Recent Cave-Digging in Derbyshire.

By W. Storrs Fox, M.A., F.Z.S.

DURING the past three or four years three papers have been read before learned societies in London on the subject of cave-exploration in Derbyshire. The discoveries thus recorded are presumably of greater interest to residents in this county than to those outside its borders; and it would, therefore, be unfortunate if there were no means of bringing these facts under the notice of those most likely to appreciate them.

The caves were situated in the Carboniferous Limestone—the first at Doveholes, near Buxton; the second at Longcliffe, near Brassington; and the third in Cales Dale, a branch of Lathkil Dale. Taking them in this order, their respective heights above Ordnance datum were 1,150 feet, 1,090 feet, and 800 feet. In point of time, the Mammalian remains found at Doveholes belong to a much earlier, and those from Cales Dale to a much later, period than the Longcliffe bones.

The Cales Dale Cave is a natural passage in the rock, probably enlarged to a slight extent by the action of water passing through it. It begins at its innermost extremity with an impassable cleft, widens out to a maximum height of 3½ft. and width of 6 ft., and opens into the dale by means of two small exits, each of which is less than 3 feet high and wide. It is quite evident that the bones found in this cave entered it from the dale through one or other of these two openings.

At the outset of the work of excavation the passage was in no way choked with earth and stone, so that its extremity could be reached without difficulty; and the deposit containing bones was only a foot or so in thickness.

Far otherwise was it in the case of the Doveholes and Longcliffe Caves. These two had many points in common. They were both broken into accidentally during the ordinary processes of quarrying. They both were filled, or nearly filled with earth and stone, with which deposits the bones were mingled. They both exist no longer, having been quarried away. But the most important point of likeness was the fact that these deposits showed unmistakable signs of having been laid down by water. In short, it has been shown by Professor Boyd Dawkins[1] and Messrs. H. H. Arnold-Bemrose and E. T. Newton[2] that each of these caverns is an old swallow-hole.

Now, anyone who visits either of these localities to-day will be struck by the fact that each of these caves was practically on the top of a hill, whereas a swallow-hole implies a gathering-ground for water. Professor Dawkins explains that the physical conditions and the lie of the land have entirely changed owing to the denudation of masses of rock which existed at the time when the caves were being filled up. He writes:

"The drainage of their eastern slope" [*i.e.*, the eastern slope of the Yoredale Shales] "passes downward until it reaches the limestone at its base. Here it sinks into the rock through the many swallow-holes which mark the upper boundary of the Carboniferous Limestone. There are no surface-streams in the limestone in the immediate neighbourhood of the quarry, which, from its position on the divide, could not, under existing geographical conditions, receive the drainage of the range of hills to the west or from any other direction. The existence,

[1] "Pliocene Ossiferous Cavern at Doveholes," by W. Boyd Dawkins; *Quarterly Journal Geological Society*, vol. lix., 1903.

[2] "The Ossiferous Cavern at Longcliffe," by H. H. Arnold-Bemrose and E. T. Newton; *ibid.*, vol. lxi., 1905.

however, of numerous 'swallets' on the divide, as well as in other portions of the Carboniferous Limestone, at a considerable distance from the impervious Yoredale Shales covering the limestone, proves that the limestone did in ancient times receive from the surface a considerable drainage which it no longer gets. Most of these 'swallets' are now filled with clay and loam, and some, as in the case of that at Windy Knoll, near Castleton, about six miles to the north-east, contain considerable quantities of the remains of Pleistocene mammalia."

Similarly, it must be granted that where there is now a hill-top at Longcliffe, there existed, at the time when the swallow-hole was active, a valley bounded by shales, and constituting a gathering-ground for water.

