Mr. BOVEY. The result of this combined work has been carefully correlated and reduced to a small scale by Mr. JORDAN, under the superintendence of Professor RAMSAY.

The map is compiled, from those of the Geological Survey and Dr. HOLL, by your reporter, who has also introduced into Mr. BRISTOW'S sections some few alterations in the form of bed No. 4 and position of *s'*, which were necessary in order to make them in

* Should be 9 inches. The right figure is given in Dr. FALCONER'S notes.

accordance with Mr. PENGELLY's observations and sections, which give many special features that could only have been noted, as they were by him, during the progress of the work.

The Report drawn up for the Committee by Mr. PENGELLY consists of three parts:—1st, "Topographical and Historical details," the essential points of which are embraced in the next chapter; 2nd, "Results of the Exploration," which contains a valuable and minute account of the contents of the cave and of the finding and distribution of the organic remains,—this is given in full in § III.*; 3rd, "Of Inferences from the facts discovered,"—although these have not been adopted by the Committee, the essential theoretical views† of Mr. PENGELLY on the origin of the cave and its contents are given and discussed with others in the "General Conclusions" (§ VIII.). In addition to this, Mr. PENGELLY handed in a "Daily Register"‡, containing an account of each day's discoveries or "finds."

Mr. BRISTOW's survey was also accompanied with some remarks on the structure and origin of the cave. Much of this is superseded by Mr. PENGELLY's more continued and complete record; but those of Mr. BRISTOW's remarks and opinions are introduced which serve either to amplify or more fully explain some point, or where the conclusions to which they lead are different. His descriptive notes are given in § IV.

The Flint Implements have been made the subject of some interesting observations by Mr. JOHN EVANS, and the more important specimens are figured (§ VII.).

As it was at the instigation of the late Dr. FALCONER that this investigation, in which he took a deep interest, was undertaken, the Committee had looked forward, but for his untimely and lamented death, to a report on the animal remains from his pen. From the same hand also they had hoped to receive the General Report. With respect to the accomplishment of the first object, Mr. GEORGE BUSK kindly took charge of his friend's notes on the subject, and has furnished the Committee with a valuable Report on the bone remains found in the cave, together with some important observations on the species of fossil Bears (§ VI.).

The Treasurer was deputed by the Committee to describe the lithological specimens and to draw up the General Report. By the terms of the grant the object of this inquiry was the "Exploration of the Brixham Cave." By this your reporter understands such a complete description of the cave and of its organic remains, and such a discussion of its origin, as may serve as a basis for further study and for more extended generalization. Referring, therefore, for information on the first of these essential points to the communications of Mr. PENGELLY and Mr. BUSK, he has limited his general observations to conclusions incidental to this special case, deeming it better to abstain from any more general considerations foreign to the immediate object of the inquiry (§ VIII.).

* With a very few alterations to avoid repetitions and to obtain uniformity of references, and by the introduction into Table I. of the dates taken from the Daily Register.

† These, we have reason to hope, will form the subject of a separate memoir elsewhere by Mr. PENGELLY.

‡ Compiled from the notes kept by him and by Mr. KEEPING, who was also always on the spot. The "finds" of each day are tabulated in Mr. PENGELLY's Tables and Mr. BUSK's Report, Parts 1 & 2.

II. *General features of the district; Position of the Cave.*

The town of Brixham is situated at the entrance of a narrow valley on the southern shore of Torbay, nine miles south of Torquay (see Map, Plate XLI.). The small stream which flows through the town into the harbour has a course only of $2\frac{1}{2}$ miles. The first part is over Devonian slates and grits; at Brixham it passes through a belt of limestone about a mile wide, and which, running parallel with the coast, terminates at Berry Head. To the north of the town is Furzeham Hill, 177 feet high. To the south, Windmill Hill (on the north-western angle of which the cave is situated) and Heath Hill rise respectively to the height of 175 and 190 feet; while to the westward, Parkham Hill is 164 feet above the level of the mean tide (Ordnance Survey maps). A small affluent passes between Windmill and Parkham Hills. The watershed between Brixham valley and that of the Dart rises to the height of from 400 to 550 feet.

Mr. Pengelly states that "Windmill Hill is entirely composed of impure thin-bedded, cleaved and jointed limestone belonging to the Devonian system,"—one set of joints having a "prevalent direction of N. 82° E. to S. 82° W., and the second running nearly magnetic north and south. In fact they have the bearings of the Brixham valleys." "The planes of the first underlie or dip southward, whilst those of the second are approximately vertical. The stratification and cleavage-planes intersect at an angle of about 40°, and with the joints cause the rock to break readily into pieces of small dimensions. The dip of the strata is about 38° north, 10° east, magnetic.

"Devonian slates, frequently traversed by thick veins of quartz, are largely developed at and south of Mudstone Bay; and a considerable mass of greenstone occurs at Sharkham Point, the headland south of Berry Head*.

"Deposits of iron-ore occur in various parts of the district. That at Sharkham Point is the red or anhydrous hematite, whilst that found elsewhere is the brown or hydrous variety. The most important deposit of the latter occurs at Furzeham. There are no indications of iron on Windmill Hill.

"A raised beach extends along the northern slope of Berry Head Hill, about 30 feet above the sea-level. It is chiefly composed of limestone pebbles, but fragments of flints and other rocks are by no means rare." There is another 'raised beach,' on the same relative level, at Hope's Nose, near Torquay, which contains shells identical with those at present existing in the adjacent sea†.

Mr. Pengelly further states that the district is generally free from all superficial deposits, except occasionally small depressed patches of sand and gravel, which also sometimes fill narrow fissures in the limestone and extend to considerable depths. The gravel is composed largely of fragments of quartz, greenstone, and other rocks not of immediate derivation. No fossils have been found in the sand or gravel. A red loam

* On the Geological Survey Map another mass of greenstone is marked near the River Dart.

† Mr. Godwin-Austen gives the following list of them:—*Cardium edule, C. tuberculatum, Cyprina islandica Modiola modiolus, Ostrea edulis, Pecten maximus, P. varius, Venerupis decussata, Littorina littorea, Murex erinaceus, Patella vulgata, Turritella terebra,* and *Serpula* (Trans. Geol. Soc. vol. vi. p. 442).

also caps most of the limestone hills. Peaty masses with prostrate trunks and erect stumps of trees occupy the mouths of most of the valleys terminating in Torbay, and extend beneath the sea to at least the depth of 5 fathoms, that is to the entrance of the Bay. This does not occur off Brixham; but traces of it were found a short way up the valley *.

The entrance of the cave, which is on the line of a north and south joint (Plate XLI. *f*, fig. 1), was calculated by Mr. Bristow trigonometrically† to be 93 feet above high-water mark; whilst Mr. Bovey made it 94 feet 11 inches by levelling, or about 66 feet above the level of the stream in the valley in front of the cave. It is therefore rather more than halfway to the top of the hill, the slope of which is without steep escarpments, but with a terrace at the level of 150 feet (Plate XLI. fig. 2‡).

The work of exploration was completed in the summer of 1859, the cave having been then emptied so far as it could be followed, although Mr. Pengelly observes "that galleries certainly extend beyond the point reached by the workmen." It is probable that the hill is in fact traversed by a number of such fissures.

Respecting the manner in which the exploration was conducted, Mr. Pengelly remarks:—"It was decided first to remove the stalagmitic floor, then the entire bed immediately below (if not of inconvenient depth) horizontally throughout the length of the cavern, or so far as practicable; this accomplished, to proceed similarly with the next lower bed, and so on until all the deposits had been removed.

"The more effectually to guard against the chance of error, the materials were first carefully examined *in situ*, after which they were taken at once outside the cavern, where they underwent a further inspection. In no instance were they removed, for even temporary convenience, from one part of the cavern to another.

"Whenever a bone or other article worthy of preservation was found, its situation (that is to say, its distance from the mouth or entrance of the gallery in which it occurred, as well as its depth below the surface of the bed in which it lay) was carefully determined by actual measurement. In order to their identification, the specimens were all numbered; those which were found in the same place received the same numeral, and were packed in one and the same box, so that at the close of the exploration the number of boxes indicated the number of localities in which fossils had been found; the boxes were also distinguished by numbers, each bearing that which each specimen within it bore. Finally, an entry of each box was made in a journal, in which were registered the number and situation of the specimens it contained, with the date on which they were found, and occasionally a few remarks respecting them."

* For fuller accounts of the geology of the district the reader can consult Sedgwick and Murchison's paper "On the Older Stratified Deposits of Devonshire," Trans. Geol. Soc. 2 ser. vol. v. p. 633; R. C. Godwin-Austen "On the Geology of the South-east of Devonshire," *ibid.* vol. vi. p. 431; Dr. Holl "On the Older Rocks of South Devon," Quart. Journ. Geol. Soc. vol. xxiv. p. 400.

† The observations were made during extremely stormy weather.

‡ The valley line is represented in the figure as descending too low.

III. Mr. PENGELLY'S *Report on the Structure and Contents of the Cave.*

Character and Extent of the Cavern.—On the termination of the work the cavern was found to be comprised within a space measuring 135 feet from north to south and 100 from east to west, to consist of a series of galleries with two small chambers, and to have four external entrances, one in the northern and the remaining three in the western slope of the hill (see Plate XLII.).

The northern (original) entrance is that which from the beginning to the end of the work was used as the working entrance. It was commonly called the "Dyer's* Entrance." The photograph was taken the day before the work began (Plate XLI. fig. 1)†.

The galleries, which measure from 6 to 8 feet in greatest width and from 10 to 14 feet in height, resolve themselves into two sets or systems, having strictly the same bearings as the joints of the Devonian rocks of the district.

It is not intended to imply that the absolute dimensions of the cavern have been ascertained. Narrow ramifications probably extend very far into the hill‡, and there is reason to believe that the cavern as it now exists is but a fragment of what it once was.

Principal Branches of the Cavern.—It was found convenient to give names to the various divisions of the cave; and though some of them may be considered somewhat fanciful, they are retained here in order to prevent confusion.

The Reindeer Gallery (that proceeding southward from the north entrance) is 135 feet in length, and is divided into a northern and a southern branch by a narrow passage 15 feet long, and varying from 15 to 18 inches wide. This part of the gallery was known as the *Crystal Gorge*, because when discovered its northern end was completely filled with stalactitic matter.

The Steep Slide Hole descends somewhat spirally (from the Reindeer Gallery) at an angle of upwards of 40°. It gradually diminishes in width, and at the depth 40 feet is too narrow for working.

Kelly's Gallery (which also branches from the same part of the Reindeer Gallery) is several feet wide at the entrance, contracts somewhat rapidly towards the inner end, and ultimately becomes a small almost vertical flue, which probably reaches the surface of the hill.

* This name was given to this entrance from the circumstance that the owner of the quarry was a dyer of the name of PHILP. We have changed this to "road" or "north" entrance as better indicating its position.

† Mr. PENGELLY says that "the distances in the Reindeer Gallery, including those in Tables I. and IV., were all measured from the point where the foot of the hill met the road, *i. e.* the actual commencement of the cavern as we first knew it, *i. e.* the "Dyer's Entrance." The photograph of the Cave represents the Reindeer Gallery about 22 feet south of the Dyer's Entrance, *i. e.* the road."

‡ "Some of the galleries certainly extend beyond the points reached by the workmen, but they had become so very narrow as to render the work extremely toilsome; in no instance, however, was the excavation abandoned until long after it had ceased to yield fossils or other objects of interest."

The *Pen Gallery* is a small tunnel with a continuous limestone floor, and connects the West and South Chambers.

The *Flint-knife Gallery* opens out of the right or west wall of the Reindeer Gallery at 64 feet from the north entrance. It is about 7 feet wide, throws off two narrow branches on the south and one on the north, extends almost due west for about 50 feet, where it becomes somewhat funnel-shaped, and terminates in the West Chamber.

Keeping's and Munday's Galleries are lateral branches of the *South and West Chambers* respectively, and are without any features requiring description.

Near the centre of the South Chamber a short pillar-like mass of limestone connects the floor and roof.

Of the *two external entrances* which open out of the West Chamber, the base of one is slightly above the vertex of the other. They were known as the first and second West Entrances respectively.

During the excavation of King's Gallery the entire mass of rock which formed its northern or outward wall, and which was estimated at one hundred tons, fell and stopped all further progress in that direction.

The roof of the Cavern.—The northern end of the Reindeer Gallery was an open cutting in the limestone without the trace of a roof for the first 5½ feet, and it had only a partial roof for the next 10½ feet, and terminated as an open fissure 16 feet south of the road. The hole through which Mr. PHILP first entered was 4 feet still further south. Excepting in the Flint-knife Gallery, a well-marked longitudinal joint everywhere exists at the vertex of the roof, through some parts of which, especially in the Reindeer Gallery, a somewhat copious drip, quite free from earthy admixture, enters in wet weather. Though distinctly marked in the Steep Slide Hole, this roof-joint is too close fitting to allow even the passage of water. A transverse or north and south open fissure, about 18 inches wide, crosses the roof of the Flint-knife Gallery, and corresponds with the narrow lateral branches which open out of the north and south walls of this division of the cavern. When discovered it was filled with angular blocks of limestone, having fine earthy matter between them. Its situation is shown at "*m*," fig. 2, Plate XLIII.

The walls of the two principal Galleries.—Vertical cross sections taken in various parts of the two principal galleries (see figs. A, B, C, D, & G, Plate XLIII.) show that the walls are very irregular, whether different sections are compared with one another or the outline of any one alone is considered. Of those taken in the Reindeer Gallery the axes are vertical (figs. A to F); whilst in the Flint-knife Gallery they dip or underlie towards the south (fig. G), thus agreeing with the joints the directions of which they respectively have.

Notwithstanding this irregularity, however, there are certain characters which the walls possess everywhere. For example, all their angles are rounded off; their surfaces, especially where they are concave, have a sort of rough polish, like that produced by

running water carrying detrital matter in a sensibly horizontal direction; and at corresponding levels in the opposite walls there are two pairs of broad deep grooves, which, without sensible inclination, run along the entire length of the galleries (see *a a* & *b b*, figs. D, E, G, Plate XLIII.). In the *Pen Gallery* the lowest pair only exists. The abrasion or polish of the walls is most strongly marked in the Steep Slide Hole.

The Limestone Floor of the Galleries.—The limestone walls, as seen in figs. D, E, F, commonly curve inwards below the lowest pair of grooves; but instead of meeting so as to form a continuous floor, they remain separated by a central longitudinal fissure, which varies from 3 to 18 inches in width, and averages about a foot. In the eastern 14 feet of the Flint-knife Gallery the floor is perfectly continuous, there being no trace of a fissure, nor indeed of any line of fracture (fig. G). Towards the northern end of the Reindeer Gallery (fig. C) there are two such floor-fissures, and each wide enough to admit of working to a greater depth than elsewhere in the galleries.

A north and south fissure crosses the floor of the West Chamber (Plate XLIII. fig. 2, *m*), and communicates with the South Chamber through an "undervaulting;" this, though somewhat wider than the floor-fissures are elsewhere, gradually narrows downward.

The Ceiling.—Throughout a considerable part of both the north and south branches of the Reindeer Gallery, what may be called a *Stalagmitic Ceiling* (*s'*) extends horizontally from wall to wall. It varies from 6 inches to upwards of a foot in thickness; and through the considerable openings which occur in it an unoccupied space is seen above, which varies from 15 inches to more than 2 feet (*o*, figs. C, D, E, & fig. 1). In several instances pieces of old stalagmite, angular, subangular, and well rounded, together with small pieces of quartz and limestone, are firmly cemented to its inferior surface.

A few stalactites depended from the roof in the Reindeer and Pen Galleries, and also in the South Chamber; and here and there the same branches of the cavern were ornamented with pillars and curtains of the same material.

A Floor of Stalagmite (*s*), varying in thickness from a few inches to upwards of a foot, commenced in the Reindeer Gallery about 17 feet south of the entrance (that is, 1 foot within the commencement of the unbroken roof), and extended over the detrital accumulations southwards into, but not through or beyond, the Crystal Gorge. A lateral branch of this "floor" extended into the Flint-knife Gallery, where it gradually thinned out to a mere film (Plate XLIII. figs. 1 & 2).

It was generally of a pure white or cream colour, unsoiled by earthy matter; but in a few instances soil-stains were conspicuous. Vertical sections showed it to be very distinctly laminated, the layers varying in thickness, and being sometimes alternately crystalline and earthy. It attained its maximum thickness near the northern end of the

Crystal Gorge. Similar floors existed in the Pen and Keeping Galleries, and in the South Chamber, but not elsewhere.

The detrital accumulations in the principal galleries were separable into distinct beds, and were respectively designated the "First," "Second," "Third," and "Fourth" (see sections, Plate XLIII.).

The First Bed was that mass of small angular fragments of limestone, cemented into a compact breccia by carbonate of lime, which filled the northern end of the Reindeer Gallery when the cavern was discovered. It was about 34 feet long, and from the commencement of the entire roof formed an inclined plane dipping southwards to a little beyond the mouth of the Steep Slide Hole, where it terminated.

The Second Bed was a thin layer of blackish matter, which the workmen were accustomed to speak of as the charcoal bed. Dr. PERCY, however, who saw it *in situ*, stated that it did not contain any thing entitling it to this appellation. It extended from 12 feet south of the entrance to near the mouth of the Steep Slide Hole, and lay immediately beneath the first bed. Its greatest thickness did not exceed 1 foot, which it attained about 2 feet from its commencement, and it gradually thinned out southwards. No organic remains were found in it, nor did any thing resembling it occur elsewhere in the cavern.

The Third Bed, sometimes called the *Loam Bed* and the *Bone Bed*, consisted of a reddish-brown, tenacious, clayey loam, and contained a large number of angular and subangular fragments of limestone, which varied in size from very small bits to masses weighing even a ton. The large blocks were found only in the West and South Chambers, and in the gallery connecting them, where the angular character of the roof, unlike that which obtained elsewhere, as well as the fact that the blocks were confined to the upper portion and surface of the deposit beneath, showed that they had fallen from above at a comparatively recent period. *Pebbles* of quartz, trap, and limestone were of frequent occurrence, especially in the Flint-knife Gallery and in the West Chamber. *Nodules of iron-ore*, well rounded, as if by travel, were occasionally met with in both the principal galleries. Dr. PERCY pronounced them all to be specimens of the brown or hydrous hematite. Fragments of stalagmite, apparently portions of an old floor, were also found in this bed in the West Chamber, the western part of the Flint-knife Gallery, and in the Steep Slide Hole—portions of the cavern in which it does not appear that a floor of this kind ever existed. Some of them measured as much as 18 inches square, and from 3 to 4 inches thick. At least a cartload of this material must have been found.

Ordinarily the third bed measured from 2 to 4 feet thick, the variations being due partly to inequalities in the surface of the deposit next below, and partly to the fact that the latter was invariably from 4 to 9 inches lower at the sides than in the middle of the galleries.

Besides the inequalities just alluded to, there were two of a more marked character:

thus at about 15 feet south of the north entrance, and adjacent to the west wall of the Reindeer Gallery, the "bone-bed" occupied a funnel-shaped pipe (*c*) 5 feet deep, 12 and 4 inches in diameter at its upper and lower ends respectively, and penetrating vertically downwards into the bed below; and in the West Chamber the loam filled in the inferior bed a basin-shaped hollow (*d*) almost as large as the chamber itself, and upwards of 4 feet deep (fig. 2, Plate XLIII.).

The West Chamber and the adjacent portion of the Flint-knife Gallery were completely filled to the roof (Plate XLIII. fig. 2). It may be doubted, however, whether the materials above what may be called its ordinary level should be regarded as really a portion of the third bed. They consisted of thin fragments of limestone and a small quantity of dry inadherent earthy matter of a drab colour, instead of the tenacious reddish loam so characteristic of bone-caverns. . . . . It is probable that much of these materials fell through the cross fracture (*m*) in the roof of the Flint-knife Gallery, and perhaps at a comparatively recent period.

With the exception of most of those found in the "basin" just mentioned every unequiaxed object lay with its longest axis in the plane of the bed, and the shortest at right angles to it; in other words, their centres of gravity occupied the lowest position possible. In the basin "*d*," on the contrary, such objects were commonly found sticking in the loam at right and various other high angles to the plane of the horizon.

At the northern end of the Crystal Gorge, within the vertical range, and forming part of the third bed, there were six or seven plates of compact, crystalline, soil-stained, finely laminated stalagmite, extending horizontally from wall to wall one over the other in a vertical series, and alternating with an equal number of interstratified layers of the ordinary reddish loam, which, as well as the plates of stalagmite, varied from half an inch to upwards of an inch and a half in thickness.

The Fourth or Gravel Bed was in all cases the basis on which the third was deposited; it consisted mainly of pebbles of different kinds of rock,—quartz, greenstone, grit, and limestone, mixed with small fragments of shale common in the Brixham district. In short it was made up essentially of such materials as were amongst the accidents of the bed above, and which, with the sole exception of the limestone fragments, were not derivable from Windmill Hill. Two of the pebbles were so remarkably round that, in addition to samples of the gravel, it was thought desirable to preserve them amongst the specimens illustrative of the cavern. The first is a sensibly spherical red sandstone ball, about $1\frac{1}{2}$ inch in diameter, and was found near the upper surface of the bed at the mouth of the Steep Slide Hole. Balls of this character, probably of concretionary origin, are common in the New Red Sandstone at Dawlish and other parts of south-eastern Devonshire. The second is larger, less spherical, and composed of very compact grit approaching to quartzite. It was found in the West Chamber in the upper portion of the bed. Though in most cases a loose aggregation of pebbles, the gravel was occasionally cemented into a conglomerate. In the easternmost 14 feet of the

Flint-knife Gallery the gravel rested on a continuous limestone floor, but elsewhere its base has not been reached, the floor-fissure being too narrow to allow of working to the bottom.

The loam which, as previously mentioned, occupied the "basin-shaped hollow" (*d*, fig. 2) in the fourth bed was not in contact with the lower part of the western wall of the West Chamber, but was separated from it by a steep talus of gravel, the summit of which was a very few inches below the base of the first west entrance, and about as much above the vertex of the second. Hence the former entrance was filled exclusively with materials of the third bed, and the latter with those of the fourth. This was the highest level to which the gravel attained.

Lines of Inclination in the two principal Galleries.—The longitudinal axes of the limestone floors of the principal galleries were sensibly horizontal. Though, as has been remarked, the "wall-grooves" were without *sensible* inclination, careful measurements showed that both pairs dip, at about two degrees, from the West Chamber, continuously through the Flint-knife and Reindeer Galleries, to the mouth of the Steep Slide Hole. Beyond the latter point to the north entrance they are not so well defined, but their dip is in the opposite direction, and amounts to four or five degrees. In the Pen Gallery the inclination is southwards—that is, from the West to the South Chamber.

Omitting the detrital accumulations in and immediately adjacent to the north and first and second west entrances, the dips of both the third and fourth beds corresponded, in amount and direction, to that of the grooves in the same branches of the cavern. But between the eastern end of the Flint-knife Gallery and the northern end of the Crystal Gorge the inclination of these beds was southwards—that is, from the former to the latter point.

In the Reindeer Gallery the stalagmitic floor dipped southwards, at an angle of 25°, from its northern end to a few feet beyond the Steep Slide Hole; thence to the eastern end of the Flint-knife Gallery its dip was reversed in direction and greatly diminished in amount; and from the latter point to the Crystal Gorge it again dipped southward, but still at a small angle. The exceptionally large inclination at the northern end was due to the fact that there the stalagmite covered the talus formed by the first bed, beneath which the second and third beds lay.

Deposits in the less important parts of the Cavern.—The description just given of the "Third" and "Fourth" Beds applies only to the West Chamber, the Flint-knife Gallery, and the northern branch of the Reindeer Gallery.

South of the Crystal Gorge the deposit was a mixture of loam, fine sand, and finely comminuted shale in variable proportions, occasionally cemented and stained with ferruginous matter. It was commonly disposed in distinct layers, which, instead of being horizontal, were parallel to the limestone walls, and therefore approximately vertical. The loam was much paler than the typical red cave-earth, and contained no stones.

KELLY'S Gallery was filled to the roof with an accumulation having precisely the same characters, both positive and negative. In short in both these branches the materials were such as to suggest that they were perhaps introduced through small crevices or flues which possibly occur in the roof.

The Pen Gallery and MUNDAY'S Gallery contained third-bed materials only; the latter, however, was too narrow to be excavated at any great depth.

The deposit in the South Chamber, KEEPING'S Gallery, and KING'S Gallery was a mixture of such materials as composed the "third" and "fourth" beds.

Shells.—A considerable number of dead land-shells of existing species were found in the stalagmitic floor and under loose stones lying on the surface in that part of the Flint-knife Gallery where there was no stalagmite. A few were met with also in, and immediately beneath, the stalagmite itself. They were most numerous near the external entrances and under the cross fracture in the roof of the Flint-knife Gallery (Plate XLIII. *m*, fig. 2). A common limpet-shell was found on the surface of the third bed immediately beneath this roof-fracture, and was the only marine organism met with.

Mammalian Remains.—Bones were found in the stalagmite and in the first, third, and fourth beds. Their distribution is shown in the following Table:—

TABLE I.

Nos. affixed to each day's find.	Date when found.	Branches of the cavern where found.	Distances from the entrance of each gallery.	Beds.	Depths in the beds.	Thickness of overlying detrital bed.	Thickness of overlying stalagmite.	Distances from nearest external entrance.	Numbers of bones found in each locality.
	1858.		feet.		inches.	inches.	inches.	feet.	
1.	July 16.	Reindeer Gallery	15	First	18	0	0	15	12
2.	17.	„ „	19	„	18	0	6	19	10
3.	19.	„ „	19	Third	24	50	6	19	1
4.	20.	„ „	20	„	24	47	6	20	9
5.	„	„ „	23	„	21	37	6	23	1
6.	„	„ „	24	„	18	33	6	24	2
7.	21.	„ „	29	„	12	17	6	29	10
8.	22.	„ „	39	„	9	0	6	39	3
9.	23.	„ „	37	„	6	0	6	37	3
10.	„	„ „	32	„	6	0	6	32	1
11.	24.	„ „	47	„	9	0	8	47	2
12.	26.	„ „	47	„	10	0	8	47	4
13.	27.	„ „	76	„	6	0	3	76	6
14.	28.	„ „	70	„	2	0	4	70	52
15.	„	„ „	67	„	7	0	4	67	1
16.	29.	„ „	71	„	30	0	4	71	1
17.	30.	„ „	67	Stalagmite	...	0	4	67	1
18.	„	„ „	36	Third	36	0	6	36	1
19.	31.	„ „	71	„	30	0	4	71	10
20.	Aug. 2.	Flint-knife Gallery	2	„	0	0	3	56	25
21.	„	Reindeer Gallery	70	„	14	0	4	70	1
22.	„	Flint-knife Gallery	1	„	9	0	3	57	9
23.	„	Reindeer Gallery	69	„	28	0	4	69	4
24.	3.	„ „	68	„	33	0	4	68	30
25.	4.	Flint-knife Gallery	4	„	0	0	3	54	65
26.	„	„ „	3	„	6	0	3	55	11
27.	„	„ „	3	„	9	0	3	55	1
28.	5.	„ „	7	„	0	0	2	51	121

TABLE I. (continued).

Nos. affixed to each day's find.	Date when found.	Branches of the cavern where found.	Distances from the entrance of each gallery.	Beds.	Depths in the beds.	Thickness of overlying detrital bed.	Thickness of overlying stalagmite.	Distances from nearest external entrance.	Numbers of bones found in each locality.
	1858.		feet.		inches.	inches.	inches.	feet.	
29.	Aug. 6.	Flint-knife Gallery	10	Stalagmite	...	0	2	48	6
30.	„	„ „	11	Third	3	0	1	47	7
31.	„	„ „	7	„	16	0	2	51	4
32.	„	„ „	9	„	33	0	2	49	2
33.	7.	„ „	12	„	0	0	1	46	9
34.	„	„ „	12	„	9	0	1	46	2
35.	„	„ „	10	„	36	0	2	48	9
36.	9.	„ „	17	„	13	0	0	41	4
37.	„	„ „	19	„	28	0	0	39	5
38.	10.	„ „	23	„	4	0	0	35	18
39.	„	„ „	20	„	24	0	0	38	7
40.	11.	„ „	24	„	34	0	0	34	8
41.	12.	„ „	29	„	14	0	1	29	2
42.	„	„ „	26	„	33	0	0	32	6
43.	13.	„ „	40	„	0	0	0	18	2
44.	14.	„ „	34	„	58	0	0	24	12
45.	16.	„ „	36	„	60	0	0	22	2
46.	17.	„ „	49	„	30	0	0	9	2
47.	„	„ „	42	„	36	0	0	16	6
48.	„	„ „	42	„	42	0	0	16	9
49.	18.	„ „	26	„	42	0	0	32	1
50.	„	„ „	36	„	54	0	0	22	1
51.	19.	„ „	40	„	60	0	0	18	29
52.	20.	„ „	46	„	60	0	0	12	64
53.	„	„ „	49	„	36	0	0	9	1
54.	24.	West Chamber ...	10	„	48	0	0	0	44
55.	25.	„ „	3	„	48	0	0	5	1
56.	26.	„ „	4	„	63	0	0	4	13
57.	27.	„ „	4	„	60	0	0	4	40
58.	28.	„ „	4	„	96	0	0	4	5
59.	„	„ „	4	„	0	0	0	4	1
60.	31.	„ „	2	„	54	0	0	6	3
61.	Sept. 1.	„ „	4	„	60	0	0	4	14
62.	2.	„ „	3	„	57	0	0	5	16
63.	3.	„ „	8	„	84	0	0	2	15
64.	5.	„ „	6	„	108	0	0	4	30
65.	7.	Flint-knife Gallery	50	„	66	0	0	8	10
66.	9.	Pen Gallery	6	Stalagmite	...	0	0	...	1
67.	10.	South Chamber...	...	„	...	0	0	...	2
68.	13.	„ „	...	„	...	0	0	...	2
69.	14.	„ „	...	„	...	0	0	...	2
70.	15.	West Chamber ...	7	Third	48	0	0	3	6
71.	18.	South Chamber...	...	„	0	0	9	...	2
72.	23.	West Chamber ...	5	„	156	0	0	5	9
73.	24.	„ „	5	„	156	0	0	5	23
74.	25.	„ „	5	„	156	0	0	5	5
75.	28.	„ „	5	„	156	0	0	5	13
76.	29.	„ „	6	„	132	0	0	4	2
77.	30.	Flint-knife Gallery	40	„	96	0	0	18	2
78.	Oct. 1.	„ „	36	„	96	0	0	22	1
79.	6.	„ „	3	„	42	0	3	55	8
80.	11.	Reindeer Gallery	34	„	58	0	6	34	7
81.	12.	„ „	24	„	42	37	6	24	8
82.	13.	„ „	10	„	42	50	0	10	2
83.	„	„ „	16	„	42	60	0	16	3

TABLE I. (continued).

Nos. affixed to each day's find.	Date when found.	Branches of the cavern where found.	Distances from the entrance of each gallery.	Beds.	Depths in the beds.	Thickness of over-lying detrital bed.	Thickness of over-lying stalagmite.	Distances from nearest external entrance.	Numbers of bones found in each locality.
	1858.		feet.		inches.	inches.	inches.	feet.	
84.	Oct. 14.	Reindeer Gallery	26	Third	42	27	6	26	5
85.	16.	„ „	70	„	0	0	4	70	1
86.	20.	„ „	34	Fourth	24	55	6	34	3
87.	22.	„ „	81	Stalagmite	...	0	8	81	2
88.	23.	„ „	82	Third	0	0	9	82	1
89.	25.	„ „	82	„	58	0	9	82	4
90.	27.	„ „	83	„	48	0	10	83	11
91.	28.	„ „	85	„	36	0	12	85	12
92.	29.	„ „	86	„	36	0	12	86	25
93.	Sept. 8.	Flint-knife Gallery	49	Fourth	6	66	0	9	1
94.	Oct. 9.	Reindeer Gallery	24	„	6	80	6	24	1
95.	30.	„ „	81	Third	8	0	8	81	8
96.	Nov. 13.	West Chamber	6	„	132	0	0	4	2
97.	18.	Reindeer Gallery	115	„	0	0	0	115	425
98.	20.	„ „	114	„	0	0	0	114	68
99.	26.	„ „	110	„	0	0	0	110	26
102.	29.	„ „	3	First	36	0	0	3	1
103.	„	„ „	10	„	30	0	0	10	29
104.	„	„ „	32	Stalagmite	0	0	6	32	7
105.	„	„ „	34	Third	24	0	6	34	3
106.	„	Flint-knife Gallery	5	„	0	0	2	53	14
107.	„	„ „	10	„	0	...	2	48	11
108.	„	„ „	14	„	0	...	1	44	7
109.	„	„ „	16	„	0	...	1	42	7
110.	„	„ „	22	„	0	...	0	36	1
	1859.								
111.	Jan. 6.	Reindeer Gallery	28	„	42	20	6	28	3
112.	14.	Steep Slide Hole	14	„	33	...	0	40	3
113.	15.	Reindeer Gallery	20	„	54	47	6	20	4
114.	20.	„ „	18	„	48	53	6	18	4
115.	21.	„ „	15	„	108	60	0	15	3
116.	Feb. 4.	West Chamber	7	„	120	0	0	3	2
117.	6.	Flint-knife Gallery	14	Stalagmite	...	0	0	44	1
122.	Mar. 8.	South Chamber	...	Third	3	0	4	...	4
124.	10.	„ „	...	„	24	0	4	...	1
125.	16.	„ „	...	„	30	0	4	...	2
126.	18.	King's Gallery	...	„	24	0	4	...	1
128.	28.	Keeping's Gallery	...	„	30	0	3	...	1
130.	April 4.	Reindeer Gallery	50	„	9	0	8	50	1
131.	6.	King's Gallery	7	„	57	0	0	...	2
132.	20.	„ „	0	„	9	0	0	...	1
135.	June 7.	Steep Slide Hole	28	„	12	0	0	54	3
139.	21.	Reindeer Gallery	36	Fourth	120	48	6	36	2
141.	23.	West Chamber	0	Third	42	0	0	10	2
	1858.								
143.	Oct. 29.	Reindeer Gallery	74	Stalagmite	...	0	0	74	1

The number 100 and a few others, which are omitted in the first column, were appropriated to other objects of interest (chiefly "Flints"). The numbers given in the first column were written on the bones for the purpose of identification and reference. By "entrance" in fourth column is meant that end of the gallery by which it is entered proceeding directly in from the road or north entrance. Thus the junction of the Reindeer and Flint-knife Gallery is the "entrance" of the latter.

The substance of Table I. is given in a compendious form in Table II.

TABLE II.

Beds.	Steep Slide Hole.	Reindeer Gallery, North.	Reindeer Gallery, South.	Flint-knife Gallery.	West Chamber.	Pen Gallery.	South Chamber.	King's Gallery.	Keeping's Gallery.	Totals.
Stalagmite	.....	11	.....	7	.....	1	6	.....	.....	25
First Bed	.....	52	.....	.....	.....	.....	.....	.....	.....	52
Third Bed	6	247	519	507	244	.....	9	4	1	1537
Fourth Bed.....	.....	6	.....	1	.....	.....	.....	.....	.....	7
Totals	6	316	519	515	244	1	15	4	1	1621

Of the bones connected with the stalagmitic floor, two deserve particular mention. At 67 feet from the North Entrance, and on the eastern side of the Reindeer Gallery, a fine bone, identified by Dr. FALCONER as the humerus of Bear, was found imbedded *within* the floor, which was beautifully white and stainless. It lay with its longest axis in the plane of the floor, and no trace or indication of it was discoverable from either the upper or the lower surface. On the same side of the gallery, a few feet further south, a little beyond the junction of the two chief galleries, lay a fine Reindeer antler. It was found lying *on* the stalagmite, firmly attached to but not imbedded in it; indeed some portions of it were completely free from more than the slightest incrustation (*antè*, p. 477).

From Table II. it is seen that the third was *the* ossiferous bed; it yielded 1537 of the 1621 bones found in the cavern—that is, 95 per cent. of the whole series. They were more abundant at the sides than in the middle of the galleries, and on the whole were larger and of darker colour in the lower part of the bed than in the upper. Occasionally some of those which were discoloured bore marks somewhat resembling such as are sometimes left by mosses on stones on which they have grown; whilst on some others were found the teeth-marks of the animals by which they had been gnawed.

In some parts of the two principal galleries the fossils were confined to an upper and lower band of the bed, which were separated by an intermediate layer of a very fine loam, usually about 9 inches thick, and destitute of stones as well as bones.

The distribution of the fossils, as to depth, in this bed is shown in Table III.

TABLE III.

Branches of the Cavern.	Depths in the Third Bed.														
	On the surface.	From 0 to 1 foot.	From 1 to 2 feet.	From 2 to 3 feet.	From 3 to 4 feet.	From 4 to 5 feet.	From 5 to 6 feet.	From 6 to 7 feet.	From 7 to 8 feet.	From 8 to 9 feet.	From 9 to 10 feet.	From 10 to 11 feet.	From 11 to 12 feet.	From 12 to 13 feet.	Totals.
Steep Slide Hole	...	3	...	3	...	...	...	...	...	...	...	...	...	...	6
Reindeer Gallery, North	2	91	17	83	43	8	...	...	...	3	...	...	...	...	247
Reindeer Gallery, South	519	...	...	...	...	...	...	...	...	...	...	...	...	...	519
Flint-knife Gallery	262	55	10	39	20	108	10	...	3	...	...	...	...	...	507
West Chamber	1	...	...	...	51	73	13	15	5	30	2	4	...	50	244
South Chamber.....	2	4	1	2	...	...	...	...	...	...	...	...	...	...	9
Keeping's Gallery.....	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1
King's Gallery	...	1	1	...	...	2	...	...	...	...	...	...	...	...	4
Totals.....	786	154	29	128	114	191	23	15	8	33	2	4	...	50	1537

Table III. presents the following prominent facts:—

(*a*) More than half of the fossils referred to the third bed were found lying on its surface; that is, either immediately beneath the stalagmite when this existed, or without any covering where it did not.

(*b*) All those found south of the Crystal Gorge lay on the surface. There was no stalagmite in this branch of the cavern.

(*c*) Excepting one only, no bones were met with either on the surface or in the uppermost 3 feet of the bed in the West Chamber.

(*d*) With the exception of one instance only, in which three small bones were found near the bottom of the "funnel-shaped pipe" between the North Entrance and the Steep Slide Hole, all the fossils which occupied depths exceeding 5 feet were met with in the West Chamber and the contiguous portion of the Flint-knife Gallery; in fact in the basin-shaped hollow (*d*, fig. 2, Plate XLIII.) formerly described.

The two last facts (*c* and *d*) show that in their arrangement the bones followed the contour of the lower rather than the upper surface of the bed; and thus support the suggestion already made, that the materials which rose above the normal level of the third bed were not really a portion of it.

The solitary bone found on the surface in the West Chamber had one of its ends cut off, apparently with some sharp instrument.

The fossils in the southern division of the Reindeer Gallery were the remains of young small rodents; they lay in three separate heaps, one of which contained as many as 425 bones, comprising probably the elements of complete skeletons.

Omitting these, the remaining 1112 specimens exhumed in other parts of the cavern were found in 124 localities, giving in whole numbers an average of nine for each locality. In a considerable number of cases, however, they were met with singly, whilst in a few others the numbers were large; and in one instance as many as 21 were lying together. Many of them were mere fragments, having no palæontological value. Bones representing distinct species of animals, and differing much in colour and other indications of exposure, occasionally lay confusedly together; whilst, with probably no more than one exception, those belonging to the same animal never were found lying in their true anatomical connexion*.

It appears from Table II. that, omitting the exceptional case of the south division of the Reindeer Gallery, the Flint-knife Gallery surpassed all other parts of the cavern in the number of bones it contained; but their different areas being considered, the West Chamber, the Flint-knife, and Reindeer Galleries yielded fossils in about the ratios of ten, five, and two respectively.

* The specimen referred to was the leg of a Bear. Mr. Pengelly says, he had the entire mass (bones and loam) carefully extracted, and that immediately beneath were found subsequently several vertebræ and ribs of Cave-Bear (see *ante*, p. 478). On further examination Mr. Busk found it necessary to introduce some corrections into the original statement (see Mr. Busk's Report, p. 533).

Though very careful attention was given to the subject, nothing having the appearance of coprolites was found in the cavern.

Large quantities of the gravel were carefully examined, but, as is shown in Table II., very few fossils were found in it.

Human. Industrial Remains.—Several pieces of flint (all more or less white and having a porcellanous aspect, and some of which at least are believed to be *human implements*) were met with in various parts of the cavern. Their exact situations are shown in Table IV.

TABLE IV.

Nos.	Date when found.	Branches of the cavern where found.	Distance from the entrance of each gallery.	Beds.	Depths in the beds.	Thickness of overlying detrital bed.	Thickness of overlying stalagmite.	Distances from nearest external entrance.	Numbers written on the flints *.
	1858.		feet.		inches.	inches.	inches.	feet.	
1.	July 29.	Reindeer Gallery	74	Third	9	0	3	74	3
2.	„ 29.	„ „	74	„	9	0	3	74	143
3.	„ 30.	„ „	47	„	24	0	8	47	5
4.	„ 30.	„ „	37	„	24	0	6	37	8
5.	Aug. 9.	Flint-knife Gallery	19	„	10	0	0	39	2
6.	„ 12.	„ „	27	„	36	0	0	31	4
7.	„ 17.	„ „	42	„	42	0	0	16	7
8.	Sept. 9.	Pen Gallery	14	„	42	0	9	22	6
9.	„ 24.	West Chamber	8	„	84	0	0	2	9
10.	„ 29.	„ „	6	„	132	0	0	4	1
11.	„ 30.	„ „	3	Fourth	6	90	0	7	10
12.	Oct. 12.	Reindeer Gallery	35	Third	33	0	6	35	11
13.	„ 14.	„ „	26	„	48	27	6	26	84
14.	„ 29.	„ „	86	„	36	0	12	86	
	1859.								
15.	Jan. 20.	„ „	18	„	48	53	6	18	114
16.	„ 20.	„ „	18	„	48	53	6	18	114
17.	„ 21.	„ „	15	„	108	60	0	15	115
18.	Feb. 4.	West Chamber.	7	„	120	0	0	3	116
19.	„ 10.	Flint-knife Gallery	34	Fourth	16	57	0	24	118
20.	„ 10.	„ „	34	„	16	57	0	24	118
21.	„ 12.	West Chamber	5	„	12	156	0	5	119
22.	„ 12.	„ „	5	„	12	156	0	5	119
23.	„ 19.	„ „	5	„	24	156	0	5	120
24.	„ 19.	„ „	5	„	24	156	0	5	120
25.	„ 20.	„ „	5	„	24	156	0	5	121
26.	„ 20.	„ „	5	„	24	156	0	5	121
27.	Mar. 24.	Keeping's Gallery	36	Third	36	0	3	...	127
28.	„ 30.	„ „	40	„	48	0	3	...	129
29.	May 26.	West Chamber	5	Fourth	108	156	0	5	133
30.	June 11.	Reindeer Gallery	33	„	126	51	6	33	136
31.	„ 16.	„ „	31	„	144	58	6	31	137
32.	„ 16.	„ „	31	„	144	58	6	31	137
33.	„ 18.	„ „	34	„	120	48	6	34	138
34.	„ 23.	„ „	20	„	144	96	6	20	140
35.	„ 23.	„ „	20	„	144	96	6	20	140
36.	„ 23.	„ „	20	„	144	96	6	20	140

* The numbers from 114 upwards correspond with those in the "Daily Register."

The flints are numbered in the first column in the order of the dates of their discovery. Numbers differing from these were written on all of them excepting the fourteenth when they were from time to time forwarded to Dr. FALCONER. In order to guard against confusion, these are entered also in the Table, and will be found in the last column. The former numbers only will be used here.

No. 2 flint was accidentally broken and found to be whitened throughout. Find Nos. 6 and 8 were discovered by Dr. FALCONER to be portions of one implement (see Mr. EVANS's Report, p. 549). No. 17 was found with three bones near the bottom of the funnel-shaped cavity ("*c*," Plate XLIII. fig. 1).

The following summary of Table IV. shows the distribution of the flints:—

TABLE V.

Beds.	Reindeer Gallery.	Flint-knife Gallery.	West Chamber.	Pen Gallery.	Keeping's Gallery.	Totals.
Third	10	3	4	1	2	20
Fourth ...	7	2	7	0	0	16
Totals.....	17	5	11	1	2	36

From the foregoing Tables we arrive at the following results:—

(*a*) In relation to its area the West Chamber was the richest part of the cavern in the "Flint Implements" as well as in bones.

(*b*) No flints were found in the first bed or the stalagmite, whilst bones were found in both.

(*c*) As in the case of the bones, no flints occurred in the so-called upper portion of the third bed, which, in the West Chamber and the adjacent part of the Flint-knife Gallery, filled the cavern to the roof.

(*d*) In the three principal branches of the cavern the third bed yielded 17 flints and 998 bones. Two of the former, or about 12 per cent., were 9 inches deep in the bed, whilst the remainder were at lower levels. Of the latter, on the contrary, as many as 372, or 37 per cent., were above the level of the highest flint, and were covered by the overlying stalagmite, in which were found remains of the Cave-Bear and Reindeer.

(*e*) Of the 1621 bones and 36 flints found in the cavern, seven of the former and sixteen of the latter were met with in the fourth or gravel bed; or, putting each total $=1000$, and equating to this, the bones in the gravel are to the flints in the same deposits in the ratio of 4 to 444, or as 1 to 111. Taken as wholes, therefore, the "implement" zone is lower than that of the bones.

Note.—This report and that of Mr. BRISTOW were received a considerable time before the others had been written.

IV. Mr. Bristow's *Notes on his Survey of the Cave.*

After describing the locality and stating that certain lines on the plan represent the floor of the cave as it existed at the time of his visit (*i. e.* after the removal of the bone-bed and part of the shingle bed), and other lines the top and bottom of the bone-bed and of the top of the stalagmite floor, Mr. Bristow proceeds to say that the "longitudinal sections through the two principal Galleries (Reindeer Gallery and the Flint-knife Gallery, Plate XLIII. figs. 1 & 2) afford a good idea of the general arrangement of the contents of the cave, while the cross sections (A to H) serve to show, in addition, the peculiar shapes into which the galleries have been worn out of the rock.

"The lower part of the cave, from the base of the bone-bed to the floor, and to as great a depth as any explorations have been extended, consists of a reddish-brown clay or loam, containing rounded pebbles of quartz, rounded fragments of the slate rocks of the district, &c., precisely similar in character and appearance to those forming the raised beaches visible on the neighbouring coast, as well as to the shingle on the shore of Mudstone sands, north of Brixham.

"Immediately overlying the pebble bed is the deposit in which numerous bones have been discovered, and which has in consequence received the name of 'the bone-bed.'

"It may be divided into three divisions:—

"The lower part, in which the supposed flint knives were met with, and also the greater portion of the bones which have been found, is a ferruginous brown-coloured loam or clay with included angular fragments of limestone, some of which are of considerable dimensions.

"There is no appearance of any symmetrical arrangement of the materials forming this bed, both the upper and the under surfaces of which are very uneven and irregular, forming undulations and filling up hollows or depressions in the upper part of the subjacent pebble bed.

"For some distance from the entrance (33 or 34 feet) a dark-coloured deposit rests upon the bed just noticed; it is composed of small angular fragments of limestone, with a white powder imbedded in a brown loamy base. From the circumstance of its being darkly stained with carbonaceous matter (apparently), the name 'Charcoal-bed' has been conferred upon it; its thickness is very variable.

"An accumulation called the 'white angular limestone,' in consequence of its being made up of broken angular fragments of limestone imbedded in a white mortar-like cement, rests immediately upon the charcoal-bed, and forms the upper part of the deposit containing the bones.

"When the cave was first discovered its present entrance was concealed by a rubbly talus of limestone, which formed a conglomerate in places, and covered the true bone-beds, as is shown at the northern end of the longitudinal section (Plate XLIII. fig. 1).

"For about the first 19 feet from the entrance the rock forming the roof was divided by a fissure, the space being filled up with a mass of rubbly limestone, similar to that already described as blocking up the mouth of the cave.

"From this point southwards the roof was more or less covered with stalactitic carbonate of lime, which is still in the course of formation.

"The charcoal-bed, as well as the 'white angular limestone,' are described as terminating somewhat abruptly near a cross joint in the limestone, between 34 or 35 feet from the entrance.

"Between the place where the charcoal-bed ends and the principal gallery westward (the Flint-knife Gallery) commences, the extreme width of the cave from side to side is 8 feet, and its greatest height from the floor 14 feet; the roof also tapers gradually to a pointed ridge, and its height is reduced to 10 feet 6 inches by the formation of stalagmite, which at a short distance from cross section D increases considerably in amount.

"Cross section D shows the peculiar form of the passages in the Reindeer, Flint-knife, and Pen Galleries. From it, and from cross sections E, F, and G, it will be perceived that the limestone has been most eroded, and that the cave assumes a peculiar elliptical form and is of the greatest width, at the part which is filled with the bone-bed.

"Four feet north of cross section D the stalagmite covering the bone-bed first makes its appearance, and extends with a slightly variable thickness as far as the Flint-knife Gallery, along the south side of which it continued for 9 feet, terminating in a minor transverse hollow worn into the limestone.

"On the north side of the Flint-knife Gallery it extended nearly to the wall of the gallery for the same distance as on the south side, without, however, actually coming in contact with it.

"Hence, onwards, in a southerly direction the passages become much contracted, and the space between the walls of the cave was, on its first discovery, almost entirely choked by a deposit of stalagmite. On the removal of this, with much labour, the explorations were continued for an additional 50 feet southwards; and small bones of recent date were found lying on the surface of the bone-bed, which at this distance falls rapidly and lies at a much lower level than it does in either of the passages already described.

"Throughout the entire length of the Flint-knife Gallery the rock forming its side has been considerably eroded, being worn into shapes somewhat resembling short broad stalactites, while the roof is smoothly arched and free from calcareous incrustation. The western extremity of the gallery is 1·21 foot higher than the eastern end, and 7·3 feet lower than the present entrance to the cave.

"At 36 feet the bone-bed rises to the roof, and for the rest of the distance towards the West Chamber it occupies the entire passage. In the West Chamber itself, the bottom of the bone-bed fills a depression or hollow in the pebble bed, extending to the floor of the cave, on a level with which bones were found and also a flint knife.

"The passage named 'Pen,' as well as the 'South Chamber,' became much contracted both in height and width; and branching off from the latter are minor hollow spaces, apparently eroded between the planes of cleavage."

V. *Notes on the Specimens of the Cave-beds.*

Together with the animal remains, a collection was made of sixty-nine lithological specimens to illustrate the character of the several deposits in the Cave, and which are numbered in the "Register" I. to LXIX. At the request of the Committee I examined and described these specimens. I do not consider it necessary to give all the details of that description here, as it would involve a repetition of much that Mr. PENGELLY and Mr. BRISTOW have described. I will confine myself, therefore, to a short abstract and summary.

Stalagmite, Nos. I.–VII., XIV.–XXV., XXX., LXVI.–LXVIII.—6 to 12 inches thick, and white or red. Limestone breccia attached to under surface of some specimens. Masses of red and white calcareous spar with some fragments of limestone from the Crystal Gorge. Mixed with the calcareous spar are seams of stalagmite. Thin plates ($\frac{1}{4}$ to $\frac{1}{2}$ inch) of red earthy stalagmite and calcareous concretions interstratified with the Cave-earth (I., II., III., XLV.).

First Bed—Limestone Breccia, Nos. XXVI., XXXIII.–IV., L., LXV., LXIX.—Angular fragments of fallen limestone of various sizes cemented by carbonate of lime, at times crystalline, at others white and earthy. An occasional fragment of bone. In some specimens from the South Chamber (LXV.) the calc-spar, which has not filled up all the interstices between the limestone fragments, assumes nullipore-like forms.

Second or black Bed, No. LV.—Peaty calcareous earth (or leaf-mould?) with angular fragments of limestone.

Third Bed—Cave-earth, Nos. XL., XLI., XLIII., XLVII.–VIII., LII., LIV., LIX., LXII.—Reddish loam, or loamy clay, with angular fragments of the limestone fallen from the roof, some of a large size. No. XL. shows that it extends to just outside the second West Entrance. No. LIX., "found in the third bed in various places," consists of pebbles the same as those composing the shingle bed beneath, with small worn pieces of quartz and minute crystals of iron-pyrites (PENGELLY), nodules of brown hematite, and pieces of cellular calc-spar coated and interspersed with the peroxide of iron. Fragments of old stalagmite (Nos. VIII. to XIII.) from the West Chamber and Flint-knife Gallery, with rounded gravel attached to the under surface of three specimens.

Fourth or Shingle bed, Nos. XXVII., XXXI.–II., XXXVI.–IX., XLII., XLVI., XLIX., LVI., LVII., LXIII.—Pebbles of clay-slate, micaceous and chloritic schist, quartz, limestone, siliceous sandstone, red micaceous sandstone, greenstone, and red porphyry, with some peculiar round red calcareous concretions full of bits of white schist, a few subangular pieces of quartz and of flints, and occasional angular fragments of limestone,—all generally in a base of reddish loam, but occasionally of sand. In places the shingle forms a red calcareous conglomerate; in others it contains innumerable very small flat fragments of schist. The base of the bed (XXXI. & XLVI., Flint-knife and Reindeer Gallery) is occasionally cemented by the oxide of iron or of manganese. In the West Chamber a few angular fragments of limestone are mixed with the shingle. No. XXXIX. was, like XL., found just outside the second West Entrance.

VI. Mr. Busk's *Report on the Animal Remains.*

Part I.—List of the Sites in which the Remains were found, and the enumeration of the various specimens which occurred in each.

The Roman numerals in the first column are those affixed to each specimen, and corresponding with those in Mr. Pengelly's "Register" (Arabic numerals), where the exact site of each "find" is described. In the second column are given the number of individual specimens in each "find" (see Table I. p. 489).

The letters H. F. indicate that the determination is on the authority of Dr. Falconer, as taken from his notes; they are applied either to specimens which have not come under my notice or which I have not identified, or to those with respect to which I have ventured to differ from him.

The situation in the Cavern of each site will be seen by reference to the corresponding number in Part II.

I.	12.	Carnassial tooth of *Canis vulpes*; ten incisor teeth of Rabbits and smaller rodents; femur of *Arvicola amphibius*?
II.	10.	Fragment of the shaft of right radius of a small ruminant (sheep or goat); a proximal phalanx of same species; numerous small Birds' and Rabbits' bones: all these specimens have a recent look, though dry and fragile.
III.	1.	Gnawed fragment of a large long bone of coarse texture; tibia of *Rhinoceros*?
IV.	9.	A canine tooth and a much-gnawed lumbar vertebra of *Ursus*; two much-gnawed fragments of the tibia of *Equus*; lower end of right tibia and what appears to be a portion of the palmate horn of *Cervus tarandus*—the latter has an incision (H. F.)? or sharp indentation on one edge; gnawed fragment of tibia of *Rhinoceros*?; fragment and base of mandible of *Hyœna*, and several undeterminable splinters of long bones, one very thick and heavy.
V.	1.	Fragment of astragalus of *C. tarandus*.
VI.	2.	Upper part of sacrum of *Hyœna*; fragment of lower molar of *Rhinoceros*.
VII.	10.	Young horn base of *Capreolus*?; much-worn upper milk-molar of *C. tarandus*; lower canine of *Hyœna*, 6″·2 × 5″·4; much gnawed fragment of radius of young *Equus*; gnawed splinter of inferior border of right scapula of *Rhinoceros*; part of nasal bone of *Rhinoceros*?; fragment of the upper end of the left radius of *Ursus*?, of a very dark colour and heavy; gnawed splinters of long bone, not certainly determinable, but probably of *Rhinoceros*.
VIII.	3.	Metatarsal of *Hyœna*; fragments of radius and of a rib of *Ursus*.
IX.	3.	Two bones of Bird; extremity of rib of *Ursus*.
X.	1.	Portion of shaft of femur of young or small *C. tarandus*.
XI.	3.	Two fragments of base of horn of *C. elaphus*; fragment of long bone of *Bos*?
XII.	4.	Gnawed fragment of femur of *Rhinoceros*; small gnawed and apparently rolled splinters of cannonbone and tibia of *Bos*; fragment of scapula of ——?
XIII.	6.	Gnawed fragment of scapula of *Rhinoceros*; proximal phalanx of *Ursus* of small size; right metatarsal and fragment of pelvis of *Capreolus*, both in the same light porous condition; proximal phalanx and splinter of long bone of *C. tarandus*.
XIV.	52.	Forty-four bones of young Hare and Rabbit? in beautiful preservation; four bones of small Birds; enamel cap of lower canine of *Ursus*; canine tooth of *Vulpes*; proximal phalanx and portion of calcaneum of *Capreolus*.
XV.	1.	Left calcaneum of *C. tarandus*.
XVI.	1.	Right lower canine. *Ursus*.
XVII.	1.	Perfect right humerus of *Ursus* of the smaller size, imbedded in white chalky matrix, and covered in part with red crystalline stalagmite.
XVIII.	1.	Large much-worn upper canine of the larger form of *Ursus* (*U. spelœus*, H. F.).
XIX.	10.	Right unciform, two metacarpals or metatarsals, a proximal phalanx, the right lower canine, the right penultimate upper molar, and a fragment of the cranium of *Ursus*; gnawed fragment of left radius of *C. tarandus*; the right upper canine and the calcaneum of *Hyœna*; much-gnawed fragment of left ulna of *Rhinoceros*. N.B. All these specimens are dark-coloured and heavy.
XX.	25.	Bones of young and older Hares, light and porous.

XXI.	1.	Right lower canine and two phalanges of large *Ursus*.
XXII.	9.	Much-gnawed lower end of radius of *Bos*; lower two thirds of humerus of *Equus*; shaft of humerus, right lower canine, and very young or fœtal tibia of *Ursus*; one trochlea of cannonbone of *C. tarandus*; much-gnawed fragment of bone of *Rhinoceros*?; left hind proximal phalanx of *Capreolus*; other fragments undeterminable.
XXIII.	4.	Three fragments of metacarpals or metatarsals of *Ursus*; an amorphous gnawed fragment.
XXIV.	30.	All bones of one and the same *Ursus*, of large size, and comprising:— 1. A nearly entire sacrum. 2. } Portions of right and left *ossa innominata*, including the *acetabula*. 3. } 4. A portion, about 9″ long, of the right femur, wanting the head. 5. Portion, between 6″ and 7″ long, of the right tibia. 6. Fragment of the right scapula, including the entire glenoid fossa. 7. Upper part (nearly half) of the left ulna. (Corresponding in size with SCHMERLING's second or most common form.) 8. Lower end of left radius, with the articular surface nearly entire. 9–18. Vertebræ, or portions of vertebræ. 19–23. Portions of various ribs, on one of which is a small notch, such as might be made by means of a flint or stone implement (H. F.). 24–30. Fragments of various bones, and an entire scapho-lunar bone. N.B. All these bones are of a light yellowish colour, friable, and porous. The cancellated tissue not at all infiltrated, but open and of a reddish colour. Among the small bones is a fragment apparently of the metacarpal or metatarsal of *Hyœna*.
XXV.	65.	A numerous collection of bones, chiefly if not entirely of young Hares, Rabbits, and Birds, with small fragments of angular bone, breccia, one containing a premolar in germ of *Ursus*, dendritic.
XXVI.	11.	Right ramus of mandible of young *Ursus*, with the canine just emerging (the crown of the penultimate molar is just extruded); right and left ultimate lower molars with fangs still in germ, all probably belonging to the same animal (considered *Ursus arctos* by H. F.); a portion of the right maxilla with the 4 pm of very large size *in situ*; five other very young teeth, all probably of the same individual; ungual phalanx, black, of *Ursus* (mature); the lower milk-canine of *Ursus*?; and a much rolled fragment of the mandible of *Hyœna*. N.B. The last two specimens are dark-coloured and heavy, and in quite a different condition from those belonging to the *Ursus*, which, except the ungual phalanx, are light-coloured and much fresher looking.
XXVII.	1.	The enamel cap of canine tooth of *Ursus*, clearly the fellow to one of those in No. XXVI.
XXVIII.	121.	Numerous bones of small rodents, including *Arvicola*, &c.; young Hares and Rabbits, &c., with the teeth; the entire left metacarpal of *Capreolus*; the right upper canine of *Hyœna*, dark-coloured and heavy, and in very different condition from the other remains.
XXIX.	6.	Left ramus of mandible of young *Ursus*, forming a pair with that recorded in No. XXVI. It contains the second incisor fully protruded, the third just appearing in the alveolus, the milk-canine still *in situ*, the base of the first premolar broken off, and the third and fourth premolars fully protruded, though quite unworn. It is to be remarked that these two portions of the same mandible, of most fragile consistence and yet quite uninjured (except perhaps at the time they were extracted), were found in the Flint-knife Gallery, one 3 feet from the entrance and 6 inches deep in the third bed, and the other 10 feet from the entrance and lying *on* the stalagmite floor. The only other bone belonging to *Ursus* was the shaft of a very young tibia, doubtless of the same animal, and which was found sticking in the stalagmite. The left metatarsal of *C. tarandus*; a long bone and the vertebra of young Hare imbedded in hard red stalagmite. N.B. Though six specimens are recorded in the Register, only five could be found.
XXX.	7.	Three enamel caps of canines and one of the outer incisor, and the fragment of the metacarpal of a very young *Ursus*; the perfect metacarpal and the calcaneum of a mature *Ursus*; two bone-splinters; portion of the astragalus of *C. tarandus*. N.B. Probably the extra specimen belongs to No. XXIX.
XXXI.	4.	Much-worn upper right canine and fifth proximal phalanx of *Felis spelœa*; portion of sacrum and proximal phalanx of *C. tarandus*; a metacarpal or metatarsal and a portion of the third right rib of *Ursus*? N.B. Six specimens were found, though only four are noticed in the Register.
XXXII.	2.	Lower half of right humerus, of large size, of *C. tarandus*, gnawed; metatarsal of large *Bos* (very like some of those figured by Buckland, H. F.).

XXXIII.	9.	Bones of Hare, Rabbit, and Bird, some of them gnawed by *Arvicola*.
XXXIV.	2.	Outer incisor and upper canine of *Ursus*.
XXXV.	9.	Shaft of femur and gnawed fragment of bone of young *Ursus*; right calcaneum and base of metacarpal of large *Ursus*; proximal phalanx of *Equus*, corresponding in size with, though differing somewhat in colour from, a second phalanx recorded in No. LII.—both belonging to a horse about 15 hands high; the gnawed fragment of a rib of a large ruminant?; gnawed splinter of a long bone, probably cervine, and the proximal phalanx of *C. tarandus*?; fragment of a fœtal or very young bone; large gnawed splinter of radius of large ruminant.
XXXVI.	4.	Lower half of left humerus of *C. tarandus*, superficially gnawed as if by a Dog or Fox; gnawed fragment, humerus (?) of *Rhinoceros*; upper canine of the long and slender form (*vide* XCI.), and the antepenultimate lower molar ($\overline{4}$ pm), also very narrow, of *Ursus*.
XXXVII.	5.	Three fragments of the sixth cervical vertebra of *Bos*, of small size; the penultimate upper molar ($\overline{2}$ m) of *Bos*; a large metacarpal of *Ursus*, exactly like that recorded in No. XLII. N.B. The molar tooth of *Bos* here noticed is dark-coloured and heavy, of large size, whilst the vertebra is light, porous, and that of an animal probably of the size of the domestic Ox, of medium or small stature.
XXXVIII.	18.	The right metatarsal (entire) of *Capreolus*, 8″·3 long; the shaft of femur of *Capreolus*?; lower end of metacarpal of *C. tarandus*; numerous broken bones of Hares, Rabbits, Birds, &c. imbedded in angular breccia; gnawed fragment of radius of *Rhinoceros*; portion of shaft of very young femur of *Ursus*.
XXXIX.	7.	Lower third and the lower half of the right tibia of *C. tarandus*, very dark-coloured on the exterior, greyish within; the point of an antler of *Cervus elaphus*?, and a much-gnawed fragment of large coarse bone, probably *Rhinoceros*; proximal phalanx of *Felis spelæa* (*Hyæna*, H. F.); a metatarsal and a fragment of the ischium of *Ursus*.
XL.	8.	A much-worn upper third molar of *Bos*; portion of ilium and much-gnawed fragment of scapula of *Ursus*; fragment of left ischium, with part of acetabulum, and fragment of pubis of *Equus*; gnawed remnant of lower end of humerus of *Cervus* or *Bos* (*Ursus*, H. F.); gnawed, or much-weathered remnant, 6″·6 long, of horn of *C. tarandus*, with brow- and second antlers; two portions of humerus of *C. vulpes*, probably the same animal as in No. LXV.
XLI.	2.	Right upper canine of *Ursus*, large size, but quite unworn; the sacrum of a Bird.
XLII.	6.	Metatarsal or metacarpal of large size, a fragment of the ulna and of the radius, and the proximal end of a metatarsal or metacarpal of *Ursus*; the fourth left metatarsal of *Equus*; a small fragment of a long bone, probably of *Ursus*?
XLIII.	2.	Left upper canine of *Ursus* of small size, much weathered and cracked; incisor of Rabbit? N.B. In the Register two specimens are noted under this number, one being a small *skull*; but the above are the only specimens forthcoming, and I find in Dr. Falconer's notes that he was only able to find the canine tooth.
XLIV.	12.	Left ramus of mandible (mature), but with the teeth unworn, and with the sockets of two small premolars immediately behind the canine and close together, and with the $\overline{4}$ pm and $\overline{2}$ m *in situ*, two right upper third molars, a portion of a metatarsal, the olecranon, a fragment of an immature ulna of *Ursus*; a nearly complete ulna, a worn fragment of the palmate horn, a proximal phalanx (split), and large part of the atlas of *C. tarandus*; the glenoid fossa of *Equus*.
XLV.	2.	Fifth left metatarsal of *Ursus*, like No. XXXVII. (metacarpal, H. F.); a splinter of tibia of large *Bos* (*B. primigenius*?).
XLVI.	2.	Much-gnawed shaft with small remnants of articular ends of metacarpal of *Equus*; fragment of humerus (*Ursus*, H. F.).
XLVII.	6.	Extremity of left mandible of *Ursus*, with the canine *in situ*, and immediately behind it two premolars close together, the anterior much the larger! (*vide* No. XLIV.); a portion of a cylindrical antler and fragment of a small tine of *Cervus*?; large, gnawed fragment of tibia of *Bos*?; fragment of pelvis and ulna, and the left parietal bone of *Ursus*, 4″·2 long and nearly entire, corresponding pretty closely with that of *U. arctos* in R. C. S. Museum (Horse, H. F.).
XLVIII.	9.	The entire crown of an unworn right upper canine, the antepenultimate lower molar ($\overline{4}$ pm), a very much-worn lower canine of the middle size, and a fragment of the radius of young *Ursus*; the lower end of the right tibia of *Capreolus*, gnawed at the broken end, and corresponding in character with the specimen noticed under No. XIV.; a much-gnawed fragment of large bone, probably tibia of *Bos*; a proximal phalanx of *Hyæna*.

XLIX.	1.	Greater part of the right mandible of *Ursus*, with canine and penultimate molar *in situ* (two premolar sockets close to canine). N.B. It seems doubtful whether the canine, which is of the long slender type, really belongs to the jaw.
L.	1.	Left upper canine, very much worn, of *Hyæna*; corresponds with that in No. XXXI.
LI.	29.	Eight portions of bones belonging to *Ursus*, viz.:— 1. Portion of a long bone? 2. } 3. } metacarpals. 4. Ungual phalanx. 5. Lower end of radius. 6. Great part of left humerus. 7. Left condyle of lower jaw. 8. Two portions of a rib (gnawed), and besides these are what appears to be a fœtal or very young tibia of *Ursus*; gnawed fragment of pelvis, the calcaneum, proximal phalanx; large gnawed fragment of right side of pelvis, with the acetabulum entire, nearly the whole of the ilium, and the distal end of the right tibia of *C. tarandus*; a portion of the shaft of humerus and a portion of the shaft of the femur of corresponding dimensions of *Rhinoceros*; numerous fragments and splinters of ribs of small *Ursus*, &c.; the third upper molar of *Bos* (*vide* No. XXXVII.).
LII.	64.	Thirty or forty bones and teeth of a young *Ursus*, doubtless all belonging to the same animal; the gnawed fragment of a scapula, ribs, astragalus, metacarpals, a sternal bone, and bones and teeth of a mature *Ursus*; upper canine of *Felis spelæa*, much worn and exactly resembling that figured in 'Reliquiæ Diluvianæ,' pl. 22. figs. 6, 7; the atlas and fourteenth dorsal vertebra, and probably fragments of other bones of *C. tarandus*; fragments of metatarsal or metacarpal and the right lower canine of *Hyæna*; the anterior lower milk-molar of *Rhinoceros tichorhinus*; three fragments of the seventh cervical vertebra of *Rhinoceros*; several gnawed fragments. N.B. Three upper molars of the young Bear set in plaster; cannot be distinguished from the corresponding teeth of a young *Ursus arctos*.
LIII.	1.	Metatarsal of *C. tarandus*.
LIV.	44.	Bones of Rabbits; the tibiæ of the latter appear to be unusually long.
LV.	1.	Proximal end of radius of *C. tarandus*.
LVI.	13?	The left tibia, scapho-cuboid, astragalus, fragment of cannonbone of *C. tarandus*; two fragments of tibia of large *Bos*, most likely *B. primigenius*; six separate teeth and a considerable part of the left ramus of the mandible, containing second and third premolars and the carnassial tooth, of *Hyæna*. The third premolar in the latter specimen is split vertically, and the entire specimen bears a striking resemblance to that figured in Cuvier's 'Ossem. Fossiles,' pl. 194. fig. 1, from Gailenreuth; portion of right maxilla of *Felis spelæa*, and with first and second premolars *in situ* (3 pm and 4 pm);—this specimen appears to pair with that in No. LXI.; the left second premolar of *Rhinoceros* in germ, but of very large size; portion of tibia of *Ursus*, of large size; gnawed fragment of *Rhinoceros*. N.B. Thirteen specimens only are noted in the "Register," but there are at least sixteen with No. LVI. upon them.
LVII.	40.	All bones of apparently a very young *Ursus*.
LVIII.	5.	Five teeth of *Ursus* of different ages.
LIX.	1.	Seventh or eighth right rib of Sheep, sawn across at the distal end, and superficially gnawed by *Arvicola*: a recent bone.
LX.	3.	Outer incisor of *Ursus*, very dendritic; a small fragment of a flat rib of ——?; an amorphous fragment of bone, probably palate of *Ursus*.
LXI.	14.	Portion of left maxilla, with premolar *in situ*, and anterior part of same maxilla, with the external incisor *in situ*, of *Felis spelæa*; portion of shaft of femur, of radius, &c., probably feline; a third metatarsal of *Ursus*; a lower molar of *Rhinoceros*, unworn; another apparently milk-molar, of smaller size and irregularly worn, with a bevelled edge, of probably the same animal; several gnawed fragments of bones.
LXII.	16.	A water-worn cylindrical base of shed horn of large *Cervus*, with the burr nearly worn off (the brow-antler springs about 2 inches above the base; the circumference immediately above the burr is 7″·7); an entire right radius of *Equus*, 12″·5 long; fragment of radius, a large portion of the shaft of left humerus, the proximal end of the left ulna, a fragment of the shaft of femur, and a fragment of the right upper canine of *Ursus*; a portion of the scapula, including great part of the glenoid fossa and the commencement of the spine, of *Bos*; left upper carnassial tooth (1 m. s.) and the capital epiphysis of femur and carnassial tooth of *Hyæna* (cf.