The question naturally arises: What caused the bones of so many animals to be carried down into these swallow-holes? Messrs. Bemrose and Newton are very cautious on this point. After suggesting several possible solutions, they favour the conclusion (1) that there may have been an old hyæna den above the swallow-hole, and that some of the bones may have been carried by water out of it into the cavern where they were found; (2) that animals may have fallen into the hole itself, and possibly through the roof of the cavern; and, lastly, (3) that the cavern itself may have at one time served as a hyæna den. The second suggestion seems hardly probable when it is borne in mind how very few unbroken marrow-bones were found. Probably no record has been kept of the exact number of such bones. The presence of a few gnawed bones and of "over forty hyæna-coprolites," gives support to the third hypothesis; and the more or less complete stratification of the soil in which the bones were deposited makes it probable that the first one at least partly accounts for the phenomena in question.

But Professor Dawkins is much more decided about the causes of what he found at Doveholes. After calling attention to the fact that "the preponderance in the cave at Doveholes

of the remains of young, as compared with old, teeth of *Mastodon* is exactly that which is noticeable in the case of calf and adult mammoths in all hyæna dens," he proceeds:

"It may be concluded that the fragmentary remains at Doveholes were derived from a den of hyænas belonging to the Pliocene Age. It is, however, obvious that they were not introduced by those animals into the chambers where they were discovered, but that they were conveyed from a higher level into it by water. My reading of the riddle is simply that they were originally accumulated in a hyæna den open to the surface, and that afterwards they were conveyed into lower chambers, where they were protected by the limestone from the denudation which has destroyed nearly all traces of the original surface."

Having now discussed the caves generally, it is necessary to give some account of their discovery, and of the animals represented in each of them.

It is not an uncommon occurrence to find in quarries a joint, or fissure, filled with earth or clay. So that when the men, in the course of their ordinary duties, broke into the cavern at Victory Quarry, near Doveholes, no special interest seems to have been aroused, nor was it deemed surprising that large bones were embedded in the deposit which filled it. Consequently, a great number of them were thrown on the rubbish-tip and were soon buried beneath an immense accumulation of waste matter. The importance of these animal remains was first brought to light by a boy who picked up some teeth of Mastodon, and showed them to Mr. Micah Salt, of Buxton. Mr. Salt at once communicated with Professor Boyd Dawkins, who visited the cave, and, having obtained the permission of the owner of the quarry, secured all the remaining "finds."

The following is a list of the bones and teeth thus preserved:—

Machairodus crenatidens.

This rare sabre-toothed lion was represented both by teeth and by bones—namely:

3 canines (2 of them being very fragmentary),

2 upper carnassials,
1 distal end of a right tibia,
1 proximal end and shaft of a right radius,
1 fragment of the shaft of a femur.

Two of these bones bear "unmistakable marks of the teeth of hyæna."

Hyæna.

1 fragment of a left ulna of a large species, bearing teeth-marks of another animal of its own kind.

Mastodon arvernensis.

18 teeth, exclusive of fragments, as well as many broken and water-worn bones.

Elephas meridionalis.

1 much-worn fragment of a molar.

Rhinoceros etruscus.

2 fragments of water-worn molars.

Equus Stenonis.

2 upper and 1 lower molar.

Cervus.

"The Cervidae are represented at Doveholes by numerous bones, all more or less fragmentary, and therefore very difficult to determine specifically. They belong, however, to one or other of the many species of Pliocene deer, and agree more particularly with *Cervus etueriarum* of Croizet and Jobert."

With regard to the period to which these remains belong, Professor Dawkins gives his opinion as follows:—

"The mammalia of Doveholes belong therefore to the *Mastodon arvernensis* fauna of the British and Continental Pliocene strata, and are clearly defined from that of the Pleistocene age, not only by the presence of characteristic Pliocene forms, but by the absence of those which came into Europe at the beginning of the Pleistocene, such as the cave-bear, the

mammoth, the woolly rhinoceros, and the living Palæarctic species."

And, again, Professor Dawkins' own words must be quoted, when he sums up the nett result of the discovery as follows :—

"It has added one species, *Machairodus crenatidens*, to the Upper Pliocene fauna of Britain, leaving out of account *Cervus etueriarum*. It has not added to our knowledge of the distribution of Upper Pliocene land and sea, but it has confirmed the conclusions arrived at on other evidence. It is the only Pliocene cave yet discovered in Europe, and is the only evidence as yet available of the existence of the Upper Pliocene bone-caves, which, from the nature of the case, must have been as abundant in Europe as those of the succeeding Pleistocene Age."