		No. LXXIII.); a much-worn upper molar, quite black and very fragile, an astragalus (finely gnawed, H. F.), the left lower milk-molar, a good deal worn and of the same black colour as the upper molar and astragalus, and a large lower molar, much and unevenly worn, of *Rhinoceros tichorhinus*; the much-gnawed distal extremity of a cannonbone of *C. tarandus*; an amorphous fragment.
LXIII.	15.	Three teeth, gnawed fragment of metacarpal or metatarsal, and the os unciforme of *Ursus*; the left upper and lower canines and the third lower premolar of *Hyæna*; an upper right molar, a lower milk-molar, and a very large lower molar of *Rhinoceros tichorhinus*; a third upper molar and gnawed splinter of humerus of *Bos*; the calcaneum of *C. tarandus*. N.B. In the "Register" 15 specimens are mentioned under No. LXIII., of which 11 are teeth. Ten only are given above; and in Dr. FALCONER'S notes only 10 are noted, and amongst them a lower molar of *Bos*, which is not now apparently forthcoming.
LXIV.	30.	Four or five bones of *C. tarandus*, including distal end of tibia, fragment of acetabulum?, fragment of metatarsal; the anterior part of right mandible, including the canine and two anterior premolars (considerably worn and of a dark colour), the distal end of the left tibia (apparently splintered and repaired during life), portion of pelvis with part of acetabulum, canine, right upper carnassial, a metacarpal or metatarsal bone of *Hyæna*; portion of right ischium and of a rib?, gnawed fragment of maxilla of a very old animal, retaining the stump of the penultimate molar worn down to the base and of a very dark colour, the left lower canine, the external incisor (*Hyæna*, H. F.), gnawed fragment of metacarpal, a proximal phalanx (*Hyæna*, H. F.), left half of atlas (*Hyæna*, H. F.), left upper canine, and a sternal bone of *Ursus*; an irregular weathered and rolled fragment of spongy bone, perhaps cranium of *Rhinoceros* or *Elephas*?, 1″·5 thick; right upper milk-molar, considerably worn, and left anterior upper molar, but little worn, of *Rhinoceros*; several gnawed fragments of bones.
LXV.	10.	Several portions of ribs of *Ursus*; gnawed fragment of lower end of right humerus of large *Ursus* (cf. No. LI.); fragment of a metacarpal or metatarsal of *Hyæna*; lower end of tibia and of radius of *Vulpes* (*vide* XL.). N.B. All these specimens of a very dark colour, hard and resonant.
LXVI.	1.	Much-worn upper right carnassial tooth of *Felis spelæa*, 1″·5 × 0″·75.
LXVII.	4.	Radius and ulna of *Ursus*; a very dark-coloured femur of young *Ursus* imbedded in a white chalky matrix; an amorphous fragment. N.B. The "Register" mentions only two specimens.
LXVIII.	2.	Portion of left maxilla with first and second molars, quite unworn and of very large size for *C. elaphus*, in situ; a broken molar, probably of the same animal.
LXIX.	2.	Two amorphous splinters of long bone, probably *Elephas*.
LXX.	6.	Distal end of right metacarpal of *C. tarandus*, much gnawed; two fragments of small ulna of *Ursus*; gnawed head of tibia, and an incisor (H. F.) of *Hyæna*; an amorphous fragment.
LXXI.	2.	Two portions of pelvis of *Rhinoceros*, including a considerable part of the ilium and the entire acetabulum, 4″·5 in diameter.
LXXII.	9.	Right astragalus, much gnawed, especially on the anterior, inner, and posterior sides, the distal end of the corresponding tibia, also gnawed on the same three sides, two other portions of the same tibia, of *Elephas primigenius*; a lower molar and right upper milk-molar in beautiful preservation, though slightly worn, of *Rhinoceros*; detached proximal epiphyses of tibia of *C. tarandus*; a fragment of scapula of *Bos*?; gnawed fragment of the base of horn of large *Cervus elaphus*?
LXXIII.	24.	A nearly perfect atlas, the upper part of the left ulna (apparently gnawed by a small carnivore, and probably belonging to the same animal as in No. LXXIV.), the distal extremity of the humerus, of very light colour, distal epiphyses of the left femur, the right lower carnassial tooth of *Hyæna*; a fragment of the right humerus, the right upper canine, a fragment of the shaft of the femur and of a rib, the penultimate right upper molar, a fragment of the palate and part of the alveolus, the right cuneiform, a fragment of the cranium?, a very much-worn right lower last molar of *Ursus*; a fragment of the right calcaneum, an entire right metacarpal, 8″·5 long, of a whitish colour, dry, fragile, weathered or sun- and air-cracked, especially at the distal end, of *Equus*; the right astragalus and the distal end, apparently gnawed, of the tibia, and fitting the astragalus, and a much-gnawed fragment of posterior border of scapula of *Rhinoceros*; a portion of the second rib, the left outer second phalanx, and the right scapho-cuboid of *C. tarandus*. N.B. Though agreeing in size, the portion of tibia and the astragalus of the *Rhino-*

		ceros would seem to differ too much in colour and condition to allow of the supposition that they belonged to the same individual, or at any rate to have been buried under the same circumstances. The astragalus is nearly black and very heavy; whilst the portion of tibia is light-coloured, and though dendritic, still comparatively very little infiltrated with mineral matter. Only 23 specimens are mentioned in the "Register."
LXXIV.	5.	A perfect right radius, part of the ischium, including the right acetabulum, fragment of a rib, and the third cervical vertebra of *Hyæna*; a last upper molar of *Rhinoceros tichorhinus* in germ.
LXXV.	13.	Portion of pelvis (young), the right patella, fragment of a rib, a metacarpal bone, of *Ursus*; canine of *Felis spelæa*; two ribs (fragments), portion of a metatarsal or metacarpal, and an entire left tibia, 7″·45 long, of *Hyæna*; left upper second premolar, very much worn, of *Rhinoceros*; astragalus of *C. tarandus*; fragment of a Bird's bone (H. F.).
LXXVI.	2.	Left radius, quite perfect, and appearing to pair with that in No. LXXIV., and the anterior portion of left mandible, including the canine and first premolar teeth, of *Hyæna*.
LXXVII.	2.	Detached proximal epiphysis of left humerus of *Ursus*; gnawed fragment of distal end of left metacarpal of *Bos*.
LXXVIII.	1.	Beautiful specimen, imbedded in indurated red clay, of the left mandible of *Canis vulpes*. The bone of the jaw, where visible, and the teeth are very dark-coloured from dendritic infiltration.
LXXIX.	8.	Right second metacarpal of *Equus*, pairing with one in No. XLVIII. Portion of scapula, with glenoid fossa and neck, of *C. tarandus*; neural spine of dorsal vertebra, proximal phalanx, gnawed fragments of metacarpal of various bones (young) of *Ursus*; a nodule of ironstone.
LXXX.	7.	Large part of right tibia, including the entire distal articulation, apparently gnawed by a large carnivore (though probably not *Hyæna*) at either end, of *Equus*; the right condyle of the mandible of *Elephas*; large fragment of right ulna, a fragment of the olecranon, and the upper part of the left ulna of *Rhinoceros*; large portion of the left ulna, of small size, of *Ursus* (*Hyæna*, H. F.); odontoid process of axis of *C. tarandus*.
LXXXI.	8.	Much-worn lower molar of *Rhinoceros*; left second premolar and much-worn canine of *Hyæna*; fragments of ribs and long bones of *Ursus*?, femur? of *Hyæna*, and fragments of a large long bone, *Bos*; fragments of ribs of *Ursus*? and *Bos*?, or *Cervus*.
LXXXII.	2.	Right upper canine of *Hyæna*; same tooth of *Ursus*.
LXXXIII.	3.	Right penultimate upper molar, and large lower molar of probably the same individual, of *Rhinoceros*; right upper molar of *Equus*.
LXXXIV.	5.	Detached distal epiphysis of left tibia of *Equus*; gnawed metatarsal or metacarpal of *Hyæna*; right os magnum (pisiforme, H. F.) of *Rhinoceros*; a fragment of rib of small *C. tarandus*, and a rolled splinter of a small long bone.
LXXXV.	1.	Small antepenultimate molar of *Ursus*, exactly corresponding with the same tooth in *U. arctos*.
LXXXVI.	3.	Left upper molar of small *Equus*; fragments of metacarpals or metatarsals, probably of *Ursus*; fragment of a very young bone, *Ursus*?
LXXXVII.	2.	Fragment of fourth cervical vertebra of young *C. tarandus*?, bone straw-coloured, very light and fragile; fragment of tibia of young Hare, both in similar condition to those in No. CIV.
LXXXVIII.	1.	Portion of right maxilla, with four teeth *in situ*, of *Bos*.
LXXXIX.	4.	Right astragalus, gnawed fragment of middle of shaft of right humerus of *Rhinoceros*; proximal end of ulna of *Hyæna*; right upper canine and fragment of shaft of left tibia of *Ursus*.
XC.	11.	Portions of two cervical vertebræ, a gnawed metacarpal, all light-coloured and porous, three molars, dark-coloured and heavy, of *Ursus*; a canine, much-worn premolar, both heavy and dark-coloured, of *Hyæna*; left outer incisor of *Felis spelæa*, very much worn, and in size &c. exactly corresponding with the same tooth *in situ* noted in No. LXI.; gnawed fragment of distal end of right humerus of *C. tarandus*; an amorphous fragment, dark-coloured and heavy (fragment of mandible of *Hyæna*?).
XCI.	12.	Fourth cervical vertebra, gnawed splinter of femur of *Bos* (*B. taurus*?)—the cervical vertebra corresponds with that in No. XCII.; portion of shaft of right humerus of *C. tarandus*?; a premolar tooth of *Cervus elaphus*?; three phalanges of light yellow colour, the right upper canine (slender form), and two fragments of rib of

		Ursus; a metatarsal or metacarpal of *Hyæna*; an upper molar of *Rhinoceros* (teste H. F., and said by him to be something like *R. hemitœchus*); the splinter of a long bone? not determinable, of remarkably close texture and great thickness.
XCII.	25.	Large portion of right tibia, including the lower articular surface, and two other fragments apparently of bones of *Rhinoceros*, all greyish-coloured and dendritic, but not heavy; portion of the left mandible with the three hinder molars, the three separate molars of the same side, the left astragalus of *Equus*; the left calcaneum pairing with No. XXXV., the seventh cervical vertebra, seven or eight portions of ribs, two large metacarpals or metatarsals, distal end of the radius (young), the left lower canine, dark-coloured and dendritic, of *Ursus*; a smaller metacarpal, probably of *Hyæna*; the tibia of a young Hare; portion of a tibia of large *Bos*?; the right os magnum of *C. elaphus*, $1''{\cdot}6 \times 1''{\cdot}6$; the third cervical vertebra of smaller *Bos* (*vide sup.* No. XCI.); gnawed fragment of long bone, *Bos*?
XCIII.	1.	Portion, about 6 inches long, of the shaft of femur of *Elephas* (crushed and quite hollow, filled up with red clayey earth; the shell of bone dark-coloured, dense and polished, and altogether in a different condition from those included under No. LXXII.).
XCIV.	1.	Left metacarpal of *Bos*, probably young, as the distal epiphysis, together, however, with the epiphysial surface, is absent; the bone is sun-cracked and slight: a small species, the upper end measuring only $1''{\cdot}75 \times 3''{\cdot}1$.
XCV.	8.	Lower half, much broken and gnawed, of the right humerus of *Rhinoceros* (*tichorhinus*, H. F.), fragment of arch of dorsal vertebra of *Elephas*, and gnawed fragment of bone of same; fragment of humerus of *Bos* of large size; anterior portion of atlas of *C. tarandus*, very dark peat-colour; base of shed horn of *Cervus elaphus* with large unworn burr, very well developed—the brow-antler is given off immediately above the base, the circumference of which above the burr is 7″ (*Strongylocerine*, H. F.); second right metacarpal of a fragment of right humerus of *Ursus*, nearly perfect and of grey colour; a fragment apparently of a palmate horn, having a deepish notch on one side, much resembling one made by a blunt or stone implement (H. F.), or it may be by the canine of a *Hyæna*.
XCVI.	2.	Seventh cervical vertebra agreeing exactly with that noticed under No. LXXIV., and doubtless belonging to the same animal, and a small fragment of a rib of *Hyæna*?
XCVII.	425.	A boxful of bones of several species of *Arvicola*, *Sorex*, *Weasel*, *Birds*, &c., found lying on the surface of the third bed.
XCVIII.	68.	A similar collection of bones of small animals.
XCIX.	26.	Seventeen bones of Birds, some like those of a Duck or Merganser, others smaller; the skull of *Fœtorius putorius*, and the mandible of another of rather larger size; the tibia of a young Hare; the right os innominatum of *Canis vulpes*; two mandibles of *Arvicola amphibius*; the fore part of the cranium and maxilla of *Lagomys spelœa* (H. F.); a small vertebra.
C.	2.	Left maxilla and mandible of *Canis vulpes*; dentition entire and in beautiful condition. The bone is white, dry, and adherent, incrusted with a very thin layer of hard red crystalline stalagmite. Exactly in the same condition as many of the Gibraltar bones.
CI.		Only earth and stones.
CII.	1.	Fourth rib of *Ursus*.
CIII.	29.	Twenty-five portions of the skeleton of a young Bear, and apparently all belonging to the same individual: the collection includes the proximal ends of both femora (head $1''{\cdot}65$ in diam.); the greater part of the right mandible, containing the canine, third premolar, sockets of two small premolars, one close to the canine and the other to the $\overline{3}$ pm; the diameter of the canine on the base of the enamel is $0''{\cdot}7 \times 0''{\cdot}5$. Fragments of the cranium and right and left third premolars of *Ursus*.
CIV.	7.	Upper part of cranium with the bosses for the horns and a considerable part of the occipital, the distal end of the right femur with small part remaining of the outer condyle, the remainder having apparently been gnawed off, and four or five teeth of young *C. tarandus*?
CV.	3.	Large part of tibia, much gnawed and weathered, of *Hyæna*?, rather larger and thicker than the one included in No. LXXV.; gnawed fragment of horn of *C. tarandus*; small gnawed fragment of cannonbone of *Capreolus* (cf. Nos. LXXX. & LXXXVI.).
CVI.	14.	Broken bones of Hares, Rabbits, Birds, &c.; fragment of rib of *Ursus*, light colour, and portion of a dorsal spine.
CVII.	11.	Several bones of a very young Bear. A tibia belonging to this collection is drilled through the middle with a perfectly circular hole about $\frac{1}{8}$ inch in diameter, and exactly of the same size and in the same situation as in the opposite tibia, clearly belonging to the same animal contained in the find No. CVIII. The edges of the

		holes on both sides are slightly chipped, but the sides within are even and smooth. All the bones are light-coloured, slightly dendritic, porous, and fragile. A small fragment of the pelvis of a very young and small ruminant (Sheep or Goat); the scapho-cuboid of the same animal, a slightly gnawed and abraded astragalus of small *Bos*?, and a fragment of a tibia of a small *Bos*?; a fragment of the os innominatum of a young Hare? and Fox.
CVIII.	7.	The shaft of a tibia of a very young *Ursus*, with a circular hole drilled through the middle (*vid. sup.*); the upper bone of the sternum of the same; three teeth (molar, canine, and incisor) of *Ursus*, all partly in germ and probably belonging to the same animal as the bones above noticed; portion of 1st rib, left side, portion of the shaft of a long bone, same size as one in No. XIII., and probably of *C. tarandus*?, dark-coloured and dense; rest light, porous.
CIX.	7.	Left mandible of young Bear with milk-dentition (H. F.); a worn old incisor with the fang, *Ursus*; five fragments of the cranium of *Ursus*.
CX.	1.	Upper half of tibia of *C. tarandus*; the bone is of a light cream-colour, incrusted in parts with hard red crystalline stalagmite, and evidently corresponding to the femur noticed under No. CIV.
CXI.	3.	Butt-end of shed horn, of large size, of *Cervus elaphus*, circumference immediately above the burr 9″·15; a metacarpal or metatarsal of *Hyæna*; splinter of humerus of *Cervus*?
CXII.	3.	Gnawed splinters of long bones, two probably bovine, one of *Ursus*?
CXIII.	4.	Proximal end of right radius of *C. tarandus*; right astragalus pairing? with one noticed under No. LXII., and right upper molar, scarcely worn, of *Rhinoceros*; portion of calcaneum, the apophysis broken off, of *Ursus*.
CXIV.	4.	Gnawed and broken fragment of left astragalus of *Rhinoceros*; proximal phalanx of *C. tarandus*; splinter of tibia of *Bos*; metacarpal, split down the middle and gnawed at one end, of *Bos*, said to have been found associated with two flint fragments 4 feet deep in the third bed, highly dendritic.
CXV.	3.	Second phalanx of *Cervus*; a detached incisor of *Hyæna* (H. F.); a splintered fragment. N.B. I have been unable to find the incisor tooth mentioned here, but which is noticed in Dr. Falconer's notes.
CXVI.	2.	Fragment of a flat bone ——? (H. F.); "a fine small tibia of ——? (H. F.); a flint fragment.
CXVII.	1.	Upper part of left radius of small *Ursus*.
CXXII.	4.	Four molars of *Equus*, fresh-looking.
CXXIV.	1.	Fragment of long bone of *Elephas*?
CXXV.	2.	Fragment of right scapula of *Elephas*?; another fragment.
CXXX.	1.	Tooth, premolar of *Hyæna* (H. F.).
CXXXI.	2.	An amorphous fragment (gnawed).
CXXXV.	3.	Two fragments of long bone of *Rhinoceros* or *Elephas*?; gnawed splinter of tibia of *Bos*.
CXLI.	2.	Gnawed fragment of scapula of *Ursus*, of large size.
CXLIII.	1.	A great antler of *Cervus tarandus*.

Appendix.—Concerning specimens either not in the "Register" or doubtful.

1. In Dr. Falconer's Notes a description is given under "No. XCII." of a magnificent specimen, consisting of the femur, tibia, and astragalus *in situ*, together with the radius and a large rib of a Great Bear, termed by him *U. spelæus*. These bones all lie very close together, and must have been originally deposited whilst connected by the soft parts. They are light and fragile and remarkably perfect, imbedded in an indurated red clay. I am unable to perceive any difference between the bones in question and those of *U. arctos*. The entire mass was contained in a separate box. It is alluded to in Dr. Falconer's (p. 478) and in Mr. Pengelly's Report, and seems to have been found over the specimens described under No. XCII.

2. *The contents of a Box marked* B.—The specimens contained in this box are said to have been found in some or other of the Devonshire caves, and were placed in Mr. Philp's glass cases by Mr. Bartlett. The specimens in the box include teeth of Horse (recent) and of the domestic Ox, together with a fragment of horn of Red Deer and bones apparently of Roebuck. The contents appear therefore to be all of domesticated animals; if found in caves, they must have been quite superficial.

3. The specimens numbered CII. to CX., inclusive, were found by Mr. Philp before he leased the cave to the Committee, and were placed by him in a glass case for exhibition.

4. The missing numbers in the above refer to the "finds" of flints described elsewhere.

PART II.—Lists of the Sites in which the remains of each species of Animal were found.

N.B. In the following lists the numbers in the first column (I.) are those of Mr. PENGELLY's "Register," and they correspond with the numbers in the preceding part of this Report, under which will be found the other specimens with which those noted in these lists were associated. In column II. the distance in feet from the entrance of the Gallery is given as stated in the "Register." Column III. gives the depth in inches at which each "find" occurred, whilst the bed in which it lay is stated in column IV. (in which column a cipher signifies the stalagmite), and the number of specimens belonging to each animal in column V. (See also Tables I. and III. pp. 489 & 492.)

1. ELEPHAS.

a. *Reindeer Gallery.*

I.	II.	III.	IV.	V.	
LXXX.	34	58	3	1	Condyle of lower jaw; on surface of fourth bed, but the ground had been disturbed.
XCV.	81	8	„	1	Portion of arch of a dorsal vertebra.
Mean....	57	33	..	2	

b. *Flint-knife Gallery.*

XCIII.	49	6	4	1	A portion of shaft of femur, 6″ long.

c. *West Chamber.*

LXXII.	5	156	3	4	An astragalus, three fragments of a tibia.

d. *South Chamber.*

LXIX.	..	..	0	..	Two fragments of bone; on the stalagmite floor.
CXXIV.	14	24	3	1	Portion of tibia.
CXXV.	14	30	„	2	Fragment of scapula? and of another bone.
Mean....	14	27	..	3	

e. *Steep Slide Hole.*

CXXXV.	28	12	3	1	Fragment of long bone.

2. RHINOCEROS.

a. *Reindeer Gallery.*

III.	19	24	3	1	Gnawed fragment of tibia?
IV.	20	24	„	1	Gnawed fragment of tibia?
VI.	24	18	„	1	Lower molar tooth, fragment of.
VII.	29	12	„	2	Gnawed splinter of left scapula (*vide* No. LXXIII.); part of nasal bone?
XII.	47	10	„	1	Gnawed fragment of femur.
XIII.	76	6	„	1	Gnawed fragment of scapula?
XIX.	71	30	„	1	A gnawed fragment of left ulna.
LXXX.	34	58	„	3	Portion of ulna; right olecranon; upper part of left ulna.
LXXXI.	24	42	„	1	A lower molar, much worn.
LXXXIII.	16	42	„	2	Two teeth, upper and lower molars.
LXXXIV.	26	42	„	1	The right os magnum, quite perfect.
LXXXIX.	82	58	„	2	Middle portion of shaft of right humerus, gnawed at each end.
XCI.	85	36	„	1	An upper milk-premolar tooth.
XCII.	86	36	„	3	A large portion of right tibia; two gnawed fragments.
XCV.	81	8	„	3	Lower half, broken and gnawed, of right humerus; fragments of vertebra &c.
CXIII.	20	54	„	2	An upper molar tooth; left astragalus, slightly gnawed (*vide* No. LXII.).
CXIV.	18	48	„	1	Gnawed fragment of right astragalus.
Mean....	45	32	..	27	

2. Rhinoceros (continued).

b. *Flint-knife Gallery.*

I.	II.	III.	IV.	V.	
XXII.	1	9	3	1	Much-gnawed fragment of lower end of tibia.
XXIX.	10	2	0	1	Lower two thirds of the right femur.
XXXVI.	17	13	3	1	Gnawed and weathered? fragment of humerus?
XXXIX.	20	24	„	1	An amorphous fragment.
XLIV.	34	58	„	1	A fragment, gnawed.
XLVIII.	42	42	„	1	Much-gnawed fragment of upper part of tibia.
LI.	40	60	„	1	Gnawed fragment of left femur.
LII.	46	60	„	5	Two teeth; three fragments of the seventh cervical vertebra.
LVI.	4	63	„	1	An upper molar, in germ.
LXI.	4	60	„	2	Two lower molars, one in germ.
LXII.	3	57	„	7	Six molar teeth; the right astragalus, entire.
Mean....	20	40	..	22	

c. *West Chamber.*

LXIII.	8	84	3	3	Three lower molars, of large size.
LXIV.	6	108	„	3	Two upper molars, one probably a milk-tooth; an amorphous fragment?
LXXII.	5	156	„	2	An upper milk-molar and a lower molar.
LXXIII.	5	156	„	3	Gnawed lower end of tibia; right astragalus; portion of scapula (*vide* No. VII.).
LXXIV.	5	156	„	1	A lower molar, in germ.
LXXV.	5	156	„	1	An upper molar tooth.
Mean....	6	136	..	13	

d. *South Chamber.*

LXIX.	?	?	0	1	A gnawed fragment; on stalagmite floor, 16 inches from roof.
LXXI.	?	?	0	1	Two fragments of pelvis, with the acetabulum entire (immediately beneath stalagmite).
CXXIV.	10	24	3	1	Fragment of femur?
				3	

e. *Steep Slide Hole.*

CXXXV.	28	12	3	2	Fragments of long bone (*Elephas*?).

3. Equus.

a. *Reindeer Gallery.*

'IV.	20	24	3	2	Two gnawed fragments of the same tibia.
VII.	29	12	„	1	Much-gnawed fragment of radius (young).
LXXX.	34	58	„	2	Great part of tibia; articular end of humerus, gnawed.
LXXXIII.	16	42	„	1	An upper left molar.
LXXXIV.	26	42	„	1	Detached epiphysis of tibia (attached to underside of stalagmite).
LXXXVI.	34	24	4	1	Upper molar (small).
XCII.	86	36	3	5	Part of mandible with three molars; an astragalus; three detached molars belonging to the same jaw.
Mean....	35	34	..	13	

3. Equus (continued).

b. *Flint-knife Gallery.*

I.	II.	III.	IV.	V.	
XXII.	1	9	3	1	Lower two thirds of humerus.
XXXV.	10	36	„	1	A proximal phalanx.
XL.	24	34	„	2	Two fragments of ischium and pubis.
XLII.	26	33	„	1	An outer metacarpal (pairs with No. LXXIX.).
XLIV.	34	58	„	1	The glenoid fossa and neck of scapula.
XLVI.	49	30	„	1	A metacarpal, gnawed.
XLVIII.	42	42	„	1	The fourth metatarsal.
LII.	46	60	„	1	A second phalanx, fitting into No. XXXV. (colour different).
LXII.	3	57	„	1	An entire radius.
LXXIX.	3	42	„	1	An outer metacarpal (pairs with No. XLII.).
Mean....	24	40	..	11	

c. *West Chamber.*

LXXIII.	5	156	3	2	Part of calcaneum; an entire right metacarpal.

d. *South Chamber.*

CXXII.	14	3	3	4	Four teeth, of small size.

4. Bos.

a. *Reindeer Gallery.*

XII.	47	10	3	1	Fragment of cannonbone.
LXXXVIII.	82	0	„	1	Portion of maxilla with four teeth (*Bos primigenius*); under the floor (Plate XLVI. fig. 11).
XCI.	85	36	„	1	Fourth cervical vertebra (*Bos* ——?).
XCII.	86	36	„	1	Third cervical vertebra of same animal.
XCIV.	24	6	4	1	Left metacarpal, wanting the lower end (small size).
XCV.	81	8	3	1	Fragment of humerus?
CXIV.	18	48	„	1	A metacarpal, split and gnawed at one end.
Mean....	60	21	..	7	

b. *Flint-knife Gallery.*

XXII.	1	9	3	1	Lower end of right radius.
XXXII.	9	33	„	1	Fragment of cannonbone, gnawed.
XXXVII.	19	28	„	4	$\overline{m}$ 2 of *B. primigenius*?; three fragments of sixth cervical vertebra, corresponding with Nos. XCI. & XCII.
XL.	24	34	„	1	$\overline{m}$ 3 of *B. primigenius*? much worn.
XLV.	36	60	„	1	Fragment of tibia.
XLVIII.	42	42	„	1	Fragment of tibia.
LI.	40	60	„	2	$\overline{m}$ 3; gnawed fragment of tibia.
LII.	46	60	„	2	$\overline{mm}$ 2, much worn; a $\overline{pm}$ very little worn, of large size.
LVI.	4	63	„	1	Gnawed fragment of left tibia (*B. primigenius*?).
LXII.	3	57	„	1	Neck of scapula.
LXXVII.	40	96	„	1	Gnawed fragment of left metacarpal.
CVII.	10	0	„	1	An astragalus, small size (with recent look).
Mean....	24	46	..	17	

4. Bos (continued).

c. *West Chamber.*

I.	II.	III.	IV.	V.	
LXIII.	8	84	3	2	pm 3; fragment of humerus.
LXIV.	6	108	„	1	Portion of olecranon.
LXXII.	5	156	„	1	Neck of right scapula.
Mean....	7	116	..	4	

5. Cervus elaphus.

a. *Reindeer Gallery.*

XI.	47	9	3	2	Gnawed and weathered fragments of base of horn.
XCII.	86	36	„	1	The right os magnum (1·6 × 1·6).
XCV.	81	96	„	1	Base of shed horn, with rose entire and origin of brow-antler (nearly black).
CXI.	28	42	„	1	Base of large horn (*Strongylocerine*, H. F.).
CXV.	15	108	„	1	A second phalanx (H. F.) (black colour). See CXV. p. 513.
Mean....	51	46	..	6	

b. *Flint-knife Gallery.*

XLVII.	42	36	3	2	Portions of a small cylindrical antler and of a larger one.
LXII.	3	57	3	1	The water-rolled base of a shed horn.
Mean....	22	46	..	3	

c. *West Chamber.*

LXXII.	5	13	3	1	Gnawed or weathered and rolled fragment of base of horn.

d. *South Chamber.*

LXVIII.	6	0	..	2	Portion of maxilla with two unworn molars, and a much-worn milk-molar, $\overline{2}$m, large size; found on the stalagmite floor.

6. Cervus tarandus.

a. *Reindeer Gallery.*

IV.	20	24	3	2	Lower end of tibia?; portion of horn.
V.	23	21	„	1	Fragment of right astragalus.
VI.	24	18	„	1	Base of sacrum.
VII.	29	12	„	1	Small snag of horn (H. F.).
X.	32	6	„	2	Portion of shaft of young femur; much-worn molar.
XIII.	76	6	„	2	A proximal phalanx; a splinter of long bone?
XV.	67	7	„	1	A left calcaneum.
XIX.	71	30	„	1	Gnawed fragment of left radius.
CXLIII.	74	0	„	1	A great antler, found on stalagmite floor over the Ebur Chasm.
LXXX.	34	58	„	1	Odontoid process.
LXXXI.	24	42	„	1	Gnawed splinter of right radius.

6. CERVUS TARANDUS (continued).

a. *Reindeer Gallery* (continued).

I.	II.	III.	IV.	V.	
LXXXIV.	26	42	3	1	Fragment of rib.
LXXXVII.	81	8	0	1	Fragment of cervical vertebra; in stalagmite floor.
XC.	83	48	3	1	Gnawed fragment of lower end of right humerus.
XCI.	85	36	„	1	Portion of shaft of humerus.
XCII.	86	36	„	1	The left astragalus.
XCV.	81	8	„	2	Gnawed fragment of atlas; a fragment of horn?
CIV.	32	0	0	1	Upper part of young cranium; portion of femur gnawed; four teeth.
CV.	34	24	3	2	A fragment of horn (gnawed); splinter of metatarsal.
CXI.	28	42	„	1	Splinter of humerus?
CXIII.	20	54	„	1	Upper end of left radius.
CXIV.	18	48	„	1	Proximal phalanx.
Mean....	48	26	..	26	

b. *Flint-knife Gallery.*

XXII.	1	9	3	1	Outer trochlea of left metacarpal.
XXIX.	10	2	0	1	Greater part of left metatarsal, the lower ends wanting. In the stalagmite.
XXX.	11	3	3	1	Fragment of left calcaneum; same condition as No. X.
XXXII.	9	23	„	1	Lower half of right humerus.
XXXV.	10	36	„	1	A proximal phalanx.
XXXVI.	17	13	„	1	Lower half of humerus; superficially gnawed.
XXXVIII.	23	4	„	1	Lower end of left metacarpal.
XXXIX.	20	24	„	3	Lower half of tibia; lower end of tibia; point of antler.
XL.	24	34	„	1	Gnawed fragment, 6·6 long, of horn, with brow- and second antler.
XLIV.	34	58	„	4	An entire right radius; fragment of horn; part of atlas and of tibia.
LI.	40	60	„	5	Calcaneum; proximal phalanx; portion of ilium femur, &c.
LII.	46	60	„	2	Atlas; second lumbar vertebra.
LIII.	49	36	„	1	Right metatarsal.
LV.	3	48	„	1	Upper half of left radius (*vide* CXIII.).
LVI.	4	63	„	4	Left tibia; scapho-cuboid; astragalus; fragment of cannonbone.
LXI.	4	60	„	1	Base of sacrum.
LXII.	3	57	„	1	Extremity (gnawed) of metatarsal.
LXXIX.	3	42	„	1	Portion of left scapula.
CVII.	10	0	„	2	Left scapho-cuboid (small); lower half of left tibia with epiphysis detached.
CVIII.	14	0	„	1	Fragment of shaft of femur?; portion of a rib, left side.
CX.	22	0	„	1	Upper end of left tibia (*vide* CIX.).
Mean....	17	30	..	35	

c. *West Chamber.*

LXIII.	8	84	3	1	An entire left calcaneum.
LXIV.	6	108	„	3	Shaft of right humerus; much-gnawed lower end of tibia; portion of acetabulum.
LXX.	7	48	„	1	Lower end of right metacarpal.
LXXII.	5	156	„	1	Detached epiphysis of right tibia.
LXXIII.	5	156	„	3	Head and neck of second left rib; a proximal phalanx; scapho-cuboid.
LXXIV.	5	156	„	1	An old, much-worn upper molar.
LXXV.	5	156	„	1	Left astragalus.
Mean....	6	118	..	11	

7. Capreolus.

a. *Reindeer Gallery.*

I.	II.	III.	IV.	V.	
VII.	29	12	3	1	Base of horn (?).
XIII.	76	6	„	2	Right metatarsal, portion of pelvis; light-coloured, porous.
XIV.	70	2	„	2	Proximal phalanx; portion of calcaneum; light-coloured, porous.
CV.	34	24	„	1	Small gnawed fragment of cannonbone (ground disturbed).
Mean....	52	11	..	6	

b. *Flint-knife Gallery.*

XXII.	1	9	3	1	Left hind proximal phalanx.
XXVIII.	7	0	„	1	Entire left metacarpal (immediately beneath stalagmite).
XXXVIII.	23	4	„	2	Right metatarsal; portion of shaft of femur.
XLVIII.	42	42	„	1	Lower extremity of right tibia.
LI.	40	60	„	2	Fragments of long bones (?).
Mean.....	28	29	...	7	

8. Felis spelæa.

a. *Reindeer Gallery.*

XC.	83	48	3	1	Left outer incisor (0·50 × 0·45).

b. *Flint-knife Gallery.*

XXXI.	7	16	3	1	A fifth proximal phalanx (Plate XLV. fig. 7).
XXXIX.	20	24	„	1	A ? „ „ (Plate XLV. fig. 8).
LII.	46	60	„	1	A much-worn canine (*vide* Rel. Diluv.).
LVI.	54	63	„	1	Fragment of right maxilla, with pm 1 and pm 2.
LXI.	54	60	„	2	Fragment of left maxilla, with pm; a second portion of same jaw with outer incisor *in situ*.
Mean....	36	45	..	6	

c. *West Chamber.*

LXXV.	..	156	3	1	A canine tooth (Plate XLV. fig. 5).

d. *South Chamber.*

LXVI.	6	?	?	1	A right upper carnassial tooth (1·5 × 0·75), Plate XLV. fig. 6.

9. Hyæna.

a. *Reindeer Gallery.*

I.	II.	III.	IV.	V.	
VII.	29	12	3	1	Lower canine (0·62 × 0·54).
VIII.	39	9	„	1	Metatarsal or metacarpal (?).
XIX.	71	30	„	2	Calcaneum; upper canine (0·69 × 0·52).
LXXXI.	24	42	„	3	Second premolar, upper canine, much worn; fragment of femur, gnawed (?).
LXXXII.	10	42	„	1	Upper canine.
LXXXIV.	26	42	„	1	Gnawed metacarpal or metatarsal.
LXXXIX.	82	58	„	1	Proximal end of ulna.
XC.	83	48	„	2	Lower canine (0·65 × 0·50); third lower premolar (0·91 × 0·55).
XCI.	85	36	„	1	A metacarpal or metatarsal.
XCII.	86	36	„	1	A metacarpal or metatarsal.
CV.	34	24	„	1	Shaft of right tibia, gnawed (? small *Ursus*).
CXI.	28	42	„	1	A metacarpal or metatarsal.
CXV.	15	108	„	1	Incisor tooth (H. F.). (In a pipe of cave-earth penetrating 5 feet deep in the gravel bed No. 4.)
CXXX.	50	9	„	1	A premolar (H. F.).
Mean....	47	37	..	18	

b. *Flint-knife Gallery.*

XXVIII.	7	0	3	1	Canine tooth, dark-coloured (immediately beneath stalagmite).
XXXI.	7	16	„	2	Upper canine; a metatarsal or metacarpal.
XLVIII.	42	42	„	1	A proximal phalanx.
L.	36	54	„	1	Lower canine, much worn, and corresponding with No. XXXI.
LII.	46	60	„	1	Lower canine.
LVI.	4	63	„	8	Portion of left mandible, with second and third premolars, and six separate teeth.
LXI.	4	60	„	1	Shaft of left femur.
LXII.	3	57	„	2	First upper molar; detached capital epiphysis of femur.
LXV.	50	66	„	1	Portion of rib (?), &c.
Mean....	22	48	..	18	

c. *West Chamber.*

LXIII.	8	84	3	2	Two upper canines (0·6 × 0·5 and 0·65 × 0·5).
LXIV.	6	108	„	3	Lower end of left tibia; right mandible with three teeth; a canine tooth (0·65 × 0·48).
LXXIII.	5	156	„	5	An entire atlas; portions of ulna, humerus, femur, &c.; a lower carnassial tooth (1·32 × 0·55).
LXXIV.	5	156	„	4	A perfect right radius; portion of pelvis; ribs; third cervical vertebra.
LXXV.	5	156	„	4	A perfect tibia; three fragments of ribs; a metatarsal or metacarpal?
LXXVI.	6	122	„	2	A perfect left radius; portion of left mandible, with four teeth *in situ*.
XCVI.	6	122	„	1	A seventh cervical vertebra, corresponding with No. LXXIV.
Mean....	6	129	..	21	

10. Ursus.

a. *Reindeer Gallery.*

I.	II.	III.	IV.	V.	
IV.	20	24	3	2	Canine tooth; lumbar vertebra, much gnawed.
VII.	29	12	,,	1	Gnawed fragment of left radius.
VIII.	39	9	,,	2	Fragments of radius and of a rib.
IX.	37	6	,,	1	Fragment of rib.
XIII.	76	6	,,	1	Small proximal phalanx.
XIV.	70	2	,,	1	Lower canine tooth (enamel cap).
XVI.	71	30	,,	1	A lower canine tooth.
XVII.	67	0	..	1	A perfect right humerus of small size, in chalky matrix, *U. arctos.*
XVIII.	36	36	3	1	A large much-worn upper canine (1·5 × —).
XIX.	71	30	,,	7	Right unciform (large size); fourth metatarsal; a proximal phalanx; lower canine; an upper molar; fragment of cranium.
XXI.	70	14	,,	3	Lower canine; two phalanges.
XXIII.	69	28	,,	3	Three fragments of metacarpals and metatarsals.
XXIV.	68	33	,,	30	Scapho-lunar bone (Plate XLVI. fig. 10); twenty-nine other bones of very large size.
LXXX.	34	58	,,	1	Large part of left ulna, gnawed at each end, light-coloured, porous.
LXXXI.	24	42	,,	1	Gnawed fragment of shaft of femur, of large size, nearly black.
LXXXII.	10	42	,,	1	Upper canine tooth.
LXXXVI.	34	24	4	2	A gnawed metacarpal; fragment of metatarsal or metacarpal.
LXXXIX.	82	58	3	2	Upper canine; fragment of left tibia.
XC.	83	48	,,	6	Three molar teeth; portions of two cervical vertebræ; a much-gnawed metacarpal.
XCI.	85	36	,,	5	Canine; three phalanges; fragment of rib.
*XCII.	86	36	,,	13	Entire left calcaneum, pairing with No. XXXV.; seventh cervical vertebra; two metatarsals; a canine tooth in germ, of large size, &c.
XCV.	81	8	,,	2	A metacarpal; portion of right humerus.
CII.	3	36	1	1	Portion of rib.
CIII.	10	30	1	27	Twenty-five portions of young skeleton; two adult teeth.
CXIII.	20	54	3	1	Portion of calcaneum, much gnawed.
Mean....	53	28	..	116	

b. *Flint-knife Gallery.*

XXII.	1	9	3	3	A canine tooth; shaft of humerus; young tibia.
XXV.	4	0	,,	1	$\overline{\text{pm 2}}$, imbedded in angular breccia.
XXVI.	3	6	,,	10	Nine teeth; $\overline{\text{pm 4}}$, *in situ*, of young animal; an ungual phalanx.
XXVII.	3	9	,,	1	An enamel cap of canine.
XXIX.	10	0	..	2	Left mandible of young animal, pairing with No. XXVI.; shaft of young femur.
XXX.	11	3	3	7	Three enamel caps of canines; a small incisor; a perfect metacarpal; a mature calcaneum.
XXXI.	7	16	,,	3	Two fragments of metatarsals or metacarpals (? *Felis*); portion of rib.
XXXIV.	12	9	,,	3	Second incisor; canine of the slender form.
XXXV.	10	36	,,	3	Shaft of left femur of young animal; right calcaneum, pairing with No. XCII.; portion of metatarsal.
XXXVI.	17	13	,,	2	Canine (slender); $\overline{\text{pm 4}}$.
XXXVII.	19	28	,,	1	A metatarsal.
XXXIX.	20	24	,,	1	A metatarsal bone (? *Felis*); fragment of ischium, very dark colour.
XL.	24	34	,,	3	Much-gnawed fragments of ilium and scapula; gnawed fragment of inner condyle of humerus.
XLI.	29	14	,,	1	Large unworn canine.
XLII.	26	33	,,	4	A metacarpal; metatarsal; fragments of radius and ulna, large size.

* *Vide* Appendix, p. 506.

10. Ursus (continued).

b. *Flint-knife Gallery* (continued).

I.	II.	III.	IV.	V.	
XLIII.	40	0	3	1	An upper canine, of small size, much cracked and weathered (*U. arctos*).
XLIV.	34	58	„	6	Left mandible of mature animal; a metatarsal; a molar tooth; olecranon, and fragment of shaft of ulna.
XLV.	36	60	„	1	A metatarsal bone.
XLVI.	49	30	„	1	Fragment of humerus.
XLVII.	42	36	„	4	Extremity of left mandible, with canine *in situ*; fragment of pelvis and the left parietal bone; fragment of ulna.
XLVIII.	42	42	„	4	Three teeth; fragments of radius and tibia, both young.
XLIX.	26	42	„	1	Part of right mandible, with canine and penultimate molar *in situ* (pairs with No. XLIV.).
LI.	40	60	„	9	Fragments of various bones, young and old.
LII.	46	60	„	50 or 60	Thirty or forty bones and teeth of a very young animal; gnawed fragments of scapula, ribs, &c.; broken astragalus of mature age, black (Plate XLVI. fig. 8).
LIII.	49	36	„	1	Gnawed fragment of rib.
LVI.	54	63	„	1	Portion of shaft of left tibia of large size.
LVII.	54	60	„	39	Bones of the skeleton of a young animal.
LVIII.	54	96	„	5	Teeth of various ages (*U. priscus*?).
LX.	52	54	„	2	An outer incisor, dark-coloured; fragment of palate.
LXI.	54	60	„	5	A metatarsal and fragments of other bones.
LXII.	53	57	„	5	A broken canine; gnawed fragments of various long bones.
LXV.	50	66	„	1	Gnawed fragment of left humerus.
LXXVII.	40	96	„	1	Detached proximal epiphysis of humerus.
LXXIX.	3	42	„	5	Spinous process of dorsal vertebra of large size, a phalanx, and gnawed fragments of other bones.
CVI.	5	0	„	1	Fragment of rib; broken spinous process (white colour).
CVII.	10	0	„	7	Various bones of one or more young animals (white colour); the tibia has a hole recently drilled through it.
CVIII.	14	0	„	6	Other bones and teeth of apparently the same animal; the tibia has also a hole drilled through it (*U. arctos*).
CIX.	16	0	„	7	Portion of lower jaw with milk-teeth (same animal?); a worn old incisor of dark colour; five fragments of other bones.
CXVII.	14	0	„	1	Fragment of left radius, corresponding with the ulna in No. LXXX.; imbedded in the stalagmite together with a shell of *Helix* ——?
Mean....	28	32	..	209	

c. *West Chamber.*

LXIII.	8	84	3	5	Three teeth; a metacarpal; os unciforme, small and dark-coloured.
LXIV.	6	108	„	7	Three teeth; fragment of right mandible with old worn stump of $\overline{m\ 1}$; right half of atlas; a sternal bone; portion of ischium.
LXX.	7	48	„	3	Fragment of ulna, gnawed, of small size; shaft of left tibia, gnawed at each end.
LXXIII.	5	156	„	7	Gnawed fragment of occipital; left ectocuneiform; several teeth and fragments of humerus, parietal, and other bones.
LXXV.	5	156	„	4	An entire left patella; portion of ischium (young); fragment of rib; a metacarpal bone.
Mean....	6	110	..	26	

d. *South Chamber.*

LXVII.	..	0	..	3	Great part of shaft of femur of young animal imbedded in white chalky matrix; a radius and ulna, gnawed; found in the stalagmite floor (*U. arctos*). (In the stalagmite.)

11. Canis vulpes.

a. *Reindeer Gallery.*

I.	II.	III.	IV.	V.	
I.	15	18	1	1	Carnassial tooth, apparently modern.
XIV.	70	2	3	1	Canine tooth, apparently modern.
XCIX.	110	0	,,	1	Right os innominatum, modern.
C.	110	6	,,	2	Left upper and lower jaws, with the entire dentition; bones in the same condition as the associated Hares, Rabbits, Birds, &c.
Mean....	76	7	..	5	

b. *Flint-knife Gallery.*

XL.	24	34	3	1	An entire humerus (broken across the middle), nearly black, dense, ancient.
LXV.	50	66	,,	2	Lower ends of tibia and radius in same mineralized condition.
LXXVIII.	36	96	,,	1	The entire left mandible with perfect dentition, imbedded in red clay (same condition).
Mean....	37	65	..	4	

12. Bones of Birds and small Mammals (*Lepus, Fœtorius, Sorex, Arvicola, Lagomys, &c.*).

a. *Reindeer Gallery.*

II.	19	18	1	?	Numerous bones of small Birds, Hare, Rabbit, &c., modern.
XIV.	70	2	3	?	Numerous bones, chiefly young Hares and Rabbits (a Fox's tooth).
XCII.	86	36	,,	1	The tibia of a young Hare, in same recent condition!
XCVII.	115	0	,,	?	Numerous bones of *Arvicola, Sorex, Weasel*, &c., Birds.
XCVIII.	114	0	,,	?	A similar collection.
XCIX.	110	0	,,	?	Skull of *Fœtorius putorius*; mandible of a second; tibia of Hare; mandible of *Arvicola*; part of cranium and maxilla of *Lagomys spelæus* (H. F.).
Mean....	86	9			

b. *Flint-knife Gallery.*

XX.	2	0	3	?	Numerous bones of very young Hares, &c.
XXV.	4	0	,,	?	Numerous bones of very young Hares, &c.
XXVI.	3	6	,,	?	Lower canine of *Meles taxus*, dark colour.
XXVIII.	7	0	,,	?	Numerous bones of young Hares, Rabbits, &c.
XXIX.	10	2	..	2	Vertebra of Hare; long bone of Bird?, in hard stalagmite.
XXXIII.	12	0	3	9	Bones of Hares, Rabbits, small Bird, some gnawed by *Arvicola*.
XLI.	29	14	,,	1	Sacrum of a Bird?
LIV.	10	48	,,	44	Bones, chiefly of Hare, amongst loose stones with but little earthy matter, in the third bed.
LIX.	4	0	,,	1	Seventh or eighth rib, right side, of Sheep, sawn and quite recent.
CVI.	5	0	,,	14	Numerous, mostly broken, bones of Rabbits, Birds, &c., in contact with the stalagmite.
Mean....	8	7			

c. *West Chamber.*

LXXV.	5	156	3	1	Fragment of a Bird's bone (H. F.).

Part III.—General Remarks on the Animal Remains.

Bones belonging to 20 or 21 species of mammals and of several species of birds were met with. The mammalian species that have been identified with certainty are:—

1. *Elephas primigenius.*
2. *Rhinoceros tichorhinus.*
3. *Equus caballus.*
4. *Bos primigenius.*
5. —— *longifrons.*
6. *Cervus elaphus.*
7. —— *tarandus.*
8. *Capreolus capreolus.*
9. *Felis spelæa.*
10. *Hyæna spelæa.*
11. *Ursus spelæus.*
12. —— *priscus* (s. *ferox fossilis*).
13. —— *arctos.*
14. *Canis vulpes.*
15. *Meles taxus.*
16. *Lepus timidus.*
17. —— *cuniculus.*
18. *Lagomys spelæus.*
19. *Arvicola amphibius.*
20. —— ——?
21. *Sorex vulgaris.*

I. Proboscidia.

1. *Elephas primigenius.*

The remains of the Mammoth occurred in five situations, viz. the Reindeer Gallery, the Flint-knife Gallery, the West Chamber, the South Chamber, and the Steep Slide Hole. For the most part they appear to have lain at a considerable depth, and, with one or two exceptions, are the only remains met with in the fourth bed. In the Reindeer Gallery a well-marked condyle of the lower jaw was found on the surface of the fourth bed; but as the ground in that situation had been previously disturbed, the exact site is uncertain. In the Flint-knife Gallery a fragment of the femur, 6 inches long, occurred at a depth of 6 inches in the same bed; whilst in the West Chamber an astragalus and great part of the corresponding tibia were found at a depth of 13 feet in the third bed, or nearly at its base. In the South Chamber and in Steep Slide Hole the remains (which, it should be remarked, have not been identified with absolute certainty) were met with more superficially. On the whole, it would appear that the elephantine remains occupied the deepest levels in the cavern.

The parts most worthy of attention are:—the condyle of the lower jaw above referred to, the astragalus and tibia found in the West Chamber, and the portion of the shaft of a femur found in the Flint-knife Gallery.

The condyle, which, though evidently gnawed, is very entire, is about 3·5 inches in its transverse diameter, and in size corresponds with that of an African Elephant of the usual size. The form of the condyle also approaches that of the African rather than of the Asiatic Elephant, the resemblance with the former consisting chiefly in its greater thickness compared with the transverse diameter, and the squareness, as it were, of the inner side, where in the Asiatic Elephant the condyle is more rounded and tapering.

The astragalus, which is also nearly entire, is much gnawed, especially on the inner,

anterior, and hinder aspects; and the lower end of the tibia found in association with it, and manifestly belonging to the same individual, is also gnawed on the same three sides. The appearance of the bones, therefore, suggests that they were lying together, connected by the soft parts at the time they were gnawed, and that the carnivore (probably Hyæna) had either been unable or had neglected to turn them over. The astragalus measures 5″·4 in the transverse and 5″ in the antero-posterior direction. The portion of femur is a good deal crushed, and it is quite hollow and filled up with red clayey earth: the bone itself is in a different condition from the tibia and astragalus, being more deeply coloured, heavier and denser, whilst its surface is somewhat polished; and from the roundness of the angles at the broken ends, it would seem to have been rolled.

It is a remarkable circumstance that no fragment of the tusk or teeth of the Mammoth should have occurred in the cavern—a circumstance from which it might be supposed that the remains discovered there were merely the relics of parts brought in by Carnivora for prey.

II. Perissodactyla.

2. *Rhinoceros.*

Between sixty and seventy specimens, certainly referrible to Rhinoceros, were met with, of which forty-nine occurred in the "Reindeer" and "Flint-knife" Galleries. In the former situation the specimens occurred at all distances from the entrance from 16 to 86 feet; and they were all lodged in the third bed, at depths varying from 6 to 58 inches, the majority, however, being found at a depth of between 3 and 4 feet: and with respect to this, it may be remarked that in some measure the depth at which the specimens were met with increased in proportion to the distance from the entrance into the Gallery.

In the "Flint-knife Gallery" the Rhinoceros remains occurred at distances of from 1 to 46 feet from the entrance; and they were all lodged in the third bed at a depth, speaking generally, of about 4 feet, the only exceptions being one specimen which was met with within a foot of the entrance, at a depth of only 9 inches, and two others which were lodged at 13 and 24 inches: but it will be remarked that these more superficial sites were all within 20 feet of the entrance, so that the apparent rule that the depth was in proportion to the distance from the entrance of the gallery, is even more strikingly manifested in this locality than in the Reindeer Gallery.

In the West Chamber the few specimens met with occurred at depths of from 9 to 13 feet, also in the third bed, or at a much greater depth than in either of the two preceding localities.

In the South Chamber, however, the case is widely different. In this department of the cavern, the remains of Rhinoceros seem to have been laid quite superficially. One specimen, only doubtfully referred to *Rhinoceros*, and which may have been elephantine, is stated to have been found "on the stalagmite floor." Two other specimens,

however, with respect to which there can be no doubt, and consisting of large fragments of the pelvis, including an entire acetabulum 4″·6 in diameter, occurred in this part of the cavern "immediately beneath the stalagmite floor;" whilst a fragment of a femur was met with 10 feet from the west entrance, at a depth of only 2 feet in the third bed, above which lay a cake of stalagmite.

The numerous teeth of both jaws and of all ages appear to me to belong, without exception, to *Rhinoceros tichorhinus*; but I should not omit to mention that, with respect to one specimen among them, Dr. FALCONER appears to have hesitated in opinion, as I find a note of his in which he remarks that "it is something like *R. hemitœchus*."

The Rhinoceros bones and teeth are all dark-coloured and highly dendritic or infiltrated with manganesic oxide: most of them are much gnawed; and amongst these I have selected one of several portions of the shaft of the femur to show the manner in which they have been attacked, undoubtedly by the *Hyœna* (Plate XLIV. fig. 1)*. But some among them are remarkably perfect, presenting no marks of gnawing nor any indication of their having been rolled by water: amongst these are two or three astragali and a remarkably perfect os magnum.

3. *Equus.*

The equine remains include about thirty well-marked specimens, and a few others not so strictly determinable. They all appear to have belonged to the same species, the individuals differing only slightly in stature, which seems to have been from 13 to 15 hands high, and are indistinguishable by any character of the teeth or bones from the existing *Equus caballus*. Remains of animals of various ages are met with, though the majority have been mature, and some aged. The bones themselves differ considerably in condition, some exhibiting every indication of great antiquity, whilst others have a more modern aspect, in which respects the equine remains closely resemble those of the Bear.

Bones of the Horse occurred in the following situations:—

1. Reindeer Gallery, at distances of from 16 to 86 feet from the entrance, and generally at depths in the third bed varying from 12 to 42 inches. The only two exceptions are:—one instance in which it is recorded that the specimen was found on the surface of the fourth bed, but in a spot where it is probable the ground had been previously disturbed; and a second, in which a much-worn tooth was met with at a depth of 24 inches in the fourth bed, associated with bones of the Bear, and in a spot where it is noted that "the ground appeared to be quite undisturbed" (the specimen is that of the first upper molar of the right side, about 1″·6 long and 1″ × 1″ in the crown).

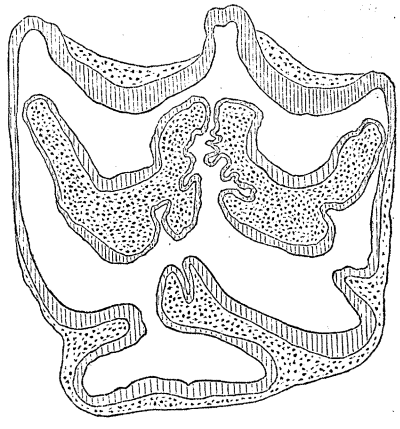
Another tooth, found at no great distance from the above, though at a less depth in the third bed, presents equal signs of great antiquity. It may not improbably have

* I am informed by Mr. W. BOYD DAWKINS that he has noticed precisely similar gnawed fragments of the femur of *Rhinoceros* in great numbers (I think he said 200) from Wokey Hole. The occurrence, therefore, of such remains may be regarded as diagnostic of the presence of the *Hyœna*, even in the absence of its own relics.

belonged to the same animal, and, like the former, presents all the characters of the corresponding tooth in the existing Horse.

Other specimens found in this part of the cavern worthy of note are part of the lower jaw containing the three hinder molars *in situ*, and the three anterior molars belonging to the same jaw and found together with it and an astragalus in association in the same spot with bones of the Rhinoceros, Bear, and Hyæna, as well as with the tibia of a young Hare, the os magnum of *Cervus elaphus*, and the cervical vertebra of a small species of *Bos*. The bone of the jaw in question, which, together with the others above mentioned, was found 86 feet from the entrance of the Gallery at a depth of 3 feet in the third bed, is nearly white, and its surface is partially incrusted, especially on one side, with a thin layer of crystalline stalagmite. It nowhere presents the slightest trace of metallic impregnation. So far as its appearance goes, therefore, it would appear to have belonged to a superficial level, probably in direct contact with, if not above, the stalagmite floor; and this supposition seems to be strengthened by its association with the bones of the Hare, Stag, and small Ox, all of which are in exactly the same condition as similar remains in other parts of the cavern, and found for the most part only in the uppermost or on the surface of the third bed and in immediate contact with the stalagmite. On the other hand, the bones of *Rhinoceros* and *Hyæna* are clearly, from their condition, of vastly greater antiquity, and must have been derived from a much greater depth. It is not easy to account for this mixture of bones in such widely different conditions, except on the supposition that by some accident they had become confounded in the extraction. The jaw and teeth are indistinguishable from those of the existing Horse, as will be seen in the accompanying figure, which shows the enamel flexures in the first upper molar, and in the following dimensions of the individual teeth (the entire series measures 6″·6):—

$\overline{1\,\mathrm{pm}}$	1·2 × ·75
$\overline{2\,\mathrm{pm}}$	1·1 × ·75
$\overline{3\,\mathrm{pm}}$	1·05 × ·75
$\overline{1\,\mathrm{m}}$	1·0 × ·75
$\overline{2\,\mathrm{m}}$	1·0 × ·63
$\overline{3\,\mathrm{m}}$	1·3 × ·61



m 1. ×2 diam.

The astragalus, which is nearly entire, gives the following measurements:—

Transverse diameter of anterior portion	2″·5
Height of scaphoid facet	1″·55
Distance between the summits of the trochlear ridges	1″·5

The bone is coated, like the jaw, with hard crystalline stalagmite, and it exactly fits the lower end of a tibia said to have been found at a distance of 50 feet from it and at a much greater depth; but this was in a locality that had been previously disturbed. There can be little doubt that the two bones belonged to the same animal.

2. Eleven specimens occurred in the Flint-knife Gallery at distances varying from 1 to 46 feet from the entrance, and all at depths of from 9 inches to 5 feet in the third bed. Amongst these remains are two perfect phalanges, which, though differing somewhat in colour, fit together so exactly as to allow little room for doubt that they belonged to the same animal, although one was found 10 feet from the entrance at a depth of 3 feet, and the other at a distance of 46 feet from the entrance and at a depth of about 5 feet. Other bones worthy of note are:—1. The lower portion of a left humerus with the distal articulatory end nearly entire, and measuring in transverse diameter about 3 inches, with the least circumference of the shaft 5″. The shaft is broken across at about the junction of the upper and middle thirds, and the fracture, though ancient, is quite sharp, and the bone exhibits no mark of its having been either rolled or gnawed. 2. An entire left radius, 12″·6 long, with the proximal end 1″·8 × 3″·25 in the antero-posterior and transverse diameters, and the distal 1″·6 × 2″·8, with a least circumference of 4″·5, exactly fits the above humerus. As in the former case of the tibia and astragalus, these two bones, though found very widely apart, would appear to have belonged to one and the same individual. They are both, it should be remarked, deeply impregnated with manganesic oxide. 3. A left metacarpal, measuring 8″·5 in length, the proximal end 1″·35 × 1″·9, and the distal 1″·3 × 1″·7, with a least circumference of the shaft of 3″·7, and consequently corresponding in dimensions with those of a Horse about 13 hands high. The bone, though quite entire, and to all appearance not rolled by water action, seems to have been exposed for some time on the surface of, or partly imbedded in, the ground, as it is much weather- or sun-cracked, principally at one end. 4. Among the remains found in this part of the cavern are a pair of small metacarpals of the right side, obviously belonging to the same limb, one of which was met with at a distance of 3 feet from the entrance and at a depth of 42 inches, whilst the other occurred at a distance of 26 feet and at a depth of 33 inches—affording another instance, of which so many are presented in the cavern, of the separation of parts belonging to the same animal, which it is reasonable to believe must have been brought into some part of the cave whilst still connected by the soft parts.

3. In the West Chamber two specimens occurred at a depth of 13 feet in the third bed, or at the most usual depth for bones in that compartment. They were both marked with characters of the greatest antiquity.

4. In the South Chamber the only equine remains were four teeth, evidently belonging to the same animal, though to opposite sides of the upper jaw. The teeth are remarkably white, though more or less dendritic.

III. Ruminantia.

4 & 5. *Bos.*

Remains belonging to the genus *Bos* are not very numerous, and, with the exception of the teeth, most of them are very imperfect. Seven specimens occurred in the Reindeer Gallery, seventeen in the Flint-knife Gallery, and three in the West Chamber.

But these include only the clearly determinable specimens, and it is quite possible that there may be several others among the splinters and fragments.

In the Reindeer Gallery, with three exceptions, the bovine remains were all met with at a less depth than 12 inches in the third bed.

The exceptions are:—

1. A left metacarpal bone, which is entire, except that the distal articular end has been broken or gnawed off. Its extreme length, therefore, cannot be stated, but it measures from the highest point in front to the vascular opening at the lower termination of the anterior sulcus 7 inches; whilst the proximal articular end measures $1''{\cdot}8 \times 3''{\cdot}2$, and the least circumference of the shaft is about $5''$. The bone itself is of a mottled grey colour, and the cortical substance when broken is of a grey hue from dendritic infiltration. The specimen, therefore, though apparently not so much mineralized as many of the others, must be regarded as belonging to an ancient period. It was found 24 feet from the entrance, at a depth of 6 inches in the fourth bed, "over which the third bed was 42 inches deep, and over this again the cake of stalagmite was about 6 inches thick." But it is added, "this ground had been broken by PHILP;" so that, notwithstanding the condition of the bone, which is by no means opposed to its occurrence at such a depth, some doubt may be entertained whether it was originally lodged at the level from which it was removed. 2. The second exception is also a portion of a cannonbone which has been split down the middle on each side, and has been much gnawed at either end, apparently by the Hyæna. The bone is of much the same size as the preceding, and it is in the same condition in other respects, or perhaps rather more mineralized. It was found at a depth of 4 feet in the third bed, together with two flint fragments (implements?). 3. The third deep-seated specimen is a doubtful fragment of a humerus.

The specimens met with near or on the surface of the third bed consist of:—(1) A small fragment of a large metatarsal. (2) The third and fourth cervical vertebræ, of which the bone is of a light colour, with scarcely a trace of dendritic deposit, and covered with a thin layer of crystalline stalagmite. These two vertebræ, in fact, are in precisely the same condition as the Horse's jaw described above. They are both stated to have been found at a depth of 3 inches in the third bed, and at a distance of 85 feet from the entrance, although from their aspect it would seem likely that they should have been nearer the surface and in contact with the stalagmite. (3) A portion of the left maxilla with four molar teeth *in situ*. This specimen was found, as it would seem, on the surface of the third bed; but it presents no trace of calcareous deposit, and the condition of the bone and teeth, as respects colour and mineral impregnation, exactly resembles that of the two cannonbones above described.

This specimen is worthy of special regard. It is probably the jaw of a rather young animal, inasmuch as the two premolars which remain are very little worn. The species appears to have been about the size of the common Ox. The length of the series of two premolars and two molars is $4''{\cdot}5$, and the dimensions of the individual teeth are the following:—

2 pm	·9 × ·9
3 pm	·9 × ·92
1 m	1·35 × 1·10
2 m	1·40 × 1·12

The second premolar is peculiar in having a double columella, which is rather curious, since several other molar teeth were met with in the Flint-knife Gallery and in the West Chamber, all of which present the same peculiarity*. One of these, a third molar of the right side, in fact fits so exactly and corresponds in other respects so closely with the teeth remaining in the jaw, that one might almost suppose it belonged to the same set, were it not that it is very much more deeply stained with black. A left second upper molar, also found in the Flint-knife Gallery, and a third left upper molar found in the West Chamber, are furnished with the same double columella, and in most respects correspond so closely with the same teeth of the right side in the jaw, as almost to justify the supposition that they belonged to the same individual; they are, however, much more deeply stained and rather less worn.

The peculiarity referred to in these teeth is shown in Plate XLVI. fig. 11.

In the Flint-knife Gallery, besides the teeth above noticed, were found (1) another left third upper molar, considerably worn, and showing the remains of a single columella, and of a very dark colour; (2) a left third upper premolar, very closely corresponding with the same tooth in the jaw above mentioned, though of a deeper colour, and clearly belonging to the same set as the second and third molars of the left side already described. And together with this tooth, which was found at a depth of 5 feet in the third bed, was found a second milk-molar of the right side, and considerably worn.

The other remains, besides the teeth, found in the Flint-knife Gallery worthy of particular note are:—

1. A sixth cervical vertebra, which in mineral condition closely resembles the jaw and two cannonbones found in the Reindeer Gallery. It occurred at a depth of 28 inches in the third bed, and 19 feet from the entrance, in company with one of the molar teeth. The length of the body of this vertebra, measured in a plane parallel with the inferior surface of the body, is 3″·6, and the height of the posterior cup 1″·4; it is therefore of about the same dimensions as in the common Ox.

2. A second well-marked specimen is the nearly entire distal articular end of the radius of a much larger animal, and closely approaching *Bos primigenius*, if not identical with it. The antero-posterior diameter of this bone is 2″·2, and its transverse 3″·7. It is of a deep black colour, and has been manifestly gnawed by the Hyæna.

3. Several gnawed splinters of long bones, for the most part of the tibia, also of very large size, and having the muscular impressions as well developed as in *B. primigenius*, and consequently much more so than in *Bison priscus*.

The remains found in the West Chamber are, besides the tooth already mentioned, a fragment of the humerus and of the olecranon, and the neck of the scapula, all deeply coloured and gnawed by the Hyæna.

* The duplication of the columella appears to be common in teeth of *Bos primigenius*.

6. *Cervus (Strongyloceros) elaphus.*

Not more than ten or eleven specimens, referrible with tolerable certainty to the subgenus *Strongyloceros*, Owen, appear to have been met with in the Brixham Cave. It is far from improbable, however, that additional pieces may exist amongst the undetermined fragments and splinters.

With three exceptions these remains lay at an average depth of between 3 and 4 feet in the third bed, in the Reindeer and Flint-knife Galleries—the least depth being 9 inches, and the greatest about 8 feet, both in the former locality. Six of these specimens consist either of the basal portion of shed horns or of fragments (two) of round antlers. All these specimens present an appearance of great antiquity, being deeply coloured, heavy, and dense. The three exceptions, on the contrary, exhibit a comparatively more modern, or rather a less ancient aspect. One of them, a proximal phalanx, was found at the bottom of a "pipe," which penetrated 5 feet into the fourth bed in the Reindeer Gallery; whilst the others, consisting of an astragalus and a portion of the right maxilla with three teeth, were met with on the surface of, or immediately below, the stalagmite floor in the Flint-knife Gallery and South Chamber.

The character of the horns is well marked, and such as to leave no doubt of the subgeneric position of the species. They all appear to have been gnawed, and perhaps rolled; and they have all formed parts of naturally shed antlers of different sizes, varying in circumference immediately above the burr from 7 to a little more than 9 inches; they were consequently about the same size as the horns of the existing European species. The only other decidedly ancient bone from which any comparison can be drawn is a gnawed, or perhaps broken, and rolled right os magnum, nearly black in colour, and which measures $1''{\cdot}6 \times 1''{\cdot}6$.

The other remains, which occurred more superficially, comprise the phalanx above referred to as found in the "pipe," a nearly perfect astragalus, and a small portion of the right maxilla, containing the first and second molars *in situ*, and scarcely worn, in association with which was found a second upper milk molar, obviously belonging to the same jaw. This specimen is nearly covered with a thin layer of red crystalline stalagmite, beneath which the bone is of a dirty yellowish-white colour, and with hardly a trace of dendritic infiltration. The teeth, which, as has been said, have been scarcely brought into wear, measure:—

1 m	·98 × ·90
2 m	1·10 × ·90

The corresponding dimensions in a fine Scottish Stag are ·77 × ·81 and ·90 × ·91, and in a female specimen from Germany ·80 × ·80 and ·90 × ·85. In the British Museum there is a very fine collection of Strongylocerine remains from Grays Thurrock, amongst which two forms, very distinct from each other in size, but otherwise indistinguishable from *C. elaphus*, can be recognized. In the larger of these forms, the two teeth in question, in a specimen of the upper jaw (No. 20,277), which is rare as compared with the lower, allowance being made for their great difference in wear, are, at any rate at the neck, of

precisely the same size as those from Brixham, whilst in the crowns they seem to correspond more nearly with the German specimen cited above. The second milk-molar, which is almost worn out, measures in its present state ·8 × ·7 *.

The astragalus, which was found in the Flint-knife Gallery 10 feet from the entrance on the surface of the third bed under the stalagmite floor, has a somewhat different aspect and condition. It is so light as to float on the surface of water, of a yellowish-white colour, with the slightest possible trace of dendritic deposit, and entirely free from calcareous incrustation or infiltration. It is superficially eroded on the more prominent points, apparently by rolling; and on one side there are two or three shallow triangular indentations, evidently ancient, such as might be produced by the canine teeth of a Dog or Fox. Its dimensions are:—

Extreme length	2″·5
Extreme breadth	1″·6
Extreme height	1″·5

The corresponding dimensions in the Stag above referred to, and in the female Deer, are,—in the Stag 2″·0, 1″·2, 1″·2, and in the Doe 1″·5, 1″·0, 0″·8. In the larger of the Grays Thurrock forms the astragalus in four specimens measures†—

2″·3 × 1″·45 and 1″·2.

The Brixham specimen consequently, as compared with either the existing or with the Grays Thurrock fossil forms, must be regarded as of rather large size. This, to a certain

* These teeth, however, are very far from equalling the dimensions which, it may be supposed, were presented by the corresponding teeth in *C.* (*Strongyloceros*) *spelæus*, Ow. If we calculate these dimensions from the size of the first lower molar in the jaw figured at page 471 of 'British Fossil Mammals,' which would appear to have been 1″·38 in longitudinal diameter, and assume that the upper and lower teeth in that species bore the same proportion to each other as they do in the Wapiti Deer, then the size of the 1 m and 2 m must, in *Strongyloceros spelæus*, have been 1·38 × 1·38 and 1·79 × 1·62, dimensions which seem to be enormous and scarcely credible. In the Wapiti Deer, the largest of the existing Strongylocerine species, the teeth in question measure 1·10 × 1·10 and 1·30 × 1·25, and in *Megaceros hibernicus* 1·20 × 1·12 and 1·20 × 1·12.

† Four astragali of the larger form afforded the following measurements:—

1.	2·25 × 1·4	and 1·2
2.	2·3 × 1·4	and 1·2
3.	2·3 × 1·45	and 1·2
4.	2·15 × 1·4	and 1·2
Mean	2·25 × 1·41	and 1·2

Four astragali of the smaller form:—

1.	1·85 × 1·1	and 1·0
2.	1·95 × 1·2	and 1·1
3.	1·85 × 1·15	and 1·1
4.	1·9 × 1·2	and 1·1
Mean	1·98 × 1·16	and 1·1

There are also numerous calcanea of the two forms, which stand in the same uniform relation to each other as regards size; and it is to be remarked that there are *no* intermediate sizes.

In fact the two forms of *C. elaphus*, if that be the species, from Grays Thurrock seem to occupy the same relative positions as *C. elaphus* and *C. barbarus* at the present time, both of which coexist in the Gibraltar breccia.

extent is in accordance with the indications afforded by the teeth; and I am disposed therefore, notwithstanding some differences in the condition of the bones, which may be accounted for perhaps by their different positions, to think that the fragment of jaw and the astragalus may have belonged, if not to the same individual, yet to one of the same size or breed. What relation this bone has to the horns and bones which lay at a greater depth I am unable to say.

7. *Cervus tarandus.*

Next to those of the Bear, the remains of the Reindeer are by far the most abundant in the collection from the Brixham Cave. I have been able to determine about seventy well-marked specimens, besides which there are, without doubt, several more among the undetermined fragments.

They occurred in about fifty different localities in the Reindeer and Flint-knife Galleries and in the West Chamber, those from the two former localities, however, being by far the most numerous.

In the Reindeer Gallery about twenty-five specimens were met with, from the surface to a depth (in one instance only) of 8 feet in the third bed, and taken generally at a depth of a little more than 2 feet, and at distances from the entrance varying from 18 to 86 feet.

In the Flint-knife Gallery five or six out of thirty-five specimens were found lying on the surface of the third bed or immediately beneath it; some below, and others either on or protruding through the stalagmite floor. But deducting these superficial specimens, the average depth at which the others occurred was a few inches deeper than in the Reindeer Gallery.

Ten specimens were found in the West Chamber, and, as in nearly all other instances, the remains there met with occurred at a much greater depth, varying from 4 to 13 feet.

With the exception of the eight or ten specimens which were found lying on or near the surface of the third bed, and either upon or immediately beneath the stalagmite floor, the Reindeer remains all have a very ancient aspect—that is to say, they are deeply coloured, dense, and dendritic.

The superficial specimens above referred to, on the contrary, are light-coloured, dry, and porous; some incrusted with a thin crystalline stalagmitic deposit, others not. And with respect to these, it is a curious circumstance that several among them, though met with in different parts of the cavern, and at some distance as it would seem from each other, appear to be parts of the skeleton of one and the same young animal. The most noteworthy of these are:—1. The upper part of the cranium of a young Reindeer, on which are seen the two horn-bosses, and which was found together with the distal portion of the left femur, having the articular end nearly all gnawed off, and whose shaft 6 inches above the lowest part of the remaining outer condyle is $3''{\cdot}7$; and at the same spot were found four or five teeth. These specimens were found in the Reindeer Gallery 32 feet from the entrance, lying on the surface of the stalagmite floor. 2. The upper

part of the left tibia, evidently corresponding with the above femur, but which was found in the Flint-knife Gallery 22 feet from the entrance, lying on the surface of the third bed. 3. Three other portions of apparently the same skeleton, or at any rate of an animal of the same age, are a portion of a cervical vertebra, which lay on the stalagmite floor in the Reindeer Gallery, 81 feet from the entrance, a fragment of a calcaneum, and the greater part of a metatarsal, which were deposited one on the surface and the other 3 inches deep in the third bed in the Flint-knife Gallery, about 10 feet from the entrance.

With respect to the older or, at any rate, deeper remains, few remarks are required. The form to which they belonged seems to have been of medium size; and most of the bones, but not all, exhibit undoubted marks of having been gnawed, most probably by the Hyæna. But of these more deeply deposited remains two exhibit the light colour and porous condition by which the superficial bones are distinguished: both are upper portions of the left radius, one of which occurred at a depth of 54 inches and 21 feet from the entrance of the Reindeer Gallery, associated with the astragalus and a tooth of *Rhinoceros* and the calcaneum of a Bear, all three of which presented the characters of great antiquity; the other was found by itself in the "Flint-knife Gallery," 45 inches deep in the third bed, and 53 feet from the entrance, but "amongst loose angular stones."

I have placed in the subjoined Table the measurements of some of the parts of different bones of the Brixham Cave Reindeer, contrasted with those of individuals of the existing Norwegian and American forms and some others, in order to afford an idea of the comparative dimensions of the species.

Comparative Dimensions of Bones &c. of Reindeer. (0″·01.)