As has already been stated, the cave at Hoe Grange Quarry, Longcliffe, was also broken into accidentally. At the place where the opening was first made there was a space left between the top of the deposit and the roof of the cave. Stalactites[1] hanging from the roof attracted the attention of a lad named Walton working in the quarry, and he crawled in to secure them. He brought out with him several bones. This led to further exploration, and soon the vast number and variety of bones and teeth attracted notice. The news of the discovery was spread throughout the locality, and before long reached Mr. H. H. Arnold-Bemrose, who at once took the matter in hand, and from that time spared neither time nor trouble in making the cave a success scientifically. Those who were associated with him in this excavation could not fail to be struck with admiration at the thoroughness and perfection of his work.

But before he came on the scene large numbers of specimens had been carried off by private collectors, to many of whom they could be of no value whatsoever. And it is regrettable that all these could not at least have been identified and catalogued. The number, however, of those secured was very great, as the following list testifies :—

[1] Watericles they are locally called.

Felis leo (Lion)	7
Felis catus (Wild Cat)	11
Hyæna crocuta (Spotted Hyæna)	667
Canis lupus (Wolf)...	5
Vulpes alopex (Fox)	1
Ursus horribilis (?) (Grisly Bear)	91
Meles taxus (Badger)	2
Vespertilio auritus (?) (Long-eared Bat)	1
Bos or *Bison*	1,855
Cervus giganteus (Irish Deer)	4
Cervus elaphus (Red Deer)	38
Cervus dama (Fallow Deer)	1,592
Capreolus caprea (Roebuck)	16
Sus scrofa (Wild Boar)	4
Rhinoceros leptorhinus	144
Elephas antiquus	1
Lepus cuniculus (Rabbit)	43
Lepus sp. (Hare)	2
Microtus glareolus (Bank Vole)	4
Microtus agrestis (?) (Field Vole)	5
Microtus amphibius (?) (Water Vole)	1
Mus sylvaticus (?) (Field Mouse)	1
Asio accipitrinus (Short-eared Owl)	2
Turdus iliacus (Redwing)	6
Erithacus rubecula (?) (Robin)	1
Rana temporaria (Frog)	30
Bufo vulgaris (Toad)	11

Thus twenty-seven species were represented, and 4,545 bones and teeth were identified. Besides these, 3,461 remained undetermined, so that altogether a total of 8,006 were secured and examined.

The most interesting discovery was the presence of fallow deer in this cave, mingled indiscriminately with other Pleistocene animals. Hitherto this species had been supposed to have

been introduced into Britain by the Romans. Its absence from other Pleistocene cave-deposits is extraordinary, but Longcliffe provided ample material for examination, and Messrs. Bemrose and Newton have sifted the evidence in a masterly manner. To quote their own words at length :—

"The deposits might have been formed at a date subsequent to Pleistocene times. That is to say, they might have been washed in from a hyæna den, or other Pleistocene deposit, and mingled with later ones. In this way the occurrence of the fallow-deer with the Pleistocene species would be accounted for. The abundant remains of what we take to be fallow-deer in nearly all parts of the bone-deposits necessitate a very careful consideration of the possibilities of these deposits being of recent origin. But the supposition that they are of recent origin would imply that the surface of land in the neighbourhood must have been sufficiently elevated above the swallow-hole to collect water to wash the remains into the cavern; and that this land has been denuded, not, indeed, since Pleistocene times, but since the redisposition of the bones in Roman or post-Roman times, if the fallow-deer was really first introduced into this country by the Romans. Such rapid denudation does not seem possible, and we do not think the supposition tenable."

In commenting upon the discoveries at Longcliffe, Dr. Boyd Dawkins declared that "the occurrence of the lower jaw of a lion's whelp was the most important recorded from any cave in this country."