Part.	Brixham Cave.	Norwegian Reindeer.	American Reindeer.	Les Eyzies.
Glenoid fossa	135×120	120×110	155×145	140×130
Distal end of humerus	190×180	185×170	195×215	
„ „	180×160			
Least circumference of humerus	350	297	335	
„ „	235			
Proximal end of radius	105×180	100×160	105×200	
„ „	95×162			
„ „	95×160			
Length of radius	920	870	1075	
Least circumference	290	235	330	
Distal end of metacarpal	90×170	80×150		
Acetabulum	120			
Distal end of tibia	115×150	115×145	135×180	
„ „	120×150			
„ „	120×155			
„ „	120×155			
„ „	120×150			
Distal end of metatarsal	90×170	85×150		
Calcaneum	390×115	340		
„	350×110			
Astragalus	180×110	170×105		
„	180×110			
Scapho-cuboid	120×130	..	..	120×135

8. *Capreolus capreolus.*

Not more than ten or twelve specimens of remains distinctly belonging to the Roebuck have been collected. They occurred in about equal numbers in the Reindeer and Flint-knife Galleries only; in the former at an average depth of about 10 inches, and in the latter of about 30. Its horizon, therefore, so far as can be judged from such scanty materials, would seem to be higher than that of the Red Deer. In the external appearance and general condition of the bones they would seem to be fully as ancient as those of any of the other animals; and though some are lighter and more porous than the rest, none can be regarded as decidedly modern. Several of the bones are quite perfect, whilst others exhibit signs of having been gnawed; and others again, if not most of the long bones, from their cracked and weathered aspect, would seem most probably to have lain exposed to the sun and weather before they were introduced into the cavern.

Among the remains of the Roebuck, the most worthy of note are:—

1. The lower end of a right tibia, with the articulation perfect, and measuring ·90 × 1·20, whose shaft appears to have been broken across about 4 inches above the end, the broken end showing signs of having been gnawed. This fragment, which is light-coloured and porous, though found at a depth of 42 inches in the third bed and 42 feet from the entrance of the Flint-knife Gallery, appears to correspond so exactly in size, colour, and general condition with a calcaneum met with, together with a proximal phalanx, in the Reindeer Gallery, 70 feet from the entrance, and only 2 inches deep in the third bed (where it was associated with numerous bones of Hare, Rabbit, and Fox, and the tooth also of a young Bear), that it is not unfair to surmise that they may have belonged to the same animal. 2. A beautifully perfect left metacarpal in similar condition. 3. An equally perfect right metatarsal, 8″·3 long, of rather darker colour, but still not very unlike the above. Both the last two bones occurred not far apart, and on or near the surface of the third bed in the Flint-knife Gallery. 4. Another right metatarsal, very fragile and deeply weather-cracked, was found, together with a portion of the pelvis, at a depth of 6 inches, and 76 feet from the entrance of the Reindeer Gallery.

IV. Carnivora.

9. *Felis (Leo) spelæa.*

Though scanty in number, the remains of the Cave-Lion are amply sufficient to show the existence of that species amongst the animals whose remains were found in the Brixham Cave. These remains, all of which present the characters of extreme antiquity, were, with perhaps two exceptions only, found at a considerable depth. The least depth at which a specimen undoubtedly belonging to *Felis spelæa* was met with was 48 inches in the third bed, and a distance of 83 feet from the entrance of the Reindeer Gallery; and it affords the only instance of the occurrence of the species in that compartment of the cavern. The specimen is a left outer incisor, very much worn; and in that respect, as well as in size and condition, exactly corresponding with the same tooth still *in situ* in a fragment of the maxilla found at a depth of 5 feet in the third bed, and

54 feet from the entrance of the Flint-knife Gallery. In that compartment of the cavern five indubitable specimens belonging to the Cave-Lion were met at the depth of about 5 feet, and all about 50 feet from the entrance. They consist of:—

1. A much-worn upper canine, exactly resembling the one figured in 'Reliquiæ Diluvianæ,' plate xxii. figs. 6, 7.

2. A portion of the right maxilla, with the third and fourth premolars *in situ*.

3. A similar portion of the left maxilla with the 2 pm and another portion of the same jaw with the third incisor *in situ*, all looking old and weathered; and the three portions appear without doubt to belong to one and the same individual.

4. A fifth proximal phalanx of the manus.

5. A fourth phalanx, probably belonging to the same individual. The former of these bones is very nearly entire, the latter is fractured at the distal end. Both, as I am informed by Mr. Boyd Dawkins, to whom I am indebted for the certain determination of these specimens, are remarkable for their comparative slenderness as compared with those which had previously come under his inspection, and also for the great depth of the dorsal pit immediately above the head of the bone. This is a character which I find varies a good deal also in the recent species, being sometimes almost wanting, and at others well marked; but I have seen no case in which it is so pronounced as in the Brixham fossils. Both of the bones are figured in Plate XLV. figs. 7 and 8.

10. *Hyæna.*

Next below those of *C. tarandus* in frequency are the remains belonging to *Hyæna*. They amount to about sixty in number, and were found distributed nearly equally in three divisions of the cavern, viz. eighteen in the Reindeer Gallery, seventeen in the Flint-knife Gallery, and twenty-one in the West Chamber.

In the Reindeer Gallery the average depth at which the bones of *Hyæna* were found seems to have been about 37 inches in the third bed, and the greatest depth about 9 feet.

In the Flint-knife Gallery the average depth was about 4 feet, and the greatest depth 5 feet 6 inches.

In the West Chamber the average depth was between 10 and 11 feet, but fully half of the bones there met with lay at a depth of 13 feet. No specimen referrible to *Hyæna* seems to have occurred above the stalagmite floor, nor more than four or five on or very near the surface of the third bed. These are:—three specimens met with in the Reindeer Gallery at a depth of from 9 to 12 inches, and at distances of 29, 39, and 50 feet from the entrance; whilst in the Flint-knife Gallery two specimens occurred at a distance of 7 feet from the entrance, one on the surface of the third bed in immediate contact with the stalagmite floor, and the other at a depth of 16 inches. The surface specimen, though presenting all the characters of the greatest antiquity, was associated, as it would seem, with more than 100 bones of the Rabbit, Hare, Birds, &c., all of which were in the usual condition of the superficial bones elsewhere. But the anomaly may probably be explained by the circumstance that in the same situation broken slabs of

angular bone-breccia were also met with, leading to the conclusion that the ground must at some time previously have been disturbed.

The general condition of all the Hyæna remains proves their great antiquity; and it is to be remarked that very few among them exhibit any indication of gnawing, weathering, or rolling, and that amongst them are several perfect bones, in all probability belonging to one and the same animal. Another point also connected with these remains is the circumstance that, whilst amongst thirty-six specimens met with in the Reindeer and Flint-knife Galleries there is scarcely an entire bone, except one or two small bones of the feet, amongst the twenty-one specimens found in the West Chamber there are several perfectly entire long and other bones belonging to at least two or three individuals; and amongst these an atlas and two cervical vertebræ, which, together with other bones, apparently belonged to the same animal. It would seem, therefore, that this part of the cavern, which forms as it were the junction between the two principal galleries, was the chief point of refuge during life, or at any rate the chief receptacle of the remains shortly after death, of the Hyænas, the marks of whose teeth are so obvious in the numerous gnawed and splintered bones of the Rhinoceros, Elephant, Bear, Ruminants, &c. associated with them.

The bones and teeth clearly indicate several individuals of all ages, or from that at which the epiphyses of the femur and tibia were still ununited, up to one at which the canine teeth were almost worn away; but no certain trace of a fœtal or very young Hyæna is perceptible. All the teeth belong to the permanent series.

With respect to the species of *Hyæna* to which these remains belong, all I would here remark is that, so far as the bones of the extremities are concerned, it must have been of a size pretty nearly corresponding with the existing *Hyæna crocuta*, though perhaps a little lower in stature. As sufficient means of comparison between the skeleton of the Cave-Hyæna with that of the existing *H. crocuta* in the wild state (for the bones of animals that have been long caged are of little avail for the purpose) are wanting, it will be useless here to enter at any length upon that part of the subject; and I would merely remark that the quite perfect radius and tibia, shown in Plate XLV., do not appear to differ in any respect, either as regards dimensions or form, from the corresponding bones in the Spotted Hyæna*.

And with regard to the teeth, though more may be said, it is, I think, impossible to

* As material for future comparison, the dimensions of some of the principal bones of the skeleton in the Cave specimens are subjoined:—

1. Atlas: antero-posterior diameters of dorsal and ventral arches, 1·10 and ·61; distance between the foramina in front 1·55.
2. Humerus: distal extremity, 1·60 × 2·15.
3. Radius: length 8·20 and 8·15; proximal end ·75 × 1·21; distal end 1·00 × 1·62; circumference of shaft (least) 2·10.
4. Acetabulum: diameter 1·12.
5. Femur: distal detached epiphysis 2·10 × 1·90; circumference of shaft 2·75.
6. Tibia: length 7·45; proximal end 2·00 × 1·90; distal end 1·50 × 1·00; circumference of shaft (least) 2·40.

point out any characters, either in size or form, sufficient to distinguish the Spelæan from the Spotted Hyæna.

In the subjoined Table I have given the mean, maximum, and minimum dimensions of the principal teeth in different species of Hyæna, from which it will be seen how very closely, in almost every tooth, the fossil Hyæna agrees with *H. crocuta* (*fera*), or, rather, as I should explain, with the larger variety of that species. Taking the individual teeth, it would seem that the upper canine is somewhat larger in the existing Hyæna, whilst the third premolar is a trifle less, its maximum size only coming up to the mean in *Hyæna spelæa*. The fourth upper premolar is considerably less, even its maximum size falling considerably short of the mean in the fossil form. The lower canine, again, like the upper, is somewhat larger in the existing species, though the difference is very slight. The first lower premolars are of nearly equal size in both, as are also the second and third; but the lower carnassial tooth appears to be sometimes a good deal larger in the fossil Hyæna, although its mean dimensions are but very little more.

Table showing the Mean, Maximum, and Minimum Dimensions of certain Teeth in different Species of *Hyæna*. (0″·01.)

	Canine.			pm 3.			pm 4.			$\overline{\text{Canine.}}$		
	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.
H. crocuta (*fera*)* ...	76×50	80×50	55×40	94×70	100×70	71×60	146×84	150×85	130×75	66×49	75×50	55×40
H. brunnea	67×50	70×52	65×50	93×63	100×67	90×60	142×85	150×90	140×82	72×50	75×50	70×50
H. striata	60×40	70×40	55×40	80×52	90×60	75×51	117×70	120×77	110×66	54×41	60×40	50×40
H. spelæa	74×46	.....	.....	100×73	.....	.....	160×87	.....	.....	71×52	.....	.....
H. (Brixham)	70×51	70×55	70×50	100×70	.....	.....	160×90	.....	.....	62×50	65×50	60×50

	$\overline{\text{pm 1.}}$			$\overline{\text{pm 2.}}$			$\overline{\text{pm 3.}}$			$\overline{\text{m.}}$		
	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.
H. crocuta (*fera*)* ...	63×44	70×48	50×35	85×60	90×62	70×50	91×52	95×50	70×50	120×50	120×55	100×40
H. brunnea	62×45	70×50	60×45	84×55	90×60	80×52	94×53	95×55	95×53	94×58	97×50	95×45
H. striata	52×32	60×35	47×30	72×44	75×48	70×40	78×43	80×45	72×40	81×40	85×40	77×40
H. spelæa	66×48	.....	.....	89×65	.....	.....	95×59	.....	.....	128×54	.....	.....
H. (Brixham)	61×46	65×48	60×45	90×61	90×65	90×60	92×58	95×60	90×55	125×53	132×52	120×50

On the whole, when we consider the fact that the dental differences between *H. crocuta* and *H. spelæa* are to the full as great, if not greater, than they are between the Lion and Tiger, I am hardly at present inclined to agree with Messrs. Boyd Dawkins

* The minimum measures under *H. crocuta* are taken from caged specimens. There is no reason for supposing that the teeth are ever so small in the wild state.

and SANFORD in considering it proved that *H. spelæa* is merely "a variety of the Spotted Hyæna of South Africa" *. That it has no relation to *H. brunnea* or *H. striata* is at once seen from the comparison of the dentition; but that it necessarily represents the third existing species, though highly probable, cannot as yet be said to have been absolutely proved †.

It is rather remarkable that no coprolites of the Hyæna should have been met with in the cavern. It is impossible, with the minute care that was bestowed in the exploration, that such well-marked objects should have been overlooked. Is it possible that they had been washed away by currents of water insufficient to remove the more solid bones?

11–13. *Ursus.*

Of all the animal remains discovered in the Brixham Cave, those belonging to the Bear are by far the most numerous, and in some respects, more especially with regard to their distribution, perhaps of the greatest interest.

In the present, as in almost every instance, of the occurrence of ursine remains in caverns, the extreme variation in size and other characters of the different bones and teeth is so great as naturally to lead to the belief that they must have belonged to more than one species. Without pretending to decide or even to enter at large into the very difficult and important question of the distinctions between numerous species of Cave-Bears that have been described by authors, I will subsequently point out what appears to me to be the amount of evidence afforded by the Brixham-Cave ursine remains in favour of the view that they belong to more than one species, but will first say a few words with respect to their distribution in the cavern, general condition, &c.

1. *Distribution of the Ursine Remains.*—The number of specimens clearly determined is about 350 or 360; but besides these there are, in all probability, thirty or forty more amongst the as yet undetermined splinters and fragments. It should be remarked, however, as in some measure explanatory of this number, that it includes several collections, each composed of numerous bones of the skeletons of animals of various ages found lying together at the same spot. But if we take the number of separate stations in which ursine remains, as compared with those of the Reindeer and Hyæna, were met with, it will be even still more clearly seen how much those of the Bear predominate. The number of stations for each of these animals is:—

Ursus	71
C. tarandus	50
Hyæna	30

Of the specimens included in the above enumeration, about 116 occurred in the Reindeer Gallery, 210–220 in the Flint-knife Gallery, 26 in the West, and only 3 in the South Chamber.

* British Pleistocene Mammalia. Introduction, p. xlii.

† Further details concerning the cranial and dental characters of the existing Hyænas will be found in a paper published in the ninth volume of the Journal of the Linnean Society.

The mean level at which the bones were deposited in the Reindeer Gallery was about 28, and in the Flint-knife Gallery about 32 inches, whilst in the West Chamber they occurred, as would seem to have been the case with all the bones found there, at a much greater depth, or at about 110 inches. The mean horizon, therefore, of *Ursus* appears to have been about the same as that of the Reindeer, and a few inches above that of the Hyæna. It is also to be remarked that, as compared with the latter animal, a much larger proportion of its remains were found lying on or near the surface of the third bed, or even imbedded in the stalagmite itself.

Another remarkable circumstance connected with the ursine remains, and which has already been alluded to, is the number of instances in which bones obviously belonging to the skeleton of the same animal were found collected together in one spot.

Amongst the most remarkable of these collections may be mentioned one which, though not recorded in the "Register," was found, as we are informed by Mr. PENGELLY, "on the 29th July, 1858, upwards of 2 feet deep in the third bed, immediately north of the junction of the Reindeer and Flint-knife Galleries, in a small recess in the west wall of the former, and about 62 feet from the entrance, at a spot where the overlying stalagmite was about 4 inches thick." The bones in question, so far as they are exposed, include an entire left femur, the corresponding tibia lying in the natural posture it would assume in extreme flexion of the knee, and having the entire astragalus articulated to it in the natural position. Close beside these leg-bones, and in fact partly overlapping the astragalus, is the left radius; and attached to the specimen, when it first came under my notice, was the detached lower articular end of the same radius, with the scapho-lunar fossette entire. In a "Report of Progress in the Brixham Cave" drawn up by Dr. FALCONER in Sept. 1858*, this specimen is described as a "superb specimen of the bones of left hind leg, comprising the femur, tibia, and fibula folded together, with the patella and astragalus *in situ*." "These were found," the Report goes on to say, "near the Ebur chasm, and the other parts of the skeleton may be looked for when that portion of the cavern is dug up." And in a note given in p. 495 of the 'Palæontological Memoirs,' dated May 1863, Dr. FALCONER states that "all the circumstances connected with the entire leg of Cave-Bear (femur with tibia and fibula folded together, and ball of astragalus partly dislocated), and its position in comminuted shale, below the ochreous cave-earth and above a well-defined flint implement, were determined by me at Torquay and Brixham on September 2. I identified the remains and the flint, and drew the inference that the leg must have been introduced, with its ligaments at least fresh, after the flint had been introduced into the lower cave-deposit."

Subsequent examination, however, of this collection of bones, after the removal of the matrix in which they were imbedded, has shown that Dr. FALCONER was, to some extent, misled as to the true state of the case. The bone which, when very partially uncovered, he naturally took to be fibula, proves, when fully disclosed, to be the radius;

* *Antè*, p. 476.

and it would seem that what is described as the patella is in reality the detached end of the radius above noticed. Besides these, a further removal of the indurated clayey matrix has brought into view a large portion of a rib; and some other bones may not improbably still be concealed in the mass, which has been left intact in order to display the original juxtaposition of the remains.

This magnificent specimen is of special interest, as being that to which Sir CHARLES LYELL, in his work on 'The Antiquity of Man'*, and Sir JOHN LUBBOCK, in 'Prehistoric Times'†, refer, but with respect to which they seem to have been not quite correctly informed. Sir C. LYELL speaks of the "occurrence at one point in overlying stalagmite of the bone of a Cave-Bear," and of the "discovery at the same level in the bone-earth, and in close proximity to a very perfect flint tool, of the entire left hind leg of a Cave-Bear." Although the argument sought to be strengthened by the circumstances thus recorded (of the contemporaneity of man with the Bear) is not materially affected by the correction, it is as well that this opportunity should be taken of stating the facts exactly as they stand.

The "bone" above referred to by Sir CHARLES LYELL as having been lodged in the overlying stalagmite is a very perfect humerus of a Bear of small size, which was found, in the position described, on the 30th July, 1858, at a distance of 67 feet from the entrance of the Reindeer Gallery, or at pretty nearly the same distance as the leg-bones; but it was, as has been said, completely imbedded in the stalagmitic floor, and consequently above the surface of the third bed, whilst the leg-bones lay at a depth of upwards of 2 feet in the clayey bone-earth; moreover, it was found at the opposite or east side of the Gallery. It should also be stated that the humerus differs from the other bones, not only in size, but very remarkably in its condition, which is nearly white, and it is wholly unstained by dendritic deposit, whilst the leg-bones are deeply coloured, very dendritic, and evidently of much higher antiquity. Nor does it appear that either the humerus or the leg-bones were found in close proximity to a flint implement. Three implements of the kind only can be referred to in speaking of these bones, viz. those numbered 1, 2, 3 in Mr. PENGELLY's Report. Of these, Nos. 1 and 2 were found nearest the leg-bones. They were both found on the 29th July, 1858, 74 feet from the entrance, and 9 inches deep in the third bed, *i. e.* 12 feet south and 15 inches above the level of the leg-bones, or 7 feet south and 9 or 10 inches deeper than the humerus; they were, in fact, deposited immediately beneath the spot where the great antler was found on the upper surface of the stalagmite. The third flint implement was found the next day at a distance of 47 feet from the entrance, and 34 inches deep in the third bed.

A second instance of the same kind, and equally tending to show the probability that these remains must have lain almost undisturbed from the period of their sepulture, whilst still surrounded by the soft parts, or at any rate connected by ligaments, is afforded in the remains, evidently belonging to one and the same young Bear, which

* Third edition, page 100. † Page 260.

are recorded under Nos. XXVI. & XXIX. in the "Register." The remains comprised under No. XXVI. were found 3 feet from the entrance of the Flint-knife Gallery, at a depth of only 3 inches in the third bed. They consist chiefly of the right ramus of the lower jaw, with the permanent canine, though partially exposed by recent fracture of the bone, still wholly in germ, and with the crown of the penultimate molar just protruded from the alveolus. Together with this were several other teeth of the permanent and milk series, which, from their age and condition, undoubtedly belonged to the same individual, and a fragment of the right maxilla showing the 4 pm *in situ* and just emerged from the alveolus. Seven feet further in from the entrance, and lying on the surface of the stalagmite floor, was the opposite ramus of the same mandible, having the milk-canine still *in situ* and the permanent tooth completely concealed in the alveolus, though the second permanent incisor is fully protruded and the third is just making its appearance. Near the same spot was also found the shaft of a very young tibia sticking in the stalagmite, and which, there is every reason to conclude, belonged to the same individual as the jaws and teeth. These bones are all in the most fragile and delicate condition; and more especially is it to be remarked that the shell of bone covering the swollen germs of the permanent canines, and consequently in a much exposed part of the bone, is as thin as paper and as fragile as glass, or even more so. Nevertheless, except the injuries necessarily received by such fragile objects at or since the time of extraction, they appear absolutely perfect. They are of a light colour and very porous, in fact closely resembling the superficial bones generally. But it is a strange circumstance that among these comparatively modern bones of a very young Bear was found the ungual phalanx of an adult animal, nearly black in colour and a good deal worn or weathered, and presenting all the characters of the most remote antiquity.

A somewhat similar instance is afforded by the specimens included under Nos. CVII., CVIII., and CIX. of the "Register," all of which occurred from 10 to 16 feet from the same entrance, some lying on the surface of the third bed, and some imbedded in the stalagmite. Amongst these bones are the shafts of the right and left humerus, of both tibiæ, and a left ramus of the lower jaw (some of the milk-teeth still *in situ*); and the occurrence of this part, as well as of the two tibiæ, renders it probable that the bones associated with it all belonged to a second individual young Bear of about the same age as the one above described. All the bones are in the same light porous condition, though slightly dendritic and infiltrated with calcareous matter. The tibiæ are each perforated near the middle by a perfectly circular hole, about $\frac{1}{8}$ inch in diameter; these holes, from the appearance of the minute fractures round the edges, are evidently recent*. Together with these bones are associated a portion of the pelvis and the scapho-cuboid of the Roe, the slightly abraded and perhaps bitten astragalus of a very small Ox, and a fragment of a long bone, perhaps of the same, together with a small

* From subsequent inquiry it appears that these holes were made for the purpose of fixing the bones on a board, in order to exhibit them with other articles.

portion of the os innominatum of a young Hare. The bones of the Roedeer and Hare are in exactly the same condition, as regards colour and amount of dendritic infiltration, as those of the young Bear, and there is no reason to doubt their contemporaneity; but with respect to the bovine astragalus, as already stated, I am by no means so certain.

A similar, though larger collection of ursine bones, but of those of a mature or perhaps rather of an aged animal, is recorded under No. CIII. The number of bones belonging to the same skeleton is in this instance between twenty and thirty, and they are all pretty nearly in the same condition as those just described—that is to say, of a reddish-white colour, exceedingly porous and friable. They were found in the Reindeer Gallery 10 feet from the entrance, or at about the same distance as the foregoing, but at a greater depth, as I should presume; though this is not very clear, as it is stated that they lay 30 inches deep in the *first* or uppermost bed. The collection includes:—the entire upper portion of the right femur and the upper part of the left minus the head, which was found detached and had apparently been gnawed or rolled, whilst all the other bones appear to be merely broken; a portion of the pelvis, with part of the acetabulum; several portions of the cranium and upper jaw, including the $\underline{1\ m}$ and $\underline{2\ m}$, both worn down nearly to the bottom of the crowns; a detached condyle of the lower jaw; and a portion of the right ramus, containing the canine and $\overline{3\ pm}$ *in situ*, and exhibiting two small sockets for the $\overline{1\ pm}$ and $\overline{2\ pm}$, one close to the canine and the other immediately in front of the $\overline{4\ pm}$. There is also a part of the left ramus, containing the $\overline{1\ m}$ and $\overline{2\ m}$, both worn down to the same extent as those of the upper jaw. The detached right upper and left lower canines and the detached head of the femur were also met with. From the size of the teeth and other bones, I should conclude the species to have been *Ursus arctos**.

A fourth remarkable specimen, but in which the bones exhibit a much greater degree of dendritic infiltration, and are, to all appearance, of older date, is recorded under No. XXIV., comprising about thirty bones of one and the same skeleton of a mature animal of gigantic size compared with the others already mentioned. In order to afford a good notion of the way in which an entire skeleton was probably left in one spot, it will be useful to mention the bones contained in this "find," which occurred 68 feet from the entrance of the Reindeer Gallery, and 33 inches deep in the third bed, or about a foot beneath and not more than 6 feet distant from the entire leg described above. The bones, however, do not belong to the same animal, but to one of much larger size. They include a nearly entire sacrum; large portions of the right and left ossa innominata, including the acetabula; a portion, about 9 inches long, of the right femur, wanting the head; a portion of the right tibia; portion of a scapula, ulna, and radius; nine vertebræ, some nearly entire; five or six large portions of ribs; an entire scapho-lunar bone and fragments of other bones; and mixed with them is what appears to be a fragment of a metacarpal or metatarsal bone of *Hyæna*.

On one of the ribs is a small notch, which Dr. FALCONER observes might have been

* One of the canine teeth of this specimen is figured in Plate XLVI. fig. 3.

made by means of a flint or stone implement. Of course this may be so; but upon close inspection I am inclined to think that it is not an incision or scratch at all, but a mere indentation by some blunt edge, which has simply depressed the soft texture of the bone without breaking the surface. The bottom and sides, therefore, of this very trifling mark appear rounded, smooth, and, under a magnifying-glass, exactly like the surrounding surface; but the appearance of antiquity which would thence attach to the indentation, were it really an incision, may, as it seems to me, be readily explained on the presumption of its being merely an accidental impression.

Several other instances might be cited, but one or two more will suffice, to show that similar assemblages of bones were formed probably at the remotest periods of the history of the cavern. In one case between thirty and forty bones and teeth of a young Bear, together with a gnawed fragment of the scapula, several portions of the ribs, an astragalus, some metacarpal bones, a bone of the sternum, and teeth belonging to a mature animal, were found at a depth of 5 feet in the third bed, and at a distance of 46 feet from the entrance of the Flint-knife Gallery, intermixed with a tooth of *Felis spelæa* and bones and teeth of Hyæna, Rhinoceros, and Reindeer. The ursine bones and teeth are all dark-coloured and dense, and, in fact, in precisely the same condition as those of the other animals.

A second instance of the kind was afforded about 8 feet further from the entrance of the Gallery and at the same depth of 5 feet, where between thirty and forty bones, or fragments of bones, of a still younger Bear were found lying altogether, but, as it would seem, without mixture with those of any other animal. These bones present exactly the same ancient character, and they would seem to have been those of a sucking cub, or of one hardly beyond that stage of growth. They very closely correspond in every respect with those of a skeleton of a young Norwegian Bear in the collection of the British Museum, in which the middle permanent incisors of the upper jaw are in place though quite unworn, and the second and third milk-incisors still retained, together with the much-worn milk-canines. In the same jaw the first and third milk-molars, and behind these the first permanent molar, or 4 pm, is nearly protruded; and behind that the first (second) molar is fully out, whilst the second or last molar is still wholly in germ, although its sac is very much enlarged. In the lower jaw the first and second incisors are fully out, whilst the third milk-incisor is still *in situ*, as well as the milk-canine and the first and second milk-molars. The point of the fourth premolar has just made its appearance, and behind that the first or antepenultimate molar is fully protruded, whilst the anterior half of the penultimate molar is visible above the alveolus, and the third molar is still wholly in germ. As the form of the ribs at this early period of growth appears to differ considerably from that which they subsequently assume (a difference which at first rendered the diagnosis of the bones very doubtful), the aid towards their identification rendered by this young skeleton in the British Museum has been invaluable. The difference in question consists in the young ribs being nearly all of them more or less square, with a rather deep groove on the anterior and posterior sides,

and in the middle ribs having a deep fossa on the dorsal aspect, between the angle and the tubercle. Except in their size, these fragments of ribs bear a close resemblance to those of the Hare or Beaver.

2. With respect to the general condition of the ursine bones, little remains to be added to what has already been noticed in the preceding observations. In general terms it may be remarked that, with the exception of the instances in which the bones were found on or close below the stalagmitic floor or on the surface of the third bed, they are more or less dendritic; and in the great majority of cases they present the same characters of extreme antiquity as are shown in the bones of *Hyæna*, *Rhinoceros*, &c. It would appear, therefore, from this circumstance, as well as from the positions in which the ursine remains occurred, that they belong to all periods of the Cavern's history, from the earliest to nearly the most recent.

Many among the bones present marks of their having been gnawed, but the condition of a great many (and this is especially the case with those of the very young individuals) plainly shows that they were tranquilly deposited in or not far from the sites in which they were found. There can, in fact, be little doubt that amongst the Bear's relics, as with those of the Hyæna, some at least must have belonged to animals which habitually used the cavern as a place of refuge, and especially perhaps at the time of parturition and when they were nursing their young.

With respect to size and other particulars, the bones, as already observed, exhibit the extreme diversity which characterizes ursine remains in all situations, and which is as manifest in the bones of the larger existing species as it is among those of their fossil representatives. But, besides size, close scrutiny will detect in some of the bones certain differences, which must, I think, be regarded as indicative of more than mere sexual or individual peculiarity. Amongst the osteological characters which have been most generally looked for in the discrimination of fossil Bears, the size and form of the cranium and lower jaw have been more especially relied upon. The Brixham Collection affords no evidence of the former kind, and not much of the latter. With respect to the cranium, its form and size in existing species varies so extremely, not only between different races of the same species, but also between the sexes, that I am not inclined to place any very great importance upon it. As regards the lower jaw, however, the case is different. The greater convexity of the "inferior contour of the ramus" has been noticed as characteristic of *U. spelæus* by Professor Owen and other palæontologists, and it was regarded as of great value by Dr. Falconer among others. It appears to be a pretty constant character even in the oldest jaws; but it should not be forgotten that in other species the inferior contour is much more convex in the young jaw before the teeth are fully out than it afterwards becomes. The length of the diasteme is a second point often referred to; but this depends so much upon age and upon the proportionate size of the jaw itself, as compared with the teeth, as not, I think, to be of much importance. The presence of any of the small premolars is excessively rare in *U. spelæus*, whilst in *U. priscus*, Cuv. (*fossilis*, Goldf.), and *U. arctos* one or more of them, though never all

three, are almost invariably found. When two exist, as is commonly the case in *U. arctos*, they are almost always the first and third, one being situated close to the canine and the other immediately in front of the $\overline{pm\ 4}$. But in two of the jaws in the Brixham Collection the two sockets are placed close together immediately behind the canine, leading to the supposition that in these cases it was the third and not the second premolar which was suppressed. There is, however, another character belonging to the lower jaw (which was, I believe, originally pointed out by Mr. WATERHOUSE) which appears to be of some value; this is the comparative thickness of the articular condyle. In all collections of fossil ursine mandibles they may manifestly be divided into two groups, from the difference in the proportions of this part; and as the difference in question is also accompanied, in the majority of instances, by certain differences in the teeth distinctive of *U. spelæus* and *U. priscus*, it may be taken as an additional specific character. The same difference, even to a still greater extent, is found between the mandibular condyle in the Lion and Tiger—the former having it very much thicker than the latter, even when the jaw itself and the teeth are of the same size. The thick condyle characterizes the lower jaw of *U. spelæus*.

As regards the other bones of the skeleton, I am not at present in a position to say any thing in detail. Many of them undoubtedly present differences which must be regarded as specific; but I am not aware that these distinctions have yet been assigned to the respective species. Amongst other bones in the Brixham Collection, differences will be observed in the humerus, more especially as regards the angle at which the supinator ridge descends from the shaft. Certain differences also may be noticed between two tolerably perfect unciform bones which are figured in Plate XLVI. figs. 9 & 10, and in the case of two astragali (one of which, however, is unfortunately very imperfect) which are represented in figs. 7 & 8.

But it is upon the teeth that we must chiefly rely in the distinction of species in fossil Bears, affording as they do the best and most easily appreciated characters. The characters of the teeth are derived partly from their relative and absolute dimensions, and in some of them more especially from their form. As regards the dimensions of the teeth, it is necessary to consider them not so much individually as relatively to each other in the same jaw. On this account the Brixham Collection, though rich in separate teeth, does not afford very abundant materials for their proper comparison *inter se*. I have placed in the following Table the dimensions of the various teeth occurring in the collection which are sufficiently entire for the purpose, which will give all the requisite information on that point, and will proceed to say a few words with respect to the forms of some among them which present the most marked characters.

TABLE I.—Dimensions of Teeth of Bears from the Brixham Cavern. (0″·01.)

	Can.	pm 4.	m 1.	m 2.	pm 4.	m 1.	m 2.	m 3.
	140×72	60×50	85×70	135×73	48×30	100×50	110×75	92×67
	135×80	65×56	90×70	155×80	58×31	100×50	105×63	98×70
	110×75	75×63	105×75	154×80	56×31	105×55	100×63	95×70
	135×80	66×55	110×60	153×80		110×55	110×66	80×65
	120×71			150×70		115×55	105×70	
	140×70			150×75		100×50	109×64	
	91×61			152×79		105×52	110×65	
	90×62						115×70	
	100×65						110×69	
	90×60						109×68	
	100×65							
	120×71							
	120×72							
	100×65							
	105×65							
	110×70							
	100×70							
	120×75							
	115×68							
	85×65							
	100×65							
	90×60							
	86×52							
Mean..	108×67	67×55	95×64	150×77	54×31	105×53	108×67	91×68

Canines.—The canine teeth in Bears appear to differ a good deal in size in the two sexes, as might be expected perhaps in animals not altogether carnivorous; and consequently, from the mere size of these teeth, within certain limits no very sure conclusions as to difference of species can be drawn. In the Brixham Collection, besides numerous incomplete or broken teeth, there are between twenty and thirty canines whose characters can be accurately determined. Their dimensions are given in the above Table; and as regards the types of form presented among them, the principal varieties are exhibited in figs. 1, 2, 3, 4 in Plate XLVI. From these it will be seen that they exhibit what may be termed three distinct forms, one distinguished principally by its small size, as shown in fig. 3, and one by its slenderness of shape, fig. 4.

If the forms of teeth here represented are compared with those given by M. SCHMERLING from the Belgian bone-caves, they will all be found amongst the latter. For instance, figs. 1 & 2 of the Brixham teeth appear to correspond very closely with M. SCHMERLING'S figs. 1, 2, 3, 4, 5, 6; whilst fig. 4 strongly resembles his figs. 8 & 9, and fig. 3 his fig. 7. Whether, as M. SCHMERLING and many others suppose, these differences in the canine teeth are of specific value, and to what extent they are so, is by no means an easy question to determine; and I fully agree with him that sufficient attention has not as yet been directed to the dental, amongst other differences dependent upon sex. It is not at all improbable, therefore, that figs. 1 & 2 (Plate XLVI.) may represent merely the male and female canines of the same species, although it is just as likely they may be specifically different. But, so far as I have had any means of judging, it appears

almost impossible that fig. 3 should also belong to the same; whilst if we regard the peculiar form of fig. 4, it seems difficult to believe that it also does not belong to a third. I am, however, inclined to the opinion that it may belong to the upper jaw of the same species as fig. 3, and also that the canine teeth in the present collection indicate the existence it may be of three, and certainly of two, distinct species of *Ursus*. In this view we might perhaps, though with doubt, refer fig. 1 to *U. spelæus*, and fig. 2 to *U. priscus*, whilst I have little doubt the two small teeth belong to *U. arctos*. This conclusion is supported by the numerical data given in the Table. The mean dimensions of the canine teeth found at Brixham are 108×67. Nine teeth are decidedly above this mean, whose average dimensions are 124×72; whilst six are as much below it, whose size is about 90×60. The dimensions of the intermediate eight are very uniformly 100×65. Among the teeth belonging to the first category there are four whose mean size is nearly 140×80, and four of 120×67. Now the former may fairly be referred to *U. spelæus*, whilst the smaller may represent either the female of that species or the large male of *U. priscus*. The teeth in the second category might in like manner be referred to *U. priscus*, whilst the smaller teeth in the third category may be assigned to *U. arctos*, in which species, from the measurements I have taken, the mean size of the canines may be given as 92×60. In *U. ferox* it is about 103×70, and in *U. maritimus* the same.

But it is in the molar teeth, and more particularly, perhaps, in those of the lower jaw, that we have to seek the most marked and distinctive dental characters.

These depend upon (1) the absolute and relative *dimensions*, and (2) on the form of the various teeth. As regards the former point, the materials that I have employed for comparison are contained in the subjoined Table, in which all the measurements I have been able to make or obtain of the molar teeth in most of the known and admitted species of recent and fossil Bears, including those from the Brixham Cave, are given. Upon these figures I will first offer a few explanatory remarks, and then proceed briefly to discuss the principal morphological characters.

In doing this, however, although most of the existing species are included in the Table, it will be needless for the present purpose to pay any particular attention to more than three or four, viz.:—1. *U. ferox*, Richardson, 1825 (*U. horribilis*, Ord, 1815); 2. *U. arctos*, Linn.*; 3. *U. maritimus*, Desm.; 4. *U. horriæus*, Baird.

The numerical data upon which I have gone in this inquiry are contained in the following Table †:—

* Under which I include *Myrmarctos Eversmannii*, Gray, *U. isabellinus*, Horsf., *U. syriacus*, Hempr. & Ehr., and all the other varieties of the European and North Asiatic Brown Bear, which have sometimes received distinct specific names, believing, as I do, that, regarded as subjects of palæontology, it would be impossible to distinguish among them.

† For the purpose of facilitating comparison the dimensions recorded in this Table are graphically represented in the "Odontograms" on Plate XLVII. These have been constructed on the plan described in Proc. Roy. Soc. 1870, vol. xviii. p. 544.

TABLE II.—Mean, Maximum, and Minimum Dimensions of the Molar Teeth of various Species of Recent and Fossil Bears. (0″·01.)

		pm 4.			m 1.			m 2.			pm 4.		
		Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.
1.	CUVIER'S measurements.....	81×	82×	79×	115×	121×	110×	180×	188×	168×			
2.	SCHMERLING'S measurements...	75×	82×	67×	114×	130×	102×	173×	196×	157×	59×	70×	47×
3.	All fossil forms. G. B.....	73×57	85×60	60×50	103×76	120×80	85×70	158×84	190×100	135×75	60×37	72×50	48×30
4.	Major fossil, *U. spelæus*?.....	80×60	.....	75×55	112×80	.....	105×75	180×91	.....	170×90	64×43	.....	60×40
5.	Minor fossil, *U. priscus*?, &c.	63×52	66×55	.....	90×71	95×70	.....	147×79	155× 80	.....	57×31	56×38	
6.	*U. priscus*. B. M. *	65×52	.....	.....	90×75	.....	.....	135×75	.....	.....	56×30		
7.	*Ursus* from Brixham Cavern...	67×55	75×62	60×50	95×64	105×75	85×70	150×77	155× 80	135×73	54×31	58×31	48×30
8.	*U. ferox*	62×47	65×55	60×36	91×67	92×70	90×60	150×73	150× 75	148×68	51×30	52×30	50×30
9.	*U. arctos*.....	61×43	65×50	58×43	83×61	90×63	80×60	126×66	140× 70	120×60	45×28	50×30	42×30
10.	*U. isabellinus*.....	56×46	60×50	50×40	82×60	85×60	80×55	130×66	140× 70	130×60	49×26	50×30	45×25
11.	*U. maritimus*.....	63×37	70×40	60×30	70×60	85×62	70×55	108×60	120× 60	95×55	53×28	55×30	50×23
12.	*U. americanus*	47×34	50×40	45×30	70×53	72×60	69×50	100×56	110× 65	92×50	37×20	40×21	33×20
13.	*U. torquatus*	52×36	55×40	50×32	80×60	85×60	75×60	117×66	120× 70	110×60	41×23	45×25	38×22
14.	*U. labiatus*	47×39	49×40	43×38	67×46	70×46	65×46	75×40	80× 41	70×40	40×20	41×21	40×20

		m 1.			m 2.			m 3.			Molar Series.	
		Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Upper.	Lower.
1.	CUVIER'S measurements.....	.....	130×	.....	115×	125×	106×	97×	102×	86×	376	
2.	SCHMERLING'S measurements...	118×	133×	110×	118×	130×	106×	100×	121×	75×	362	395
3.	All fossil forms. G. B.	109×56	125×60	100×50	111×68	130×80	92×60	100×74	120×80	75×62	334	380
4.	Major fossil, *U. spelæus*?.....	114×58	.....	110×55	116×74	.....	108×70	118×84	.....	100×70	372	412
5.	Minor fossil, *U. priscus*?, &c.	100×52	108×52	.....	105×64	110×66	.....	86×67	98×70	. ...	300	348
6.	*U. priscus*. B. M. *	100×50	.....	.....	95×60	.....	.....	75×65	.....	.....	290	326
7.	*Ursus* from Brixham Cavern...	105×53	115×55	100×50	108×67	117×70	105×63	91×68	98×70	80×65	312	358
8.	*U. ferox*	97×46	98×50	95×45	102×63	105×70	100×60	92×62	100×60	85×55	303	342
9.	*U. arctos*.....	90×42	100×50	85×36	90×55	100×60	85×52	70×54	80×60	60×50	270	295
10.	*U. isabellinus*	85×42	90×45	80×40	92×60	110×60	80×60	76×60	80×65	70×55	268	303
11.	*U. maritimus*.....	86×38	95×40	80×35	81×45	85×50	76×40	61×47	70×50	50×40	241	281
12.	*U. americanus*	74×36	81×40	70×31	78×46	85×50	72×42	61×47	80×50	52×45	217	250
13.	*U. torquatus*	86×38	91×40	82×40	85×52	91×55	80×50	72×55	80×60	66×	242	284
14.	*U. labiatus*	67×37	70×35	65×30	60×40	60×40	60×40	44×	45×	43×	189	211

In this Table are given the mean, together with the maximum and minimum, dimensions of the molar teeth in nearly all the instances of different species to which I have had access, and they may be deemed sufficient to afford fair averages. It would have been satisfactory to have had more numerous specimens of *U. ferox*; but they are not attainable, so far as I know. Above my own measurements, I have placed in the two uppermost lines the mean measurements taken from those given by CUVIER and those extracted from M. SCHMERLING'S invaluable memoir on the Belgian Caves. In the third line will be found the mean and other dimensions of the fossil teeth of all kinds that I have met with, and these include, of course, all the possible fossil species. Taking these mean sizes as the standard, I have separated all those teeth which came decidedly below the mean from those which as decidedly exceeded it. The results thus arrived at are given in lines 4 and 5. It thus appeared that the fossil ursine molars could primarily be divided into two very distinct categories, within one of which all the indisputable or typical specimens of *U. spelæus* were exclusively, or nearly so, included; whilst in the other, represented by the typical *U. priscus*, Cuv. (*fossilis*, Gldf.), fell a very

* These measurements are taken from M. GOLDFUSS'S original specimen in the British Museum, which is probably that of a female.

considerable number now in the British Museum, the actual dimensions of which are given in the sixth line. In the seventh line are given, for the purpose of direct comparison, the mean dimensions of the Brixham molar teeth, as taken from the former Table. These numbers, it will be seen, do not greatly exceed those in the fifth and sixth lines, though they fall far short of those in the fourth. This is in support of the opinion that these teeth belong to more than one species; but at the same time the lowness of the numbers would serve to show either that there was a great admixture of very small with the large teeth, or that the greater part of them were of an intermediate size, corresponding pretty nearly with that of *U. priscus*. This I believe to be the case; but the evidence in support of the supposition is defective in some measure, as before observed, in the case of the Brixham teeth as compared with that of the others, in the circumstance that the dimensions are taken not from the successive teeth in the same jaws, but from isolated ones.

In the eighth line will be found the dimensions of the various teeth in *U. ferox*, between which and those of the minor fossil form and of the typical *Ursus priscus* (GOLDFUSS's type) the closest correspondence will be seen to prevail, not in any particular teeth especially, but throughout the entire series, both upper and lower, as may be gathered at a glance from the two last columns in the Table, in which it is shown that the conjoined lengths of the upper molars is in smaller Cave-Bear 300 and in *U. ferox* 303, and of the lower 348 and 342, whilst the actual lengths of the molar series in *U. priscus* are 290 and 326 *. These coincidences appearing to me to be too close to be merely accidental, I compared side by side the typical skull of *U. priscus* in the British Museum with that of a fine and large specimen of *U. ferox* (No. 1137 [b]). In doing this I was unable to perceive any difference whatever between them, except the rather larger size of the recent specimen. In every essential particular they appeared to be identical; and I am consequently strongly inclined to the belief that it is impossible to draw a specific distinction between *U. priscus*, Cuv. (*fossilis*, Gldf.), and *U. ferox*. On the same occasion also I compared a tolerably perfect cranium from a peat-bog at Clonbourne in Ireland, and which is named in the collection *U. arctos* (No. 28906), and found that it exhibited all the characters of the other two, and was manifestly as much *U. priscus* as the typical specimen itself. In the museum of the Philosophical Society of Leeds there are also two Irish-peat crania, one named *U. spelæus* and the other *U. priscus*, though there may be reason to doubt whether the former is correctly so named†. The differences between them, including the width of the glenoid fossa, were precisely those which

* This coincidence will be still more readily appreciated upon comparison of the Odontograms, Nos. 12 and 13, Plate XLVII.

† With respect to that named *U. priscus* I entertain no doubt; but as the determination of the other has been made principally from its large size, it may possibly be the skull of a gigantic *U. arctos*, whose jaw, as represented by that from Manea Fen, is described by Professor OWEN as equal in length "to the largest specimen of the lower jaw of the *Ursus spelæus*." If so, the Fen Bear must have greatly exceeded any form of the existing Brown Bear, as Professor OWEN himself observes.

exist between *U. spelæus* and *U. priscus*; but unfortunately the teeth are wanting in both. Again, upon taking the measurements of the teeth in the fossil ursine remains from Grays, I find that the mean dimensions of those in three mandibles agree very closely with the sizes in *U. priscus* and *U. ferox*, as will be seen in the subjoined Table III., in which, for convenience, I have brought together only the mean dimensions of the molar teeth, adding those of the specimens from Grays.

TABLE III.—Mean Dimensions of Molar Teeth in Fossil and some recent Species. (0″·01.)

	pm 4.	m 1.	m 2.	$\overline{\text{pm 4.}}$	$\overline{\text{m 1.}}$	$\overline{\text{m 2.}}$	$\overline{\text{m 3.}}$	ms.	$\overline{\text{ms.}}$
U. spelæus	80×60	112×80	180×91	64×43	114×58	116×74	118×84	372	412
U. priscus?	63×52	90×71	147×79	57×31	100×52	105×64	86×67	300	348
U. ferox	62×47	91×67	150×73	51×30	97×46	102×63	92×62	303	342
U. arctos	61×43	83×61	126×66	45×28	90×42	90×55	70×54	270	295
U. maritimus	63×37	70×60	108×60	53×28	86×38	81×45	61×47	241	281
Ursus (Brixham)	67×55	94×64	150×77	54×31	105×53	108×67	91×68	312	358
Ursus (Grays)	.....	100×72	150×75	58×37	101×54	100×69	87×70	.....	346

In these cases, again, we find a coincidence, as it seems to me, too close to be accidental; and I think further inquiry will demonstrate beyond doubt that the *U. priscus* is the same species as those above noticed from Ireland and Grays.

As regards the other species of Bear included in Table II., it is scarcely necessary here to make any remark. The numbers themselves will show pretty conclusively that, with the exception perhaps of *U. arctos*, none can be well confounded with either *U. spelæus* or *U. priscus*. In isolated teeth it will in many cases be quite impossible to distinguish between the smaller forms of *U. priscus* or *U. ferox* and the larger ones of *U. arctos*, in which species, as will be observed, the maximum size of the teeth equals, and in some instances exceeds, the minimum size of the same tooth in the others; whilst in many of the teeth there is very little, if any, difference of size at all. The most characteristic teeth with respect to size, as distinctive between *U. priscus* (*fossilis*, Gldf.) and *U. arctos*, appear to be m 2, $\overline{\text{m 2}}$, and $\overline{\text{m 3}}$; but even in these cases the maximum size in *U. arctos* sometimes equals the minimum in the other. This circumstance is an exemplification, in addition to others which might be adduced, of the great tendency to variation exhibited in *U. arctos*, as has been already noticed. Its existence, however, shows the necessity in many cases of caution in the determination of a doubtful species from isolated teeth. Though I believe the mean dimensions, taken from a sufficient number of teeth *in situ*, may to a certainty be relied upon, mistakes may otherwise readily arise.

Having thus seen reason from the dimensions alone to refer *U. priscus* (*fossilis*, Gldf.) to *U. ferox*, and to believe that the greater part of the Brixham specimens belong to the

same species, intermixed with a few of a larger size and several of a smaller, it will be interesting to inquire whether these conclusions are borne out by the forms of the more characteristic teeth. The most distinctive of these are, in the lower jaw, $\overline{pm\ 4}$ and $\overline{m\ 3}$, and in the upper, pm 4 and m 2. In his very careful description of the Manea Fen jaw, Professor OWEN * notices that the lower last premolar in *U. spelæus* has "two distinct tubercles and a ridge developed from the base of the principal cone," whilst in the Manea-Fen jaw there was only the single cone, as in *U. arctos*. Subsequently, in speaking of *U. priscus*, he remarks that the same tooth also presents a second cusp on the inner side and a little behind the first. Now these characters appear to me to be very constant and of the utmost possible value. There can be no doubt, so far as I have seen, that in the true *U. spelæus* the last lower premolar has usually two cusps, and always one very distinct and, in some cases, a very large secondary cusp on the inner side, one of which is in front of the principal cone, and by which, irrespective of its size, that tooth may always be distinguished. In the typical specimen of *U. priscus* in the British Museum the last premolar, at any rate on the right side, of which I have a cast before me, has but an extremely faint indication of a second cusp, or rather tubercle, as it should be called in this species; but as the teeth in this specimen are much worn, the indistinctness may be owing to that circumstance. In a jaw of undoubted *U. priscus* from Gower a tubercular elevation is very distinctly situated also on the inner side of the tooth, but altogether behind the main cone; whilst in several of the Brixham teeth the small accessory tubercle in the same position is extremely well shown. In the only specimen of *U. ferox* in which I have had an opportunity of making the observation, the last premolar presents a distinct tubercle in the same situation, and the hinder talon, as it may be termed, is bitubercular. The next characteristic tooth in the lower jaw is the last molar. In *U. spelæus* this tooth, though varying, as is shown in the table, considerably in size, always presents more or less completely an oblong or quadrangular form with a deep sinus on the outer side, whilst in *U. priscus* it is always more or less triangular, and either not at all or very slightly notched on the outer border. It presents, so far as I have seen, the same general form in *U. ferox* and *U. arctos*; and it would in many cases be impossible, I imagine, to distinguish between these three species with respect to the shape of this tooth. There are five specimens of the last lower molar in the Brixham Collection, two considerably worn, the others very perfect. In all its shape is triangular, and altogether different from that presented by it in any specimen of *U. spelæus* that has come under my observation. One of the largest and smallest of these teeth are shown in figs. 5 & 6, Plate XLVI. The smaller may, and I believe does, belong to *U. arctos*, and I have no hesitation in referring the other to *U. priscus*.

In the upper jaw the differences in size are perhaps even more strongly marked than in the lower teeth; but, as regards their form, they appear to be less constant, and to

* Brit. Foss. Mammals, p. 80. (It would be very desirable to have the measurements of all the teeth in this specimen.)

exhibit less trenchant distinctive characters. The last premolar, though usually very much the larger in *U. spelæus*, presents no difference in form. In both it is tricuspid, and the relative sizes of the cusps appear to be much alike in both. In *Ursus arctos* I have noticed two distinct forms: one exactly resembles that in *U. spelæus*, *U. priscus*, and *U. ferox*, and is tricuspid, whilst occasionally the small inner cusp is entirely wanting, and the smaller hinder outer one is so much diminished in size as almost to give the tooth very much the form that it has in *U. maritimus*, in which the hinder cusp is very much less in proportion to the anterior. I am unable to point out any peculiarities between the different species beyond size in the penultimate upper molar; and with regard to the great tubercular molar, it presents such extraordinary diversities in size and form in one and the same species, that I have been at loss to seize any satisfactory characters in it. Speaking generally, as regards form, the last molar in *U. spelæus* is less contracted behind than it is in *U. ferox* (under which I include *U. priscus*) and *U. arctos*; but so many exceptions occur to this that the character becomes of little real value. Nor in minor particulars am I better able to discern any upon which it is worth while to dwell. But there is a sort of coarseness, as it may be termed, in the sculpturing of the tooth which appears to distinguish it from that of either *U. spelæus* or *U. arctos*. Most of the Brixham teeth have altogether the facies of *U. priscus*, and there is certainly none which can be referred to *U. spelæus*. But among the teeth is one so remarkable for its size amongst the others and for its form as to demand passing notice, although it probably has no more than an individual peculiarity. This tooth is shown in fig. 14, Plate XLVI. It is a left upper last premolar, fully as large as the mean size of that tooth in *U. spelæus*; and the inner cusp, instead of being single, is subdivided into three distinct points, of which the middle one is nearly as large as the usually single cusp occupying that situation.

From the foregoing particulars, it would seem that the majority of the Brixham teeth exhibit, not only in their size but also in their form, the characters rather of *U. priscus* than of *U. spelæus*, of which latter species indeed we have, so far as I can perceive, extremely scanty evidence among the cave remains.

Although it is quite certain that the true *U. spelæus* has been by no means rarely met with in Britain, not only in caverns, but also, as it would seem from the Bacton specimen, in lacustrine beds, associated in both cases with the older extinct mammals, it appears to me, from what I have been able to observe in ursine remains from Ireland, that they are all referrible to what I should term *U. ferox fossilis*. No undoubted instance of the former existence of *U. spelæus* in Ireland has as yet occurred to me; and although it elsewhere most certainly coexisted with *U. priscus*, it appears, so far as I have been able to go into the subject, to be tolerably clear that the latter species, more especially towards the later period, has in this country been the more abundant of the two as a fossil, and has even survived to the present day in western North America under the form of *U. ferox*.

We may perhaps thus see some reason for imagining that there has been a very gradual succession in northern Europe of ursine species. Not to go further back, we find the gigantic *Ursus spelæus* of the German caverns, if not abounding, at any rate existing at an early period in these islands, if islands they then were. When it first became associated with *U. priscus* we have perhaps no means of knowing, but that in progress of time it gradually gave way to the latter seems to be highly probable. It survived, however, in all probability, sufficiently long to be associated also with *U. arctos*, which in its turn seems to have supplanted *U. priscus* (*U. ferox fossilis*). There is no reason to suppose, but quite the contrary, since we find that they were coexistent, that either of the smaller forms represents a degenerate descendant from the larger.

When the conditions of nature were such as to allow of the flourishing in these countries of the Cave-Lion and Hyæna, together with that of the gigantic herbivorous mammals, it is pretty clear that the Bear of that day to hold his own against such competitors must have possessed corresponding powers. But as these conditions changed, the change, in all probability, was to the advantage of a smaller and less powerful ursine carnivore. This form would flourish, as the Grisly Bear does at the present day, so long, and only so long, as the external conditions resembled those under which *U. ferox* now exists in North America. As that species is probably destined before very long to disappear, and perhaps to be wholly replaced by *U. americanus*, so in this hemisphere *U. priscus* became gradually replaced by *U. arctos*, a species which probably (in part from its less purely carnivorous habit, but in part also perhaps from its greater variability and consequently greater adaptability to circumstances) has become the sole representative of the ursine genus in the northern parts of the Old World.

That the Grisly Bear should have existed here at a remote period is of course no more strange than that *Ovibos moschatus* should at one time, and perhaps at the same epoch, have been a member of the British fauna. And their companion, the Reindeer, is another instance pretty nearly of the same kind, common though it still be to both continents. The Beaver also might be cited as an American inhabitant of Britain down to a very late period, were it certain that the American and European species were identical. The *Lagomys*, again, is at present as far removed from us, or nearly so, as *U. ferox**.

* Since the above was written, I have devoted a good deal of attention to the subject of the American Bears, and have come to the conclusion that in all probability there are two distinct species, or at any rate very distinct subspecies, included under *U. ferox* (*horribilis*, Ord)—a larger one found, as it would seem, mostly to the west of the Rocky Mountains, as in California &c., and the other and smaller more to the north and even to the east of that range, the former being the true Grisly Bear, and the latter the so-termed "Barren Ground Bear" (apparently the form named *U. horricæus*, Baird). Nor is it impossible that the same two forms might have coexisted at a former period in these islands.

14. *Canis vulpes.*

Seven instances occurred of the bones and teeth of the Common Fox, comprising nine specimens, five of which were met with in the Reindeer Gallery, and all but one on or near the surface, the exception being a carnassial tooth, which lay at a depth of about 2 feet. In one instance the upper and lower jaws were found intermixed with numerous apparently recent bones of the Hare, Rabbit, and Birds, and all the other specimens from this Gallery are evidently of comparatively recent date. Four specimens were found in the Flint-knife Gallery, one at a depth of 8 feet, another at 5 feet 6 inches, and the most superficial at about 3 feet. All these bones, in contradistinction to those from the Reindeer Gallery, are highly mineralized and obviously belong to a far more ancient period. In no other respect, however, is there the slightest difference between them.

It is remarkable that no specimen belonging to the Badger occurs in the collection. A canine tooth, which I had referred to that species, turns out upon further inspection to be the lower milk-canine of *Ursus* (*vide* No. XXVI.).

V. Rodentia.

Innumerable bones of the Hare and Rabbit, of different sizes and of all ages, occurred in the Reindeer and Flint-knife Galleries, for the most part on or near the surface of the third bed or in the stalagmite floor. The only marked exceptions to this are in "find" No. XCII., in which the tibia of a young Hare occurred at a depth of 3 feet in the Reindeer Gallery, but apparently in the same condition as the more superficial bones; and in No. LIV. numerous bones were met with "amongst loose stones with little earthy matter," at a depth of 4 feet in the Flint-knife Gallery. The other rodents whose remains are found in the collection, and which occurred apparently in the same superficial situations, are at least two species of *Arvicola* and, the most interesting of all, a fragment of the cranium (including fortunately the entire maxilla and all the teeth but one) of *Lagomys spelæus*. This specimen (of which a figure is given in Plate XLVI. figs. 12 & 13) was found, together with numerous bones of the Polecat, Hare, Rabbit, Water-rats, Sorex, &c., in the Reindeer Gallery, 110 feet from the North Entrance, lying on the surface of the third bed. It differs in no respect in appearance from the other bones with which it was associated, and, like most of them, is slightly dendritic.

VII. Mr. Evans's *Remarks on the Worked Flints found in Brixham Cave.*

Of the fragments of flint of various sizes discovered in the Brixham Cave, and nearly all showing, in a greater or less degree, traces of human workmanship upon them, thirty-two have been submitted to me for examination.

They have for the most part undergone great alteration in their structure, having become white, absorbent, and brittle, in the case of the thinner flakes throughout their entire substance, and in the larger pieces to a considerable depth from the surface, if not, as appears to be the case with the largest of all, throughout. Though much softened in texture, the surface retains in some instances a bright porcellaneous glaze. On several there are portions left of the original surface of the flints, which appear to have been derived from the chalk. In one instance this original external surface is much battered, as if the block of flint had been exposed for some time upon the sea-shore before it was picked up in order to be utilized by man.

The following is the description of the more remarkable specimens, and of the circumstances under which they were found. The numbers are those used by Mr. Pengelly in the 1st column of his Table IV. (p. 494):—

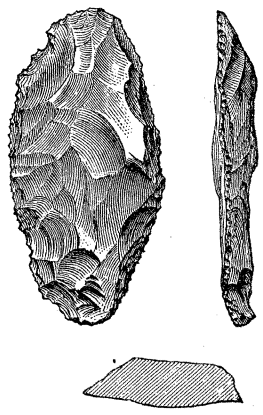
No. 1. Portion of a flake, $2\frac{3}{4}$ inches long and $1\frac{1}{4}$ wide, the ridge side with three facets for about one third of its length, one of which ceases abruptly, while the others are continued to near the point, where they intersect the natural crust of the flint. The flake is obtusely pointed, and truncated at the butt-end, the part at the bulb of percussion having been broken off; it bears evident marks of wear at the truncated end, the edge being quite worn away. Both the side edges have also been much used. This instrument was found near the junction of the "Reindeer Gallery" and the "Flint-knife Gallery," at a depth of 9 inches in the loam bed, and just under the great antler.

No. 4. Broad, irregularly shaped flake, $2\frac{3}{4}$ inches long, and in one part nearly 2 inches wide, but tapering to a rounded point. Three principal facets on the ridge side. The edges in several places have been worn away by use. About halfway along is a rounded notch, apparently produced by scraping some cylindrical object. (It is worth while to notice that a portion of a small cylindrical pin or rod of ivory was found in the cave.) This flake was found at a depth of 2 feet in the loam bed in the "Reindeer Gallery," 37 feet from the "North Entrance."

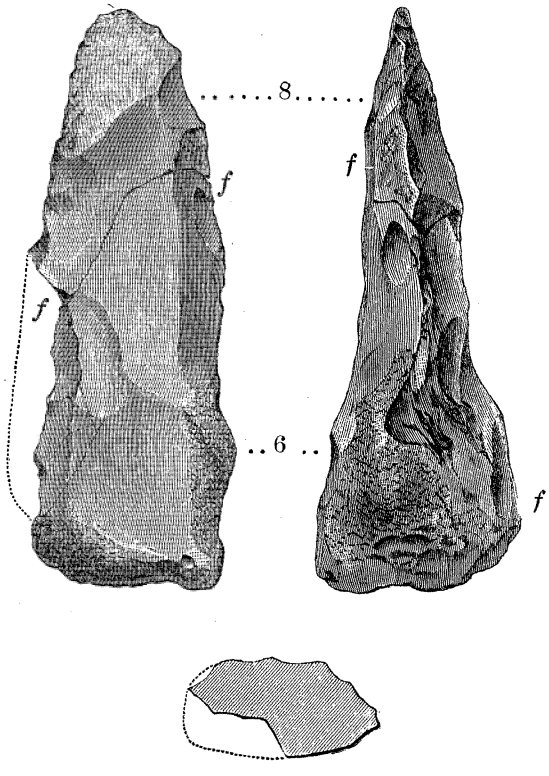
No. 5. Broad-ended flake $2\frac{3}{4}$ inches long, the ridge formed by two facets, with a third transverse facet at the broad end. This flake has been chipped or jagged along one edge, apparently by use, while the broad rounded end is so much worn away, in all probability by scraping some hard material, as to give the implement almost the character of the "grattoirs" of the French caves. These evidences of this extremely simple instrument having been designedly formed, and of its having been employed for cutting or scraping purposes, are most clear and satisfactory. It was found in the loam bed in the "Flint-knife Gallery," at a depth of 10 inches, and 19 feet from its eastern extremity, where it joins the "Reindeer Gallery."

No. 7. Implement of an elongated oval form, $3\frac{1}{4}$ inches long and $1\frac{3}{4}$ inch broad in the

widest part, and about half an inch thick. It has been made from a large flake or splinter of flint with an approximately flat face, showing strongly the curved and waved lines of conchoidal fracture, and has been shaped by a succession of blows given in such a manner as not to injure the flat face, but to produce a more or less bevelled scraping or cutting edge all round. Some parts of this edge seem to present appearances of wear by use. In general character this implement resembles that of a boat-shaped form discovered by M. LARTET in the cavern of Aurignac, but it is not so neatly or symmetrically finished; at the same time it is more carefully chipped than an implement of nearly similar form from the valley gravel of the Lark, at Icklingham, Suffolk, which is in my own collection. Closely analogous implements occurred in the cavern of Le Moustier, in the Dordogne, explored by Messrs. LARTET and CHRISTY (see 'Reliquiæ Aquitanicæ,' A. pl. iii. fig. 1). It is shown in the figure on the scale of one half.



Nos. 6, 8. Round-pointed implement of a lanceolate form, about 6 inches in length and $2\frac{1}{2}$ inches in diameter at the butt-end, which is roughly cylindrical. In general outline it closely resembles the spear-shaped implements from the valley gravels of France and England.



The point is symmetrically chipped, but the original surface of the flint has been left over the greater part of the butt-end, which is more squarely truncated than is usual with chalk flints, but is well adapted for being held in the hand. The implement has had the pointed end broken off by an irregularly diagonal fracture (*f*) rather more than half way along it, and the butt-end has subsequently split up lengthways with what might be called a "faulted" line of fracture, and about a quarter of it has been lost. The fractures are evidently of very ancient date; but what is most remarkable is that the butt-end (6) was found 12th August, 1858, 3 feet deep in the loam bed in the "Flint-knife Gallery," 27 feet from its eastern extremity or junction with the "Reindeer Gallery," while the point (8) was not found until 9th September following, 3 feet 6 inches deep in the loam bed in the "Pen Gallery," and 14 feet from its entrance or its junction with the West Chamber. It was not until some time afterwards that it was discovered that the two fragments fitted each other

and that the true character of the implement was seen. It is shown in the annexed woodcut (p. 550) on the scale of one half linear*.

No. 9. Lozenge-shaped implement, $3\frac{1}{2}$ inches and 2 inches in extreme length and breadth, and $\frac{1}{2}$ inch in greatest thickness. One face of the lozenge is nearly flat, and two of the sides subtended by the longer axis are nearly straight and quite obtuse, while the other two come to a sharp edge. The outline of one is curved inwards, and the obtuse angle of the lozenge is rounded; there is a small portion of the original crust of the flint at one point. The sharp edges are considerably worn away by use; there are also marks of wear along the obtuse edges. This implement was found at a depth of 7 feet in the loam bed in the West Chamber.

No. 10. Fragment of a rounded block or pebble broken off by a single blow; the fractured surface is nearly flat, of ovate form, 3 inches long and 2 wide. It has a conical protuberance where the blow was given to produce the fracture. The rounded side has a waterworn appearance, as if the flint had been found on the sea-beach. The edge is chipped away, but whether by use or not it is impossible to say. This flint was found 11 feet deep in the loam bed in a fissure crossing the West Chamber.

No. 11. Short fragment of a flake, $1\frac{1}{4}$ inch long and 1 inch wide, the flint much decomposed. It bears no distinct marks of use upon it, and was found in the West Chamber at the depth of 6 inches in the "Gravel Bed," and 8 feet deep in the total deposit of loam and gravel.

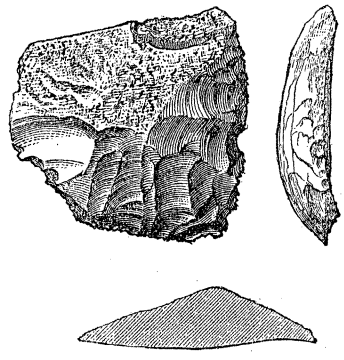
No. 12. Portion of a narrow flake, one edge of which has been lost owing to the flake having split longitudinally; what remains is $2\frac{1}{2}$ inches in length, about $\frac{1}{2}$ inch in width, and $\frac{1}{4}$ inch in thickness. The flake appears to have had originally three principal facets on the ridge side, but has been trimmed into a nearly semicircular outline at the butt-end; it bears slight but not very distinct traces of use or wear. This also was found in the "Reindeer Gallery," 35 feet from the "North Entrance," and 2 feet 9 inches in the loam bed.

No. 13. Angular fragment of flint of irregular obtusely pyramidal form, the base of the pyramid being a trapezium, the average length and breadth of which is $1\frac{3}{4}$ inch by $\frac{7}{8}$. Most of the edges at the base are chipped away by wear or use. This very rude instrument was found in the "Reindeer Gallery," 26 feet from the "North Entrance," lying on the gravel bed and beneath a deposit of 7 feet, viz. stalagmite floor and cemented angular stones 3 feet, and cave loam 4 feet.

No. 27 ?. Irregularly shaped subangular flint pebble, somewhat pear-shaped in form. On one face the surface consists principally of the natural crust of the flint, and that of the other appears to be due to some natural fracture; so that in this case, unlike all the others, there is no evidence of the form being due to human agency. Most of the salient points, however, are battered and bruised; and though some of this may be due to the pebble

* By permission of the Committee, Nos. 6 & 8, 7, and 29 were figured by Mr. Evans in his 'Ancient Stone Implements of Great Britain,' and the above woodcuts are reproductions from that work. The other specimen (4) figured by Mr. Evans has since been found to be a surface specimen placed amongst the others by mistake. Mr. Evans had noted that it closely resembled some of the "scrapers" found on the surface of the soil and belonging to a more recent period than the Cave specimens (*l. c.* p. 470).

having been exposed to the action of the waves on the sea-shore, yet, from the excessive battering of some of the angles, it seems probable that it may have served as a hammer-stone, simply held in the hand.



No. 29. Fragment of a large broad flake showing on its convex face a portion of the original crust of the flint. It is $2\frac{5}{8}$ inches in extreme width, and appears to have been originally of an approximately oval outline, but has lost one end by a straight fracture, where the flake was 2 inches wide. This end appears to have been broken off in ancient times after the rest of the instrument had been chipped into shape. The fracture at the other end is more irregular and existed before the completion of the tool, as several flakes have been removed from its convex face by blows administered on the fractured surface. One side of the flake has been trimmed by chipping, first boldly, and then more minutely, to a segmental bevelled edge much resembling in character that of some of the large "side scrapers" from the cave of Le Moustier in the Dordogne, like that engraved in the 'Reliquiæ Aquitanicæ,' A. pl. v. fig. 2. The edge presents the appearance of having been used for scraping some hard substance. This instrument was found 9 feet deep in the gravel of the West Chamber.

Implements of the same character occur occasionally, though rarely, in the old river-valley deposits.

?. Broad flake, $2\frac{1}{2}$ inches long and about $1\frac{3}{8}$ wide; the ridge side formed with two facets, but a portion of the ridge at the butt-end, or that at which the blow was administered to dislodge the flake from its parent flint, removed; the other end of the flake thick and truncated. This flake shows signs of use along a part of one of its edges. The other edge has been broken off, the flint being much decomposed, and the flake itself broken into three pieces.

The remaining specimens consist either of flakes, more or less perfect, or of splinters and rough fragments of flint, by far the greater part bearing evidence of having been artificially produced, inasmuch as one or more of their faces show the conoidal eminence or "bulb of percussion" as it was termed by the late Dr. FALCONER, or the corresponding depression, where the blow was administered by which they were fashioned. Some of the splinters are very small; and yet one of them, only $\frac{3}{4}$ inch by $\frac{5}{8}$ inch, shows the worn edge resulting from its having been in use as a scraping-tool.

The general result of the examination is that the worked flints from the Brixham Cave are found to present analogous, and in some cases almost identical, forms with those discovered in the ancient river-gravels and in other caves associated with the remains of animals now extinct, and that many of the implements prove not only to have been made by man, but to have been actually in use for cutting and scraping purposes before becoming imbedded in the cave-loam; while from nearly the whole presenting some signs of human workmanship or use upon them, it is evident that their presence in the cave must, in some measure, be due to human agency.

VIII. *General Conclusions respecting the Cave.*

The main object of this investigation is necessarily to put on record, in a form available for future examination, information of that special and exact character which, from the costly nature of the work and the variety of subjects connected with it, places it generally beyond individual research. It could not, in this case, have been carried out but for the liberal and timely assistance of the Royal Society and the cooperation of several members of the Committee, each taking a separate department. The able papers accompanying this Report describe in minute detail the structure and contents of a new and unexplored bone-cave. As before mentioned, the questions of theory will be restricted to those alone which are suggested by the local nature of the phenomena, some of which have, however, an important bearing upon the general question of ossiferous caves.

All observers agree that the cave follows the course of the two lines or planes of joint traversing the limestone rock, and that the galleries forming the cave have been excavated or worn along these lines of joint by the slow and prolonged action of water. Mr. Pengelly further points out that two sets of side grooves extend through the length of the cave with a dip inwards to one point, whence he infers its action at two successive levels, and that "each pair of grooves seems to be distinctly referable to a stream of fresh water which was not subject to great floods, and which flowed constantly from the West Chamber through the Flint-knife and Reindeer Galleries to the Steep Slide Hole, and the bottom of which was successively on the plane of the lower margins of the grooves themselves; while another stream came in at the road entrance and flowed to the same Hole."

Mr. Bristow, on the other hand, inclines to attribute some portion of the formation of the cave and the introduction of the shingle to marine action, at the time when the land was lower, and when, by the same marine action, the present valley was being excavated; and he observes that "the grinding-action of the waves and shingle may have assisted in widening a preexisting fissure and joint in the limestone, and have tended materially to increase the dimensions of those parts of the cave which were being formed by atmospheric influences, coupled with the flow of water resulting from the filling and emptying of the cave at every change of tide;" and in his communication to the Committee he points to the fact that the "pebbles of quartz, rounded fragments of the slate rocks of the district, &c. (forming the pebble bed in the cave) are precisely similar in character and appearance to those forming the raised beach visible on the neighbouring coast, as well as to the shingle on the shore of Mudstone-Bay sands north of Brixham." Mr. Pengelly considers that, in the case of the side grooves just referred to, "the tides and waves could not have allowed the preservation of levels so restricted," and that in confined spaces like the narrow galleries of a cavern, the waves of the sea would have arranged the materials differently to what they would on an open beach. There is an entire absence in the cave-shingle of shells, whether marine (such as would prove the presence of the sea) or freshwater (such as might be introduced by the action of a running stream). Fragments of the former would have been more likely to have been preserved

than those of the latter, although there are many cases in which, in well-marked sea-beaches, there is an entire absence for considerable distances of any shell-remains. The bed of cave-earth which covers the shingle to a depth of several feet is attributed, both by Mr. PENGELLY and Mr. BRISTOW, to subaërial action; but the former considers it to have been chiefly carried into the cave by running water, whereas the latter considers it mainly due "to the erosion of the limestone in which the cave is formed; that is to say, when the calcareous portion was dissolved and carried away, the insoluble portion was thrown down and left behind as a red mud forming the loam in question." The quantity of insoluble residue is, however, seemingly too large to be accounted for by the solution of the limestone removed in the formation of the cave, even including that of the fissures overhead, as the depth from the surface of the ground does not exceed 30 to 40 feet, and the fissures are close or nearly so. It is most probable that the greater part of the cave-earth was carried in by water from the exterior. Mr. PENGELLY is also of opinion that the bones so numerous in the cave-earth were likewise drifted in from the exterior by the action of water; while Mr. BRISTOW considers that "the bones are for the most part those of animals which were carried into the cave to be devoured by the beasts of prey whose lair it may have been, or they may in some cases have fallen through fissures extending to the surface."

Mr. PENGELLY supports his view by reference to the wear of many of the bones, the absence of coprolites, and particularly by the position and arrangement of the bones and stones, all of which (except those in the West Chamber) were lying lengthways, following the direction of the galleries, implying thereby "that the materials of this deposit were introduced and arranged by water flowing constantly in one direction."

But it is difficult to suppose this to have been the sole cause; for a large proportion of the bones are little or not at all rolled, very many of them are gnawed, and a few limbs have been found entire, while several others were, in the opinion of Mr. BUSK, introduced with the flesh on them, although the bones were afterwards scattered. These facts seem to point to the cave having been inhabited by animals at some time or times. The absence of all traces of coprolites is not sufficient evidence to the contrary, as in a cave so subject to the irruption of water, the residence of the predatory animals could not have been prolonged, and their droppings may not have been placed under conditions favourable to their preservation. Even without rolling, the fractured edges of the bones also would often, like the angular fragments of limestone, be apt to lose their sharp angles by the solvent action of the water so long continued or by weathering.

Of the 669 bones (omitting the 152 teeth) examined and arranged by Mr. BUSK, 67 are stated to be gnawed. But this refers only to the strongly marked cases; for, speaking of the bones of the Rhinoceros, Mr. BUSK says, "most of the bones showed traces of gnawing by Hyænæ;" and he makes the same remark respecting the bones of the Reindeer. A certain proportion of the bones of the older Bears were in the same condition, as also were a considerable number of the undeterminable fragments of bones. Referring again to the bones of the Rhinoceros, Mr. BUSK remarks that "some are very

perfect and have no indication of having been rolled by water;" and he repeats the same observations in speaking of the state of the bones of the other animals. This condition of the bones is hardly compatible with their having been carried in by water, but is in accordance with the conclusion Mr. Busk has independently arrived at with Mr. Bristow, and which agrees with our own, that the cave must at one time have been a place of resort to Hyænæ, by whom most of the remains of other animals were brought in, often in the state of entire limbs surrounded by their soft parts. He is further of opinion that at a later period of the cave it was used as a place of refuge and at times of parturition by the Bears, as the bones of very young animals, sometimes mere sucking cubs, are often found together in heaps, and are neither rolled nor gnawed. Of very young Hyænæ there are no traces.

At the same time Mr. Busk mentions a left metacarpal bone of horse "quite entire and not rolled, which seems to have been for some time exposed on the surface, or partly imbedded in the ground, as it is much weathered or sun-cracked, principally at one end;" and he notices the same appearances on some other bones, leading, as he considers, to the inference that some portion of the bone-remains had been exposed to the open air on the surface of the ground, and afterwards washed into the cave by the action of a stream of water.

The dispersion of the bones of the same limbs in different parts of the cave did not escape the notice of Mr. Pengelly, and he accounts for the fact by their separate introduction and transport to variable distances into the cave by the stream; but the cases in which Mr. Busk has recognized an original connexion between the bones of the same animal in different and distant parts of the cave are sufficiently numerous, and their general condition is so alike and irrespective of position, that it is, we conceive, taking all other considerations into account, more probable that the limbs were, as he supposes, carried in entire, and that, as they were devoured, the bones were dispersed by the animals themselves through different parts of the cave.

The total number of bones found in the cave amounts to 1621; but of these as many as 691 belong to birds, rodents, and other small animals, which with few, if any exceptions, were brought in at a comparatively recent period, leaving 930 specimens belonging to the old cave-animals proper. Of these 669 have been determined by Mr. Busk, and 261 were in such a fragmentary state as not to be determinable. The number of species has proved more restricted than was anticipated, and the remains of only one Elephant and one Rhinoceros, both the common Pleistocene species, have been found. But though the species are limited in number, an addition has nevertheless been made to the cave-fauna of an unexpected and very interesting nature. Mr. Busk has determined the presence of two, and probably of three, species of Bear, viz. *Ursus priscus*, *U. arctos*, and more doubtfully *U. spelæus*, the first named (which Mr. Busk was led, in this case for the first time, to identify with the *Ursus ferox*) being by far the most abundant. It would thus seem that, in addition to the Musk-Ox, whose remains have within the last few years been discovered in the quaternary beds of this country and in the north of

France, the Grisly Bear, an inhabitant of the Rocky Mountains and other parts of North-western America, should also be added to the list of the old cave Mammalia of Europe.

This important determination has a bearing beyond the local case of the Brixham Cave, as Mr. Busk considers there is reason to believe that many of the Bear-remains found in caves in this country and on the Continent and referred to *Ursus priscus* belong in fact to *Ursus ferox**. The presence of another small North-American animal has been ascertained, viz. the Lemming; and though its remains were found very near the surface, it has been met with elsewhere in association with Pleistocene Mammalia.

Excluding the more doubtful smaller animals†, the list, as determined by Dr. Falconer and by Mr. Busk, of animal remains found in the Brixham Cave consists of:—

		Number of determined specimens.
1. *Elephas primigenius*	Mammoth	11
2. *Rhinoceros tichorhinus*	Tichorhine Rhinoceros	67
3. *Equus caballus*	Horse	30
4. *Bos primigenius*?	Great fossil Ox	28
5. —— *longifrons*?	Small fossil Ox	
6. *Cervus elaphus*	Great Red Deer	12
7. —— *tarandus*	Reindeer	72
8. *Capreolus capreolus*	Roebuck	13
9. *Felis spelæa*	Cave-Lion or Tiger	9
10. *Hyæna spelæa*	Cave-Hyæna	57
11. *Ursus spelæus*?	Cave-Bear	354
12. —— *arctos*	Brown Bear	
13. —— *priscus* s. *ferox*	Grisly Bear	
14. *Canis vulpes*	Fox	15
15. *Lepus cuniculus*	Hare	?
16. *Lagomys spelæus*	Lemming	1

The order of distribution of the remains of these animals in the cave is fully described in Mr. Busk's Report. From this it results that:—

Few bones, and no teeth or fragments of tusk, of the Elephant were found, and those few belong to the earliest occupancy of the cave: both the specimens occurring in the shingle bed were gnawed and probably brought in by some Carnivore.

The remains of the Rhinoceros were far more numerous, and increased in numbers in proportion to the distance from the entrance, and were probably taken into the deeper

* All the ursine remains from the Gower caves, that have come under Mr. Busk's observation, appear to belong to the so-called *Ursus priscus* (s. *ferox fossilis*, Busk).

† It is a question whether the *Arvicola*, *Sorex*, and some birds should not be included in the later part of the Cave period. See particulars of "finds" Nos. XIV., XLI., LIV., & XCIX.

recesses of the cavern to be devoured by Hyænas or Tigers. They were mostly deep in the cave-earth in all parts of the cave.

The Horse was less abundant. Mr. BUSK mentions several instances in which the limbs seem to have been brought into the cave while held together by their soft parts, and the bones afterwards dispersed, as in the case of an astragalus and tibia found 50 feet apart, two phalanges 36 feet apart, also two metacarpal bones belonging to the same limb 23 feet apart. Three specimens are from the fourth and the rest from the third bed.

The bones of the Ox were in about equal numbers with those of the Horse. One specimen was found in No. 4 bed and the others at variable depths in the cave-earth. We see no objection in connecting some of the specimens found in the Flint-knife Gallery with others found in the West Chamber, notwithstanding the difference of mineral characters.

Next to the Bear the remains of the Reindeer were most plentiful; and they occurred at all depths, from the surface of the stalagmite down to the top of the shingle bed, in the three chief passages. Mr. BUSK'S measurements show the animal to have been intermediate in size between the American and the Norwegian variety.

Few remains of the Red Deer were found, and of these six were basal portions of shed horns. They were mostly gnawed, and, except one found in the stalagmite, they were all in the cave-earth.

The Roebuck is equally scarce with the Red Deer, and several of the few dispersed specimens belonged apparently to the same animal. They were all in bed No. 3.

Of the Lion or Tiger most of the very few bones were deep in the cave-earth, chiefly in the Flint-knife Gallery, and several belonged to the same animal. The teeth were in large proportion.

In the case of the Hyæna the preponderance of teeth is again noticeable, and, like with the remains of the Lion, a large proportion of the specimens were deep in the cave-earth, and became rare near the surface. The West Chamber, Flint-knife and Reindeer Galleries were nearly equally resorted to by it: there is an entire absence of the bones of very young animals.

The number of the bones of the Bear exceeds that of all the other animals put together. A great part of them occurred at some depth in the cave-earth, but many were also found on its surface and in the stalagmite. Comparatively few specimens were gnawed; and generally the bones of the young animals, of which there were a large number, were neither gnawed nor rolled. They were mostly met with in the Reindeer and Flint-knife Galleries.

The remains of the Fox were scarce; some may be of recent origin, but a sufficient number show evidence of antiquity. One specimen was 8 feet deep in the cave-earth.

The same remark applies to the Hare, the remains of which, scattered in the two main galleries, were, however, much more numerous and superficial.

Only one specimen of the Lagomys was found, and that on the surface of the cave-earth far in the Reindeer Gallery.

These species represent the succession of animals frequenting the cave, or those living in the district, during the time the cave-beds were accumulating*; and the question next to be considered is the manner in which their bones were introduced. It is evident that the cave served for a very long period as a passage for water, though there appears equal reason to believe that the bones were not brought in by water; while, at the same time, we think that the cave could not be considered a Hyæna-den in the ordinary acceptation of the word.

In the first place, the shingle may have been brought in by a stream entering through the lower opening of the West Chamber, passing thence along the Flint-knife Gallery and the northern branch of the Reindeer Gallery. This stream, or its affluents, must have flowed over the slates, grits, and shales to the westward of Brixham, pebbles of which rocks, together with others of greenstone and ironstone, have been carried into the cave along with the more numerous local limestone pebbles. The area of drainage is, however, so small and the rocks so impermeable, that the stream would have been occasionally dry; and at such periods probably were the remains of the Mammoth, Horse, and Ox, which then inhabited the district, brought in at intervals by Tigers and Hyænas and devoured on the spot, for the bones show little traces of wear and much of gnawing.

In the second place, the bone-earth shows an entire change in the hydrographical conditions, while the palæontological conditions remain unaltered. Water charged with silt probably found its way into the cave by the lower or north entrance and deposited the cave-earth, in which occurs so great an accumulation of bones, including, in addition to the above-named animals, those of the various Deer, Bears, Fox, Rhinoceros, Hare, and Lemming. Looking at all the circumstances of the case, I consider it most probable that at that second period the cave was at times dry, and at other times flooded, not by streams flowing in from higher ground, but by flood-waters from streams at a level lower than that of the cave—that during the former intervals the cave continued to be frequented by Carnivores who brought in their prey to devour—and that with each successive inundation successive collections of bones were covered up and imbedded in the sediment with which the flood-waters were charged.

There are two facts frequently noticed by Mr. Busk and apparently irreconcilable, but which are in perfect accordance with this view of the subject. The one is that many of the bones, although found at some depth in the cave-earth No. 3, are yet slightly incrusted with stalagmite; and the other is that, as already mentioned, some of the bones show a condition which Mr. Busk considers to be the result of exposure to the sun and air on the surface of the ground. But if we follow out what may have been the consequence of the state of things we have suggested, both these effects would in all probability have resulted therefrom; for it is not conceivable but that, under favourable

* See Part 2 of Mr. Busk's report, which gives the relative mean depth at which the remains of the different animals were found.

conditions, the water dripping from the roof of the cave must at all times have tended to the formation of stalagmite *; and, in fact, Mr. PENGELLY has shown that under such conditions (probably sheltered places) stalagmite did form alternately with the cave-earth. It would therefore follow that those bones which, from time to time, were exposed on the surface of the floor of the cave to the drip from the roof would receive an incrustation of carbonate of lime of thickness proportionate to the time between their being left by the predatory animals on the floor of the cave, and their being covered up by silt (the cave-earth) from some subsequent inundation. We know also that stalagmite did not form in all parts of the cave; and where such was the case, or where the bones were more out of the reach of the inundating waters, some of them must have been exposed to the long-continued action of currents of air in the cave, and such action probably produced the drying and weathering effects referred by Mr. BUSK to atmospheric action outside the cave. It was only when the cave was no longer subject to the recurrence of inundations that the formation of stalagmite became uninterrupted, and that the slowly accumulating layers of carbonate of lime formed the great stalagmitic mass, which finally sealed up the cave-earth with its contained multitude of bones.

As the deposit of the cave-earth proceeded, a change appears to have gone on in the animals frequenting the cave, either from lapse of time accompanied by a change in the animals frequenting the district, or else owing to the circumstance of the cave having become gradually drier and less subject to flooding. The remains of Elephant, Rhinoceros, and Cave-Lion gradually disappear, and those of the Hyæna become less common, whilst the Bears increase largely in numbers. Both circumstances combined, and possibly the presence of so powerful and savage an animal as the Grisly Bear, may have tended to the exclusion of the Hyænæ; but the same cause will not account for the great number of the common Brown Bear which frequented the cave during its later period. This animal seems to have made it a place of habitual resort, and to have taken possession of the more retired parts of the cave, such as the Flint-knife Gallery and the further part of the Reindeer Gallery, to the almost entire exclusion of other predatory animals. Instead of detached bones, numbers of bones of Bears, including those of very young cubs, were found together, leading to the inference that they were the remains of animals which died or were killed on the spot†; and as they are neither gnawed nor dispersed, it may be inferred that the Hyænæ had ultimately ceased to frequent the cave.

Contemporaneously with the latter change is the gradual appearance of the smaller mammals, rodents, and birds in the cave. A few of their bones have been found as deep as 4 feet in the cave-earth No. 3; but the greater number occurred on the surface of this bed and where it is not covered by stalagmite. From the recent-looking state of the bones of the Hare, though found at this depth, their antiquity might be questioned;

* The coating of some of the pebbles, the cementation of portions of the shingle bed, and the thick mixed deposit of ordinary stalagmite and crystalline calcareous spar in the Crystal Gorge, which was out of the main water-channel, points to the prevalence throughout the whole time of similar conditions.

† Sometimes possibly drowned by the inundations to which we have referred.

but it is to be observed that some of the bones of the larger mammals have also a very recent aspect.

With the appearance in the cave of the smaller common rodents now living in this country, we have to note a remarkable exception, that of the Lemming (*Lagomys spelæus*)*. At the same time it is also evident that a certain number of the older cave-animals, including the Reindeer, Ox, Horse, Roebuck, and Bear, and possibly the Mammoth, lived on to a comparatively late period in the history of the cave, as their remains were found in several instances in and upon the stalagmite floor, the deposition of which marks the period when the main entrances into the Brixham Cave were finally closed by falling débris to all except the smaller burrowing animals and a few bones introduced through fissures opening on the surface.

Although no line of demarcation in the fauna can be drawn from the accidental occurrence of the stalagmite floor, which seems due to favourable circumstances rather than confined to any particular period, still it is to be noted that the smaller and common animals do not appear till at a late period in the history of the cave, and when the deposition of the cave-earth had almost or entirely ceased. Did this arise from their more recent introduction into the district? to a change in the climatal condition and the dying out of the larger Mammalia? or was it (as we think more probable) merely a circumstance dependent chiefly upon the cave becoming drier, more closed up, and less resorted to by the larger animals?

Some doubt must always attach to the determination of the relative antiquity of the cave-remains, owing to the several possible causes of disturbance, whether by physical operations which rearranged the contents of the cave, or by the agency of animals or of man producing local displacements. It is well known that fragments and pebbles of an older stalagmite floor are sometimes found in the beds below the existing compact stalagmite now forming the floor, and also that portions of an old stalagmite floor are sometimes found attached to the sides of the cave in a higher position than the existing bed of stalagmite. SCHMERLING, in his account of the caves of the neighbourhood of Liége, describes several instances of the former, and the latter your Reporter has noticed in the celebrated "Grotte D'Arcy," near Auxerre. In this case the under surface of the stalagmite was coated with pebbles. Mr. PENGELLY records precisely similar facts as part of the phenomena of the Brixham Cave. Now it is evident that this could not have taken place without a large remodelling of the contents of the caves. In the first place, the caves were filled to a much greater height than at present with shingle, and this shingle was directly covered by a bed of stalagmite. To have broken up this bed, to have removed part, or lowered the whole mass, of shingle, and to have worn the broken fragments of the stalagmite into pebbles, indicates a considerable disturbance, such as, if any organic remains existed in that portion of the bed which was so disturbed, would have removed them from their original position, and subjected them to more or less

* This circumstance tends to give a greater antiquity to a portion of the smaller remains than from their condition and position we might have been disposed to assign to them.

wear and fracture. But as some of the fragments of stalagmite are rolled and some nearly angular, the test of wear or of angularity in distinguishing the older remains from those of more recent introduction becomes of no avail, as the disturbing cause has not produced a uniform result on materials, all of which must have been originally of the same character.

The treading of the ground by the larger animals, the habit of hiding their spoil, or their search after spoil, and even the agency of man, whose presence here we shall presently show, may also have led to some displacement of the bones in a cave where they were lying loose on the floor or only buried a slight depth in soft cave-earth. Thus, while on the one hand we see cause to believe that some of the bones may not be in their original position, yet on the other hand, in case of the bones occurring together, it does not follow (owing to causes we have before referred to) that because they differ in mineral character they are necessarily of a different age. It is evident that as other conditions besides those of age and imbedding, such as previous weathering or stalagmitic coating, influence the fossilization of the bones, it must be difficult to decide upon the limits of error to which such differences of condition may give rise. Though the fact of the variations in the state of the bones may be ascribed to several causes and does not vitiate the argument of antiquity, still it may be better to eliminate all such doubtful cases (and after all it is the general condition and aspect of the bulk of the remains upon which we must in the main depend), although the exceptions, even admitted, will be found to be so few as hardly to affect the main question at issue, whether as regards the actual or the relative age of the mammalian remains generally.

This group of cave-animals may be referred to a late quaternary period, probably coeval with and prolonged beyond that of the raised beach which in places fringes the south coasts of England; for mammalian remains of the same species have been found in the rubble beds which overly the raised beaches of Plymouth, Brighton, and elsewhere.

We now have to consider another question sought to be settled by the exploration of this cave; and although the antiquity of man has since been established on other grounds, this work must be ever considered as inaugurating, and as forming the first systematic attempt to solve, this important problem.

Traces of Man's work.—Amongst the extraneous materials found in the Cave were thirty-six specimens of chalk flint (see Mr. PENGELLY'S Table No. IV. p. 494)*, fifteen of which show unmistakable evidence of having been artificially worked, and are of forms which have their modern analogues in the stone knives, skin-scrapers, and pointed flakes used by uncivilized man, while one specimen (6, 8) is of that extinct large spear-head type so common in the high-level gravels of Amiens and other places. Fourteen of these specimens are described by Mr. EVANS (see p. 549). There are nine others of which the workmanship is very rude or doubtful†, while there are seven which I think show

* In Mr. EVANS's 'Ancient Stone Implements' the numbers in column X. of Table IV. are used. In this Report the numbers in the first column are given.

† These are marked by an asterisk; they are all from the shingle bed, except Nos. 14 and 18.

no traces of having been worked at all. In the long interval since their discovery four specimens have been mislaid. The others may be sorted approximately as under:—

Worked FLINTS (*implements and chips*).	Nos. 1, 4, 5, 6, 7, 8, 9, 10*, 11, 12, 13, 17, 21*, 23*, 24*, 25*, 27*, 28, 29, 30, 31*, 32*, 33, 35* .	24	specimens.
FLINTS not worked† (*natural forms*).	Nos. 14‡, 18, 19, 20, 22, 26, 34 .	7	,,
		31	,,

Nos. 2, 15, 16, and 36 are mislaid; but, on the other hand, there are three extra specimens, one of which is worked and two are doubtful, upon whose numbers we cannot agree.

Omitting the nine more doubtful specimens and mere chips, the distribution in the Cave of the worked forms of flints, such as may have been used by man, was as under:—

	Reindeer Gallery.	Flint-knife Gallery.	West Chamber.	Pen and Keeping Galleries.	Total.	
CAVE-EARTH	5	3	1	2	11	15
SHINGLE BED	2	0	2	0	4	

While of the unworked flints the distribution is as follows:—

CAVE-EARTH	1	0	1	0	2	7
SHINGLE BED	1	2	2	0	5	

The four flint implements found in the bed of shingle were at depths of from 6 inches to 10½ feet, or, including the overlying beds, of from 8 to 14 feet. As the bed of shingle is, on the whole, perfectly distinct from the succeeding cave-earth, there can be no doubt that the associated flint implements, unless subsequently introduced by some artificial means, date also anterior to the cave-earth; and there is no appearance of the overlying ground, at the several places where they were found, having been disturbed either by man or by animals. In a few places mentioned by Mr. PENGELLY the shingle, it is true, is partly mixed with cave-earth; but there it seems to have been caused by the rapid influx or efflux of the flood-waters charged with the silt which formed the cave-earth, or to be owing to remnants of pebbles which remained lodged on the sides or roof when the shingle bed stood higher. They are evidently foreign to the bed, as the local fragments of limestone so common in it are all angular and show no indications of the action of a running stream to which the pebbles are due.

The relative position of the bones of the Cave-animals and of two of these Flint Implements is shown in the following Table, based on Mr. PENGELLY'S Table IV. and Mr. BUSK'S lists:—

† Specimen No. 3 is merely a fragment of slate nearly covered on one side with stalagmite.

‡ A specimen, No. 144 in the collection, corresponds in the description of its find in the "Register" with No. 14 of Table IV.

Number attached to the find in first column of Table IV.	Depth of specimen in the shingle bed.	Thickness of the overlying cave-earth.	Gallery in which found, and distance from entrance.	Animals remains of which were found in the cave-earth at the same distance from the entrance.	Number of bones of each species.
29.	8 feet.	13 feet.	West Chamber—5 feet (see "finds" Nos. 72, 73, 74, 75).	Elephant	4
				Rhinoceros	7
				Horse	2
				Ox	1
				Red Deer	1
				Reindeer	4
				Tiger or Lion	1
				Hyæna	13
				Bear	13
33.	10 feet.	4 feet.	Reindeer Gallery—34 feet (see "finds" Nos. 80, 105).	Horse	1
				Roebuck	1
				Reindeer	2
				Rhinoceros	3
				Hyæna	1
				Bear	1
				Elephant	1

In the West Chamber eight bones were found in the cave-earth at the same distance from the entrance as Flint No. 11; while in the Reindeer Gallery, over and within 1 foot on either side, twenty-one bones of various animals were found in the cave-earth overlying Flint No. 30. Both these flints were in the shingle bed.

The following specimens were, on the contrary, found in the cave-earth, and were associated with, or were beneath, bones of the different animals here mentioned*:—

No. of find in Table IV.	Animals whose remains were found on the same vertical with the bones, and the number of the latter (see Tables I. and IV.).	Depth in the cave-earth.		Distance from entrance.
		Flint.	Bones.	
		ft. in.	ft. in.	feet.
1.	Reindeer (1) (in the overlying stalagmite)	0 9	0 0	74
4.	Hyæna, Bear? (3)	2 0	0 9	37
6.	Rhinoceros, Reindeer, Bear, Horse, Hyæna (9)	3 0	2 0	31
7.	Roebuck?, Reindeer, Hyæna, Horse, Rhinoceros (6)	3 6	1 0	16
8.	Rhinoceros, Hyæna (2)	3 6	1 6	22
12.	Red Deer, Ox? (3)	2 9	0 9	15
13.	Horse, Hyæna, Rhinoceros, Reindeer (4)	4 0	3 6	26
17.	Deer, Hyæna? (2)	9 0	9 0	15

At the same distance from the entrance and the same depth in the cave-earth in the West Chamber as Flint No. 9 there were found fifteen bones of Bear, Hyæna, Ox, and Rhinoceros; while in the Flint-knife Gallery flint No. 5 was found overlying three bones of Ox and Bear.

Besides these cases—which determine, first, the occurrence of worked flints in the bottom or shingle bed, and the superposition on it at the same spot of a considerable thickness of undisturbed cave-earth rich in mammalian remains, and, secondly, the association

* The Register does not record the distance from the walls of the cave, so the superposition may not always be quite vertical; but from the small width of the galleries there is little room for error.

of bones and worked flints at the same places in the cave-earth—it is well to remember that the relation of the cave-earth to the shingle is constant and uniform, and, further, that the cave-earth itself is overlaid throughout a great part of the cave (including those parts where the flint implements Nos. 4, 8, 12, 13, and 30 were found) by a layer of stalagmite in which bones of Bear, Reindeer, and Elephant or Rhinoceros were, in several places, found imbedded.

The Cave furnishes also some other slight indications of man's presence. Dr. Falconer alludes to part of a Reindeer's horn (No. 4 find) which has an apparently artificial incision*; and Mr. Evans also draws attention to the discovery of a small "cylindrical pin or rod of ivory," but the position of this is not certain. Two nearly round pebbles were also found in the shingle bed—one of siliceous sandstone, weighing 1 lb. 3 oz., in the West Chamber, and the other of red sandstone, weighing $5\frac{3}{4}$ oz., at the entrance of the Steep Slide Hole. The first is one of those hard pebbles forming the Budleigh-Salterton conglomerates,—beds which do not range westward of the Ex. This pebble shows, on the side opposite to that by which it is most readily grasped by the hand, the distinct marks and indentations arising from use as a hammer-stone. On the smaller and softer pebble these are less marked. These specimens are unique, and the first is of especial interest, as it seems to have been brought from a distance and could not have been introduced by natural causes into the cave†.

Amongst the débris of bed No. 3, Dr. Percy noticed some pebbles of brown hematite, a mineral which does not occur on Windmill Hill. Mr. Pengelly refers them to Furzeham Hill; at the same time they may have been derived from denuded portions of Parkham Hill, at the base of which this mineral is still found, and which is on the line of the valley above the cave; otherwise they must have been introduced by artificial means.

But although the evidence, taken altogether, sufficiently indicates the existence of man at the cave period, we doubt whether Brixham Cave was at any time inhabited by man. Caves have constantly been places of resort for uncivilized man, either for shelter or for security. When resorted to for these objects, traces of his habitation, in the form of refuse (whether of bones cast away at meals, of broken and lost tools of daily use, and, after the discovery of fire, of hearths and their surroundings), necessarily occur in quantities more or less abundant, according to the length of man's habitation. Further, when a common and brittle material is in use for implements, the number lost or spoilt must always have been large, as in the case of the caves of Les Eyzies, Moustiers, and others in the south of France, where rudely worked flints occur literally in thousands. Again, man usually takes possession of a cave when dry and capable of affording permanent shelter, so that the layers of débris formed during his period of occupancy are

* Mr. Busk sees reason to question this conclusion, see page 537.

† Budleigh Salterton is about twenty-five miles eastward from Brixham. Mr. Pengelly informs me, however, that quartzite pebbles are occasionally met with on the Devon beaches. A broken quartzite pebble has also been found in Kent's Cavern (see Brit. Assoc. Report, 1870, p. 22).

on a given zone,—that zone being generally above the deposit of cave-earth covering up the remains of animals which may previously have frequented the cave.

In the instance, however, of the Brixham Cave, although we have in evidence these primitive works of man, they are so few and so scattered, and they occur also on levels so widely different (no two, in fact, of the fifteen flint implements found there having been met with on the same level), that it is not possible to conceive that man inhabited the cave at any time. The specimens are not numerous enough: they are found isolated and without any corroborative adjuncts.

Nor do we think that the flints could have been brought in by wild beasts with human prey, for not a fragment of a human bone was found in the cave; whereas, like with the animals serving as prey, some of the remains of man in the shape of gnawed bones or teeth must, in that case, have escaped destruction. Could the worked flints have been washed in, as the unworked flints doubtlessly were, with the shingle of the fourth bed or with the silt of the third bed? This is possible; still we are not disposed to adopt that view, inasmuch as although some of the specimens show marks of wear, that wear arises rather from use, and none exhibit the general wear and rounding produced by running water; the wear is, in fact, often so slight, that in the instance of the remarkable flint implement which was found broken in two pieces (p. 550), and each piece in a different gallery, the broken edges (*ff*) when brought together fitted as closely as two pieces of freshly broken porcelain. One fragment (No. 6) was found in the Flint-knife Gallery on the line of main water passage and the other (No. 8) in a different direction in the Pen Gallery, so that their position was in all probability determined by artificial agency. The worked flints also in the cave-earth are to those in the shingle in the proportion of nearly 3 to 1; whereas with the unworked flints, on the contrary, the proportions are more than reversed, there being only 2 in the cave-earth to 5 in the shingle bed, where the stream was the natural means of their introduction. The flints in the cave-earth in No. 3 bed are in the inverse ratio in which as extraneous bodies they should occur had natural agencies only been in operation.

After full consideration of the subject, we can only conclude that the worked flints were lost or left behind by man during occasional visits to the cave, either for the sake of temporary refuge or in following prey which may have sought shelter there. The former alternative is the more likely, as during the formation of the shingle, in which the four specimens were found, the cave was but little frequented by animals, only 7 bones occurring in that bed; whilst in the cave-earth, though 751 bones were found, not more than eleven worked flints were met with. The proportion of bones to flints shows therefore no relation one to the other, whether it be considered that man was subject to be the occasional prey of carnivorous animals, or whether man sought his prey amongst the herds of wild deer, oxen, and some other animals. On the other hand, the absence of human bones would seem to indicate that early man had the skill and activity necessary to avoid falling a prey to the powerful wild animals of the period, while at the same time his senses, like those of animals, must have been as acute and keen

as theirs to have carried him safely through the deep and narrow recesses of such a cave as that of Brixham; for it is to be noted that although the larger proportion of flint implements were found near the entrances where a glimmer of light might penetrate*, still a few were found 30 and 50 feet (and in one case as many as 74 feet) from the nearest external entrance, where little if any light could penetrate; and there is no evidence of early man having been acquainted with the use of fire.

The view we have suggested with respect to the early condition of Brixham Cave is one also in unison with the other phenomena of the cave, which, from the evidence we have now gone through, points, we conceive, to the following conclusions. In the first instance, some small watercourses, draining a small upland tract of Devonian slates and shales situated between the site of the cave and the valley of the Dart, emptied themselves and were lost, as is common now in limestone districts, in the narrow fissures or open joints of the limestone rocks. These were the channels along which were transported the worn and rolled shingle derived from those rocks and which were deposited along the bottom of the cave, forming bed No. 4. As the fissures in the limestone could but have been on the level at which these streams flowed, the valley of Brixham and its tributaries, which then as now formed the channels of drainage of the district, must have been from 70 to 80 feet less deep than at present.

It would seem that the stream originally entered the cave by the West Chamber† and escaped through the north entrance, and perhaps in part through the Steep Slide Hole—the sea-level being then probably the one marked by the old raised beach, which would show that the land then stood about 30 feet lower than at present. After filling the lower part of the fissures with shingle, the prolonged action of the stream wore and expanded the upper part of them into the wider passages at present constituting the cave, and finally nearly filled them with shingle. The lower wall-grooves (*b b*) may have formed before the shingle had choked up the cave, when, in fact, the stream was in full force, and the upper one (*a a*) at a later period, when the current was more impeded, and when, judging from the level of the old stalagmite floor, the shingle had found an exit through the north entrance. The traces of a reverse or inward dip of the wall-grooves between the road entrance and the Steep Slide Hole may be due to the influx of the flood-waters at a later period. During this period, when the streams were low or dry, the cave was resorted to, on a few rare occasions, by animals to devour their prey; but at this time they cannot be traced far beyond the entrance—in no case more than 36 feet in the Reindeer Gallery, and, in the Flint-knife Gallery, to 25 feet from the west entrance. In the same way we recognize the restricted presence of man, in the two flint implements found at a distance of 34 feet from the north entrance, and the two within 7 feet of the west entrance.

After the cave had become choked with shingle, the stream, either from that cause or from the deepening of the channels outside, kept more in the main valley, and a period

* The first 16 feet was then, however, an open fissure.

† The openings in the South Chamber may also have given passage to a stream.

of quiet succeeded, during which a first bed of stalagmite was deposited immediately upon the bed of shingle. Remnants of this old layer of stalagmite, with the pebbles forming the top of the original shingle bed attached to its under surface, were found adhering to the sides of the cave, 3 to 4 feet above the second or later stalagmite floor. The breaking up of this layer of stalagmite and the lowering of the surface of the shingle bed to the extent of from 6 to 10 feet, was accompanied by a complete change in the state of the cave (see figs. C, D, E, Plate XLII.).

These effects may have been produced either by an irruption of water carrying away part of the shingle, and so undermining the stalagmite, or by the breaking up of the stalagmite, and the settling down of the shingle deeper into the fissures, by earthquake movements. We are disposed to adopt the latter alternative; for Mr. PENGELLY has remarked that the surface of the shifted shingle, instead of presenting a depression in the middle with edges rising up to the sides of the passages, is, on the contrary, raised in the middle and is depressed on the sides—a form which is hardly compatible with the action of flowing water, but rather accords possibly, in our opinion, with the results of the vibrations and settlements caused by earthquake action. From this moment new conditions of the cave commenced. Instead of fissures receiving shingle-bearing streams, and water more or less constantly flowing through the cave, we now come to a period when the cave was habitually dry, though it remained subject to occasional floods from the main stream of the Brixham valley, then in the course of excavation. The flood-waters charged with silt deposited the cave-earth gradually during each successive inundation, like as, in other districts, the loess was deposited during the river-floods in the more sheltered spots of the main and lateral valleys; while during the whole time blocks and fragments of the old high-level stalagmitic floor continued to fall in more or less abundance.

We admit the difficulties of the case,—of realizing how, in so short a course as the Brixham stream had, and with so small an area of drainage, a sufficiently powerful body of water could be collected to excavate such a valley; but it is a difficulty which meets us in many valleys of denudation when we contemplate the small causes at present in operation with the comparatively gigantic effects produced. We can only account for it, as we have done elsewhere, on the hypothesis of an intensely cold climate, of which we have such abundant evidence, accompanied by a greater rainfall, by spring floods of great power such as now occur annually in all arctic regions, and by ice action. It is further possible that a slow movement of elevation was in progress during this period, which counteracted the loss of gradient in the lower part of the valley caused by the process of denudation. The submarine forest of Torbay, which afterwards grew on land now 30 feet beneath the sea, shows the entire rise at one time to have been 40 feet or more above the present sea-level, or 70 feet or more above the level of the old raised beaches, to which extent the fall of the stream was then increased.

The breaking up of the first and original bed of stalagmite, and the lowering of the

surface of the bed of shingle, whatever may have been the cause, gave greatly increased room in the cave; and as it was no longer a mere channel for a flowing stream, but, on the contrary, presented for certain periods open passages with a dry bed of loam and limestone débris, it became a place of resort for the predatory animals of the district. They there brought their prey to devour, scattering the gnawed bones of the disjointed limbs in different and distant parts of the cave. The Hyænæ carried their prey to all the main passages of the cave, but sought chiefly for that purpose the more retired galleries, while their own remains are more equally scattered. Of the 669 bones determined by Mr. Busk, if we omit the bones of the Bears, we find that the distribution of the others was as follows:—

	West Chamber.	Flint-knife Gallery.	Reindeer Gallery, North.
Bones of the various animals excepting Bears	57	124	109
Bones of Hyæna.....	21	18	18

It may, however, be doubted whether the Hyænæ made the cave more than a place of temporary resort, as, unlike in other old caves which they frequented, no coprolites of Hyænæ have been found here, though that may admit of the explanation before given. But although now generally dry, the cave continued subject to be flooded, perhaps at long intervals; and it is probable that the water found its way into the cave by the north entrance and so through the Reindeer Gallery, the Flint-knife Gallery, to the West and South Chambers. As it retired we may suppose it to have caused, by its fall over the limestone ledge above *d* (fig. 2, Plate XLIII.) in the West Chamber during rapid subsidence, the disturbed and abnormal position of the bones in the cave-earth there noticed. To such advance and retreat of the waters may also be attributed the irregular deposition of the cave-earth, the variable depth at which bones of the same limbs are buried, and the silting up of the passages furthest from the point of entrance of the waters, which latter their outflow kept clear. The influx and efflux of water was also of sufficient power to move and rearrange the bones throughout its course, as, according to Mr. Pengelly, they were mostly found, not as scattered indiscriminately by wild animals, but lying with their length in the direction of the passages of the cave. By the repetition at distant intervals of these inundations, and by the accumulation during these intervals of fresh crops of bones, the bone-bearing cave-earth was gradually formed; at the same time the occasional visits of man are indicated by the rare occurrence of a flint implement lost as he groped his way through the dark passages of the cave—into the more innermost recesses of which he now occasionally penetrated, though keeping, in most cases, to within 20 to 50 feet of one of the main entrances.

As the denudation and deepening of Brixham valley proceeded, the cave became less and less subject to inundations, that after a time ceased to reach the level on which it stood. With this greater freedom from inundations, the increasing number and proportion

of their bones show that the cave became a place of more frequent habitation for Bears. Their remains in all stages of growth, including those even of sucking cubs, were met with in greater numbers than were the bones of any other animal. These animals resorted especially to the darker and more secluded Flint-knife Gallery, where 209 out of 354 of their determinable bones were found, whereas only twenty-six were met with in the West Chamber and 116 in the Reindeer Gallery.

Finally, whether from a change of climatal conditions or from the cave becoming quite out of the reach of the flood-waters, and partly possibly from its being more blocked up, the formation of the stalagmite floor proceeded without interruption. The cave, however, still continued to be the occasional resort of beasts of prey, for remains of the Reindeer, including a fine entire antler, together with bones of the Bear, the Rhinoceros, or the Mammoth, were found in the stalagmite floor. But no flint implements and no remains of man are found in this position; and while therefore we have reason to believe that the cave continued to be frequented by some of the older Mammalia as long as it remained open, we have no evidence that it was latterly resorted to by man. After a time the falling in of the roof at places from the effects of rain and weathering (and every earthquake movement must also have detached blocks from it) stopped up some parts of the cave, and closed its entrances with an accumulation of débris. From that time it ceased to be accessible, except to the smaller rodents and burrowing animals, and remained unused and untrodden until its discovery in February 1858.

The instances in which the remains of man or of his works have been found in caves in association with the remains of extinct Mammalia are many. They were duly noticed by Schmerling in Belgium, by Tournal and others in the South of France, by Dr. Buckland in Wales, and by Mr. M^{c}Enery and the Natural-History Society of Torquay in Kent's Hole; but in all these cases they were either explained away, in many instances by the observers themselves, from a preconceived improbability or rather impossibility of the circumstance, or the facts were refused credence on the same grounds and the evidence negatived, as in the case of Kent's Hole, without investigation. At this time it is not necessary to contend for the correctness of many of those observations; they are too numerous and too well attested to admit of doubt, and are now generally accepted; at the same time it is to be observed that the discovery and early reports of Brixham Cave had a very important influence in bringing about such a result. The discoveries of Schmerling and others had dropped into oblivion, the assertions of M. Boucher de Perthes were ignored, until the certainty of the facts established by the exploration of Brixham Cave showed the strong *primâ facie* evidence of the contemporaneity of man and of the great extinct Mammalia. Fresh from this new ground, and strong with convictions acquired on other grounds, Dr. Falconer visited the valley of the Somme in which the reputed works of man had, it was said, been found in quaternary deposits; and so satisfied was he with the force of the evidence, taken in conjunction with the observations already made at Brixham Cave, that he at once urged in the

strongest manner inquiries into its correctness and value, which we ourselves had long been contemplating, but which might have been still longer postponed but for the corroborative testimony afforded by Brixham Cave. Late as we are therefore in bringing forward the whole of the evidence afforded by this cave, it must not be overlooked that, however interesting the full record may prove, the exploration has already had an immediate and direct value in the successful impulse which it gave to so important a question as that of the antiquity of man. Well established as this fact now is from other and independent grounds, nevertheless the evidence of Brixham has its own special points of value,—in the completeness of its record, in the certainty of its data, and in the fact of its having been the first entire ossiferous cavern which was worked out in a systematic and complete manner, and the contents preserved for scientific use and reference*. It records also a time in geological science of very great importance, one marked by the removal of the boundary which had hitherto divided man from the extinct animals—a barrier no sooner removed than the search, before directed timidly to the measurement of man's age by the span of historical and traditional periods, became now boldly directed back into the later geological periods in search of his first appearance. But, notwithstanding the range of our new vista, we should not so much speculate on its indefinite extension, but rather seek to obtain those indisputable data, whether as regards the true position of the strata in which such remains may be found, or as regards the artificial character of those remains, without which we might have continued yet to hesitate to admit man's existence in the Quaternary period.

JOSEPH PRESTWICH.

Agreed and approved. { GEORGE BUSK. / R. GODWIN-AUSTEN. / A. RAMSAY.

DESCRIPTION OF THE PLATES.

PLATE XLI.

Fig. 1. Photograph of Entrance to Cave after clearing away the talus of limestone débris by which it was hidden. "*f*," north and south joint coincident with the line of the Reindeer Gallery.

Fig. 2. Section of Brixham Valley, showing the position of the Cave on the slope of Windmill Hill. The 150-feet terrace is on the authority of a section by Mr. PENGELLY.

Fig. 3. Geological Sketch Map, showing the direction of Brixham Valley and the rocks through which it passes.

* All the specimens are to be deposited in the British Museum, and the original documents and maps in the archives of the Royal Society.

PLATE XLII.

Plan of the Cave, with the position of the several sections given in Plate XLIII. The original names are retained, with the exception of that given to the north entrance and certain letters indicating the Galleries.

PLATE XLIII.

Fig. 1. Section along the Reindeer Gallery from the entrance to the Flint-knife Gallery. The original surface line continued sloping to the road. The entrance is here represented after the brickwork had been introduced into the first part of the fissure *f* and the finishing of the doorway. *s'*, remaining portions of old stalagmite, is from Mr. PENGELLY'S section.

Fig. 2. Section along the Flint-knife Gallery from the Reindeer Gallery to and across the West Chamber. The entrance to a short side gallery is shown under *m* and to Munday's Gallery at and above *d*.

Figs. A to G, M M and N N. Sections across different galleries. In the section M M the entrance to the Flint-knife Gallery is traced in central outline, and in the section N N the entrance to Kelly's Gallery. The position of the old stalagmite in fig. 1 and the rounded surface of the shingle bed No. 4, in the several cross sections, is given on the authority of Mr. PENGELLY'S sections.

The plan and sections were taken by Mr. BRISTOW, *of the Geological Survey, with the exception of the lower part of Bed No.* 4 *and of the line defining the bottom of the cave after that bed was removed. These additions were made by* MR. BOVEY *of Torquay.*

PLATE XLIV.

N.B. The figures, with the exception of fig. 13, Plate XLVI., are all of the natural size.

Fig. 1. Portion of the middle of the shaft of the femur of *Rhinoceros* gnawed by Hyæna.

Figs. 2, 3. Upper and lower aspects of the astragalus of *Rhinoceros tichorhinus*.

Fig. 4. Outer aspect of the third upper deciduous molar, left side, of *Rhinoceros tichorhinus*.

Fig. 5. Crown surface, in which there is no appearance of the median pit or "accessory valley" being formed by the fusion of two "combing" plates.

Figs. 6, 7. Similar views of the second upper deciduous molar of the right side, in which the same thing is still more plainly shown.

Figs. 8, 9. Similar views of a less worn third upper deciduous molar of the right side, on which no cementum appears to have been deposited. The outer or dorsal lamina of enamel is entirely removed. This specimen still more strikingly shows the median pit surrounded by a continuous wall of enamel, and that the inner lamina of the dorsal enamel plate is continued uninterruptedly from one side of the tooth to the other.

Figs. 10, 11. Outer aspect and crown surface of the first lower premolar, left side ($\overline{\text{pm 2}}$).

PLATE XLV.

Fig. 1. Portion of the left mandible of *Hyæna spelæa*, with the canine and three molars.
Fig. 2. The radius.
a. The proximal articular surface.
b. The distal articular surface.
Fig. 3. The tibia.
a. The proximal articular surface.
b. The distal articular surface.
Fig. 4. A portion of the maxilla of *Felis spelæa*, containing the second premolar.
Fig. 5. A canine tooth of *Felis spelæa*.
Fig. 6. A carnassial tooth of the same.
Figs. 7, 8. The fifth and fourth proximal phalanges of the manus.

PLATE XLVI.

Figs. 1, 2, 3, 4. Various canine teeth of *Ursus*.
1. *U. spelæus*?
2. *U. priscus*.
3. *U. arctos*.
4. *U. arctos*?
Figs. 5, 6. Two last lower molars.
5. *U. arctos*?
6. *U. priscus*.
Fig. 7. Astragalus of *U. priscus* or *spelæus*.
Fig. 8. Astragalus of *U. arctos*?
Fig. 9. Os unciforme, *U. priscus*?
Fig. 10. Os unciforme, *U. arctos*?
Fig. 11. Portion of maxilla with four teeth of *Bos primigenius*.
Fig. 12. Dentition of *Lagomys spelæus*.
Fig. 13. Ditto, $\times 2$ diameters.
Fig. 14. Peculiarly formed pm 4 of *Ursus* ——?

PLATE XLVII.

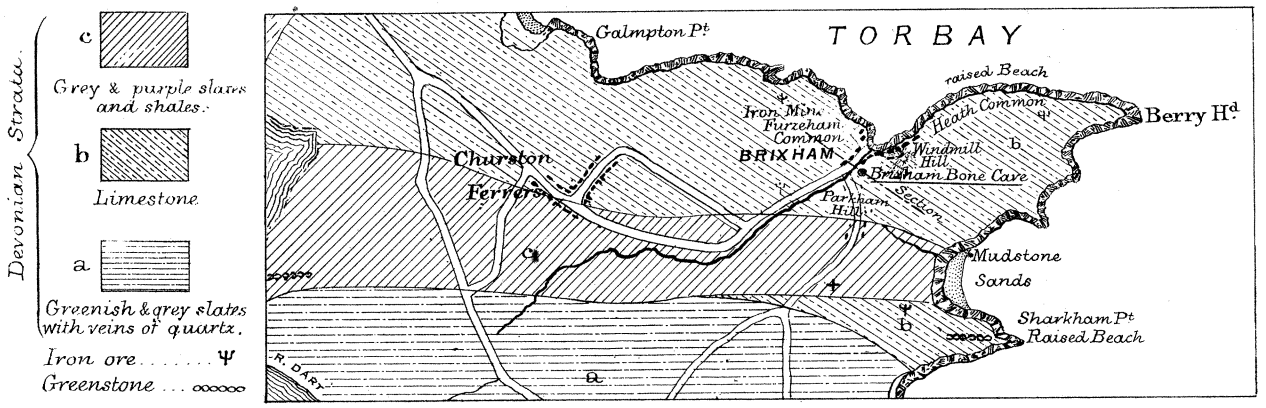
Odontograms, or graphic representations of the dimensions of the teeth in:—
1, 6, 11. *Ursus spelæus*.
2, 7, 12. Mean of all fossil species of *Ursus*, taken together.
3, 8. *Ursus ferox fossilis* (mihi).
13. *Ursus priscus*, Cuv. (*fossilis*, Gldf.). (Brit. Mus. sp.)
4, 9, 14. *Ursus ferox* (recens).
5, 10, 15. The Brixham-Cave Bears.
16, 17, 18. *Ursus arctos*.
19, 20. *Ursus maritimus*.

Phil. Trans. MDCCCLXXIII. Plate XLI.

Fig. 1. *Road Entrance to Cave after removal of talus.*

From a photograph.

Fig. 2. SECTION ACROSS THE VALLEY AT BRIXHAM.



SKETCH MAP of the district around BRIXHAM.

SCALE.

½ 1 mile

W. H. Wesley lith.

W. West & Co imp.

GROUND PLAN of the Bone Cave AT BRIXHAM,

reduced from drawings by

H.W. BRISTOW F.R.S. & W. BOVEY.

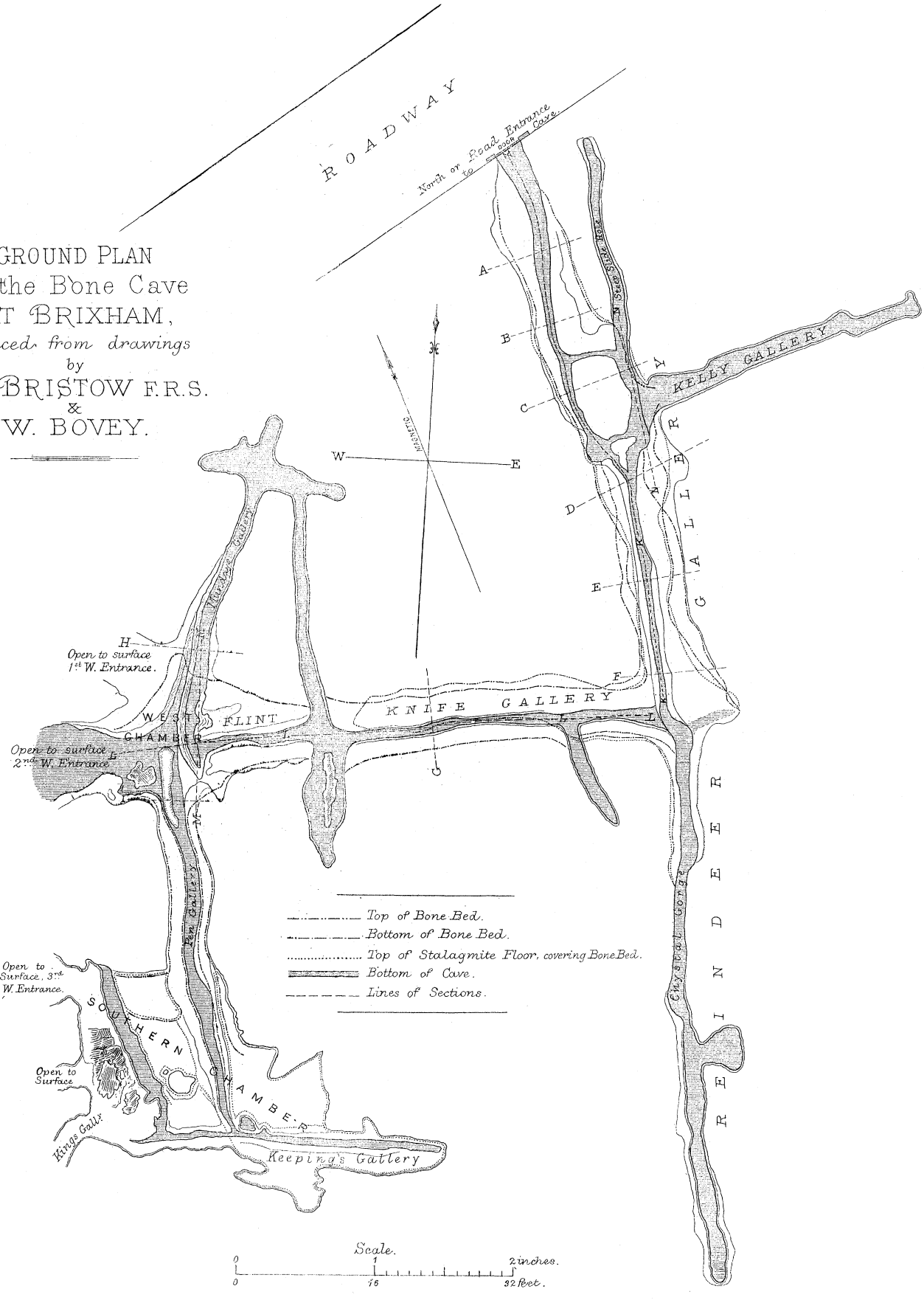


Fig. 1.

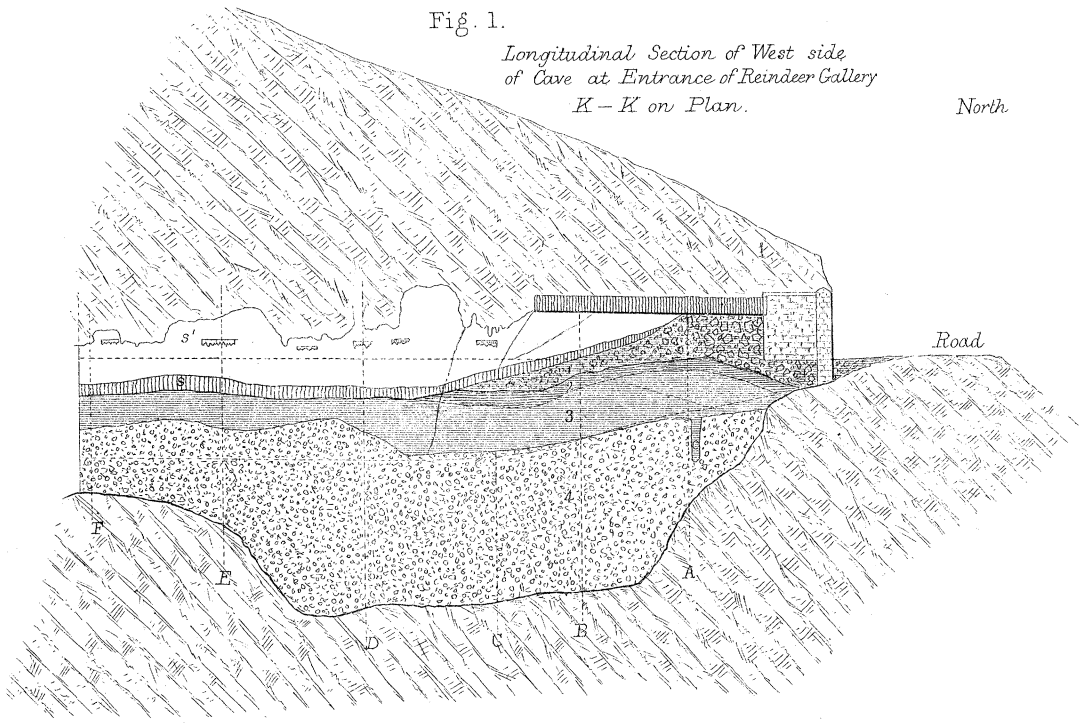
Longitudinal Section of West side of Cave at Entrance of Reindeer Gallery K — K on Plan.

South

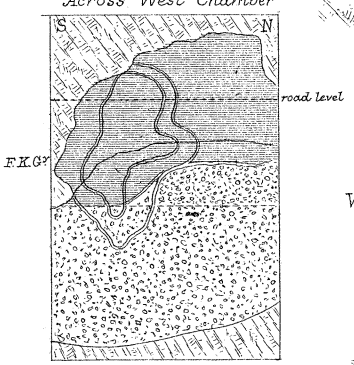
North

s'. Old Stalagmite
s. Stalagmite
1. Breccia
2. Black bed
3. Cave earth
4. Shingle
.....Level at Road Entrance

Scale
0 4 8 16 feet

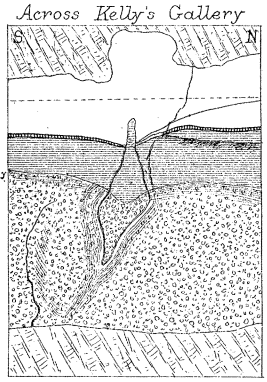


Across West Chamber



M — M

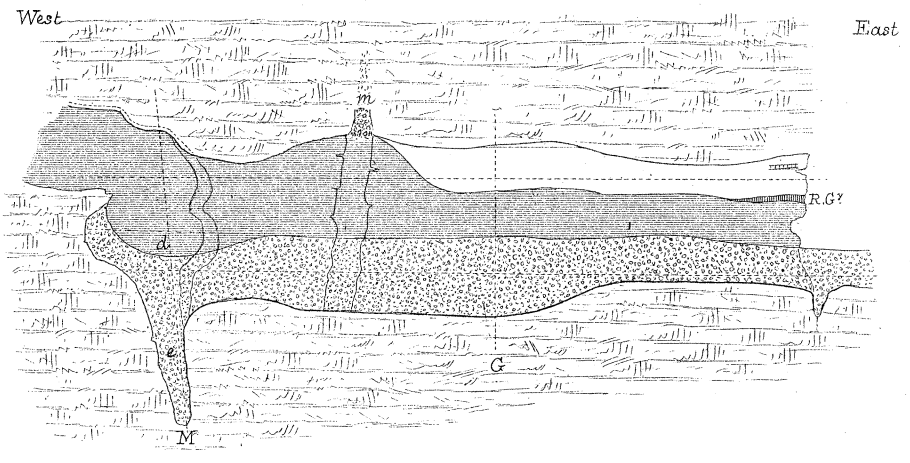
Across Kelly's Gallery



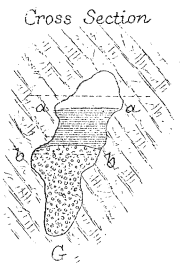
N — N

Fig. 2.

Longitudinal Section of North side of Flint-Knife Gallery, into West Chamber L — L on Plan.



Cross Section



Figs. 3

Cross Sections of Reindeer Gallery

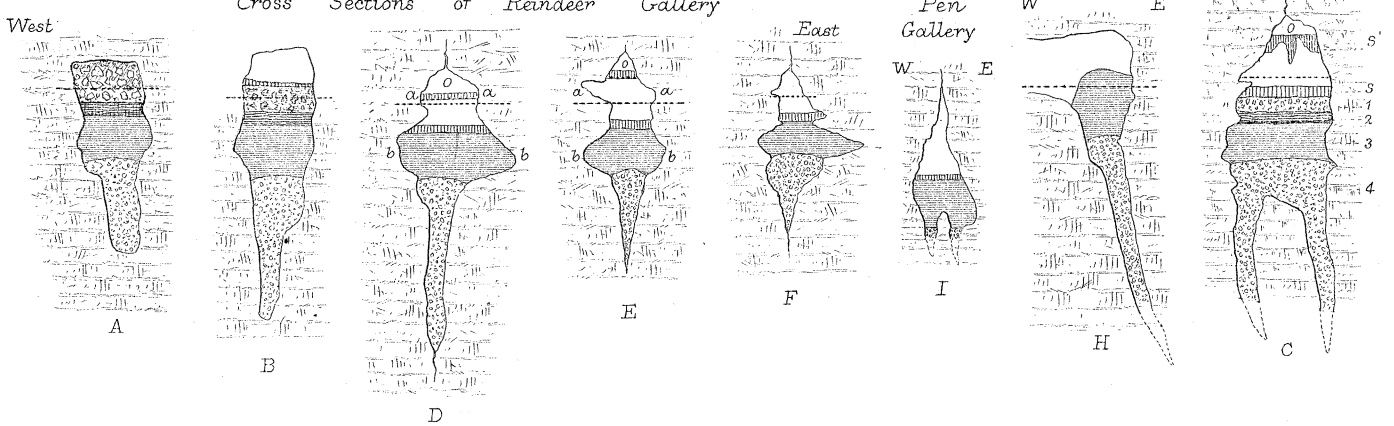


Fig. 2.

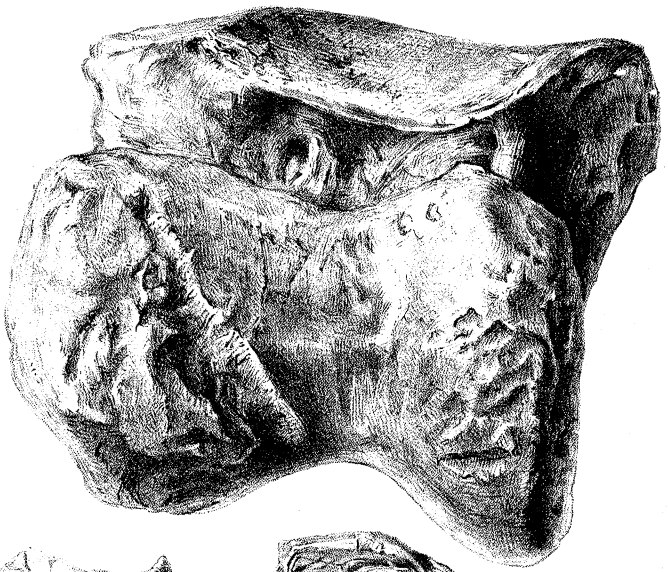
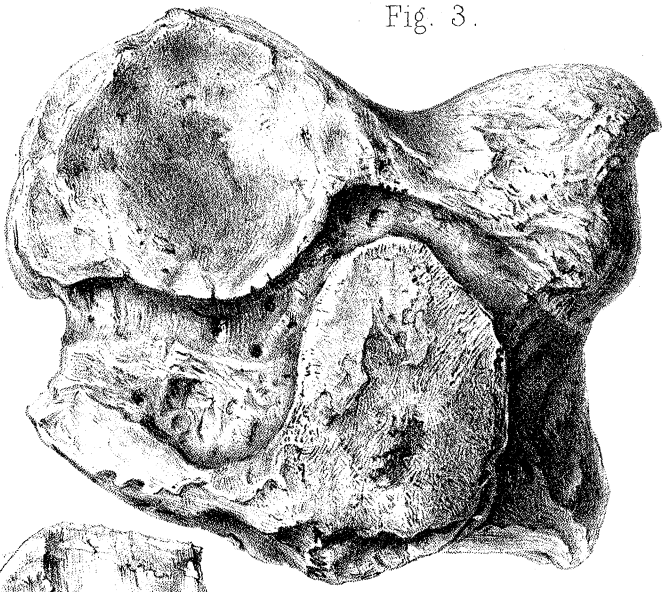


Fig. 3.



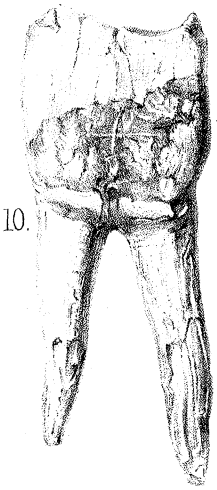


Fig. 10.

Fig. 7.

Fig. 6.

Fig. 4.

Fig. 11.

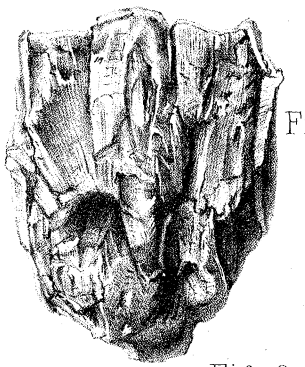
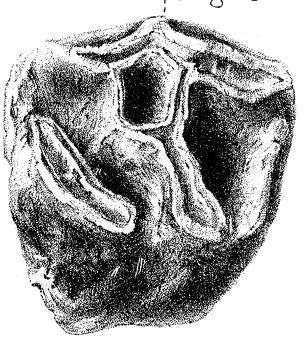


Fig. 8.

Fig. 5.



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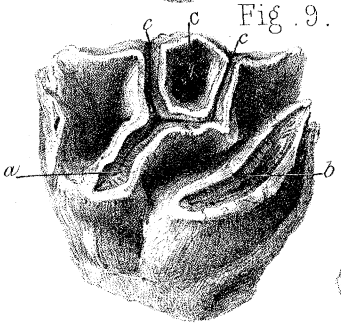


Fig. 1.

E. M. B. ad. nat. del.
W. H. Wesley, Ann. Lith.

Maclure & Macdonald, Lith.rs London.

Fig 2.[a]

Fig 2

Fig 1.

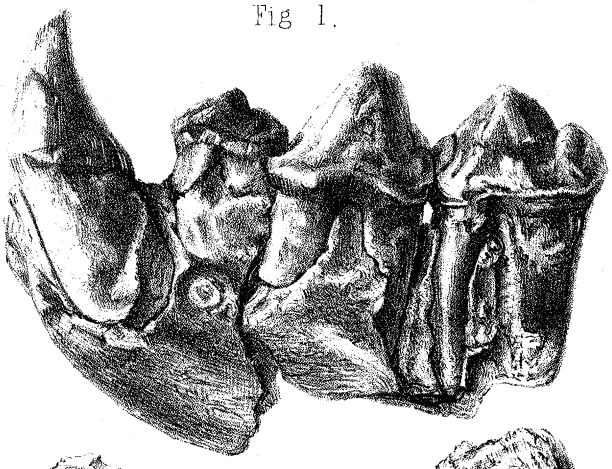


Fig 3.[a]

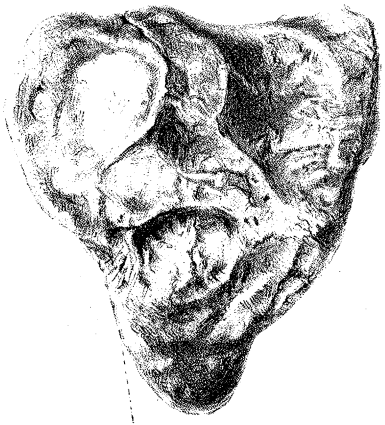


Fig 3.

Fig 4.

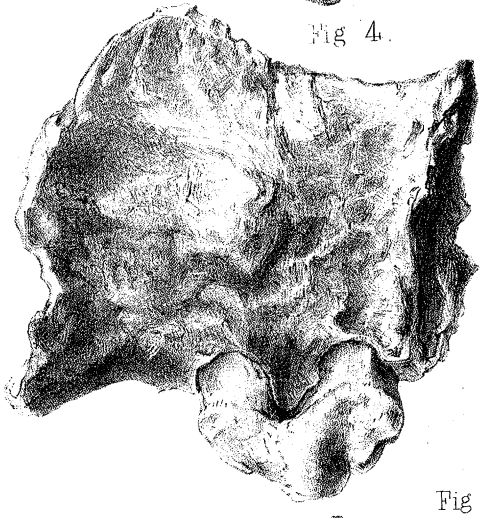


Fig 5.

Fig 6

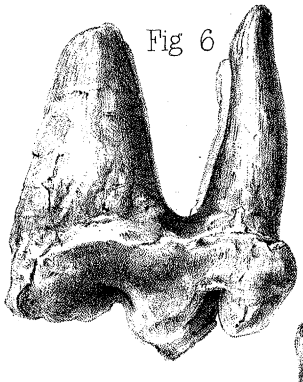
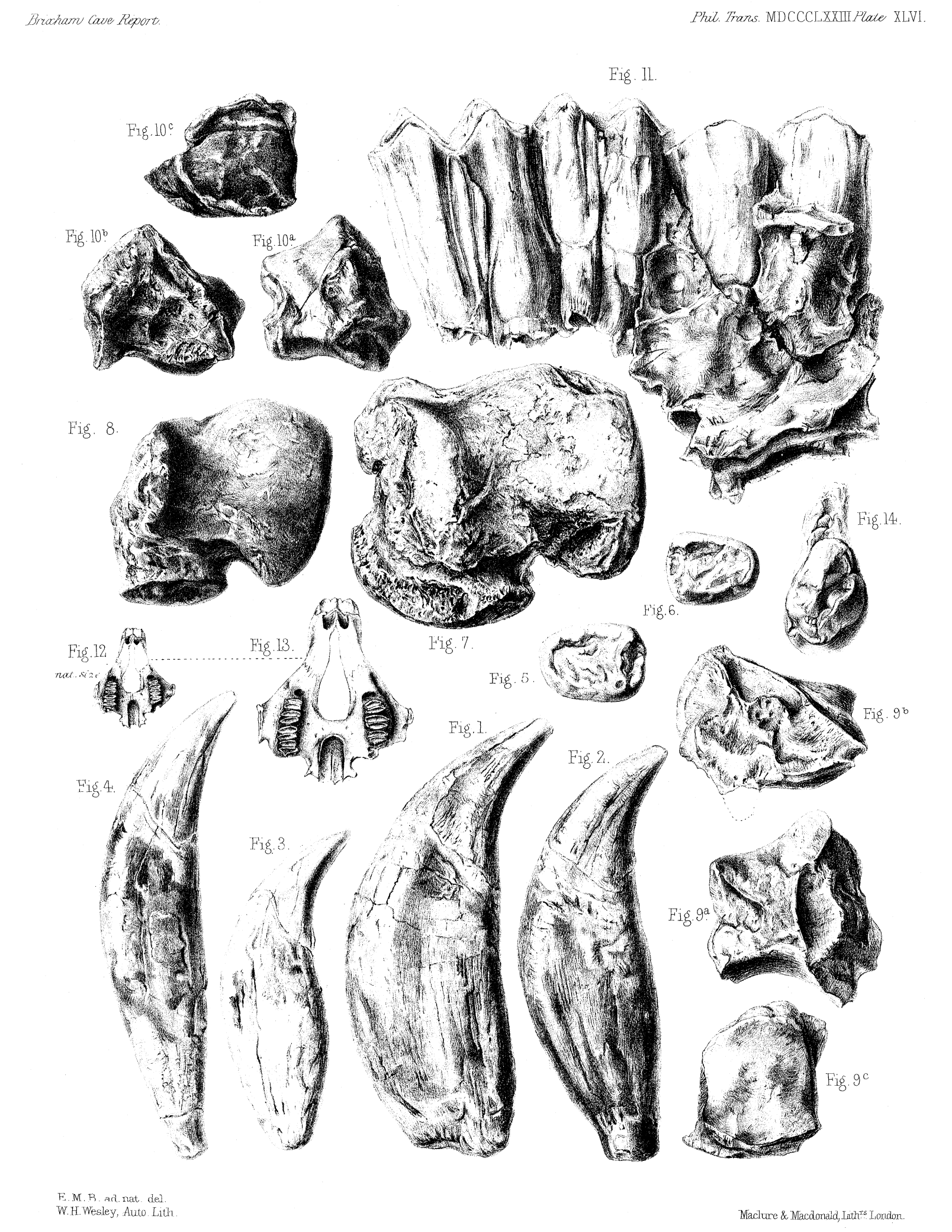


Fig 7.

Fig 8

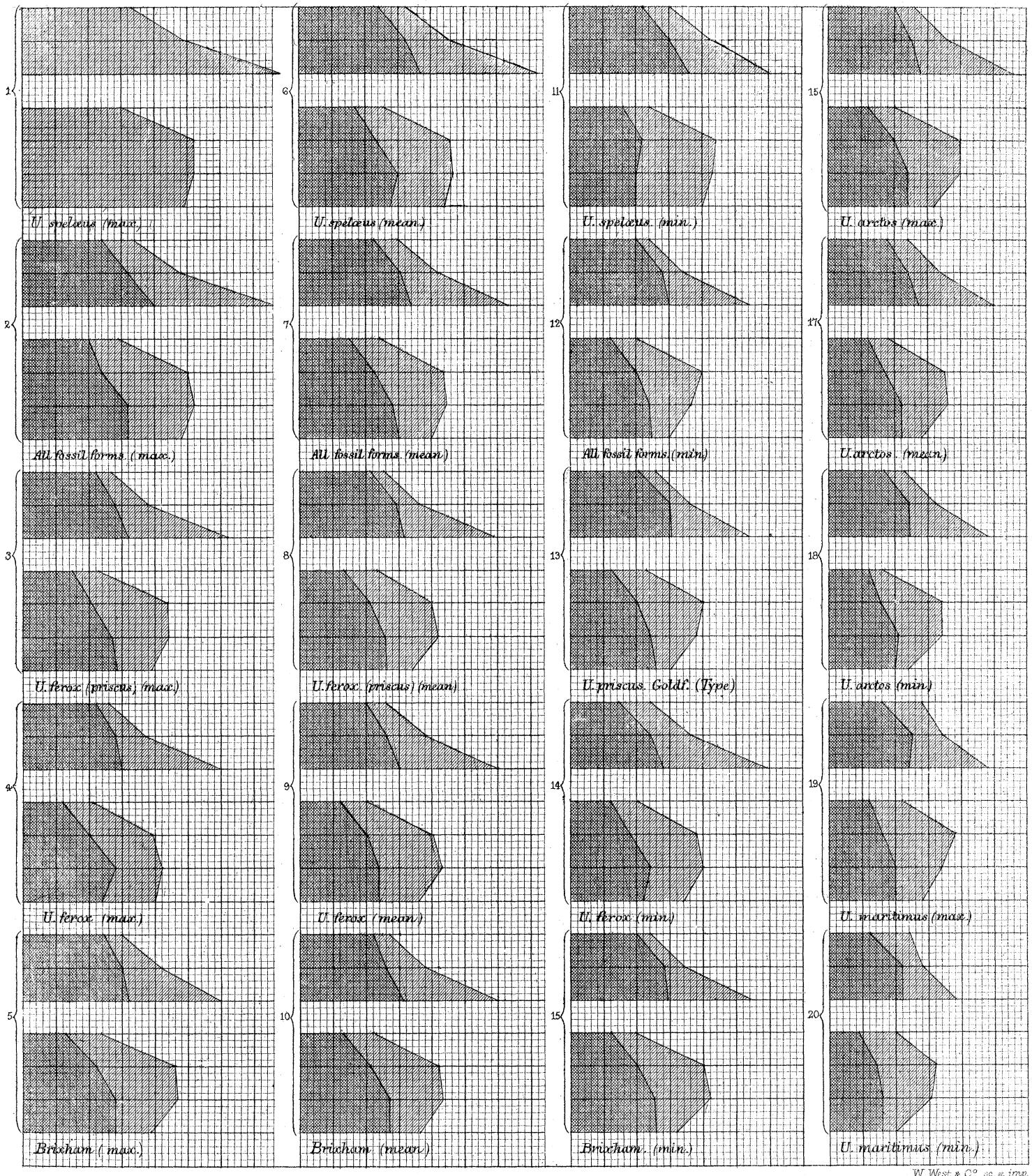
Fig 2[b]

Fig 3[b]



E. M. B. ad. nat. del.
W. H. Wesley, Auto. Lith.

Maclure & Macdonald, Lith^rs London.



W. West & Co. sc. et imp.

Odontograms of Ursus