Whereas the Doveholes Cave was 90 ft. long, 15 ft. high, and 4 ft. wide at its mouth, and the Longcliffe one was half as long again, that in Cales Dale[1] is only 40 ft. long, and its narrow passage only in one place is enlarged into a sufficiently spacious chamber to form a suitable den for a fair-sized animal. Not many bones were obtained from it, but many of those which were found were of special interest.

[1] "On Some Bones of the Lynx from Cales Dale, Derbyshire," by W. Storrs Fox, *Proc. Zool. Soc. of London*, *1906*, vol. i., pp. 65-72.

EXPLANATION OF PLATES I.–VIII.

Plate I.

Fig. 1. Upper canine of *Machairodus crenatidens*, nat. size: *a* = serration magnified.

Figs. 2 & 3. Left upper carnassials of *M. crenatidens*, nat. size.

Fig. 4. Left upper carnassials of *M. crenatidens*, from the Val d'Arno: nat. size.

„ 5. Upper milk-tusk of *Mastodon arvernensis*, nat. size.

Plate II.

Fig. 1. Upper canine of *Machairodus crenatidens*, nat. size.

„ 2. Outer view of lower milk-tusk of *Mastodon arvernensis*, nat. size.

„ 3. Outer view of upper milk-tusk of *M. arvernensis*, nat. size.

„ 4. Outer view of upper milk-tusk of *M. arvernensis*, nat. size.

„ 5. Lower milk-molar 3 of *M. arvernensis*, from the Crag of Norfolk: nat. size.

Palte III.

Fig. 1. Last upper milk-molar of *Mastodon arvernensis*, unworn, nat. size.

„ 2. Last upper milk-molar of *M. arvernensis*, worn, nat. size. (*d.* = talon.)

„ 3. Lower milk-molar of *M. arvernensis*, nat. size.

„ 4. Section of molar of *Elephas meridionalis*, nat. size. (*a* = enamel; *b* = dentine; *c* = cement.)

Plate IV.

Fig. 1. Tibia of *Machairodus crenatidens*, $\frac{1}{2}$ nat. size. (*a*, *a* = tooth-marks.)

„ 2. Left lower true molar 2 of *Mastodon arvernensis*, $\frac{1}{2}$ nat. size. (*a* = ridges; *b* = secondary cusps; *c* = valleys; *d* = talon.)

„ 3. Humerus of *Mastodon arvernensis (?)*, gnawed by hyæna: $\frac{1}{2}$ nat. size.

„ 4. Femur of *Machairodus crenatidens*, gnawed by hyæna: $\frac{1}{2}$ nat. size.

PLATE V.

Figs. 1, 2 & 3. Upper molar of *Equus Stenonis*, nat. size.

,, 4, 5 & 6. Upper molar of *E. caballus*, from the Pleistocene of Creswell Crags, nat. size. (*a* = columella.)

PLATE VI.

Fig. 1. View of the cavern soon after the work was commenced, showing the wooden door at the entrance, 27 feet north-north-west of the place where the men first broke in. The rock on the left-hand side had been quarried before the cavern was discovered. (From a photograph taken by Mr. W. Walker, of Buxton.)

,, 2. A more general view of the quarry, showing the position of the cavern. (From a photograph taken by Mr. Arnold-Bemrose.)

PLATE VII.

[All the figures are of the natural size, and are reproduced from photographs.]

Fig. 1. *Felis leo:* left ramus of the lower jaw, with milk-teeth.

,, 2. *Felis catus:* left femur, from the front.

,, 3. *Felis catus:* right humerus, distal portion, from the front.

,, 4. *Ursus horribilis (?):* last lower molar.

Figs. 5 & 5a. *Elephas antiquus:* half milk-molar 3, side- and end-views.

Fig. 6. *Cervus dama:* three true molars of the left side.

PLATE VIII.

[All the figures are half the natural size, and are reproduced from photographs.]

Fig. 1. *Cervus giganteus:* metacarpal.

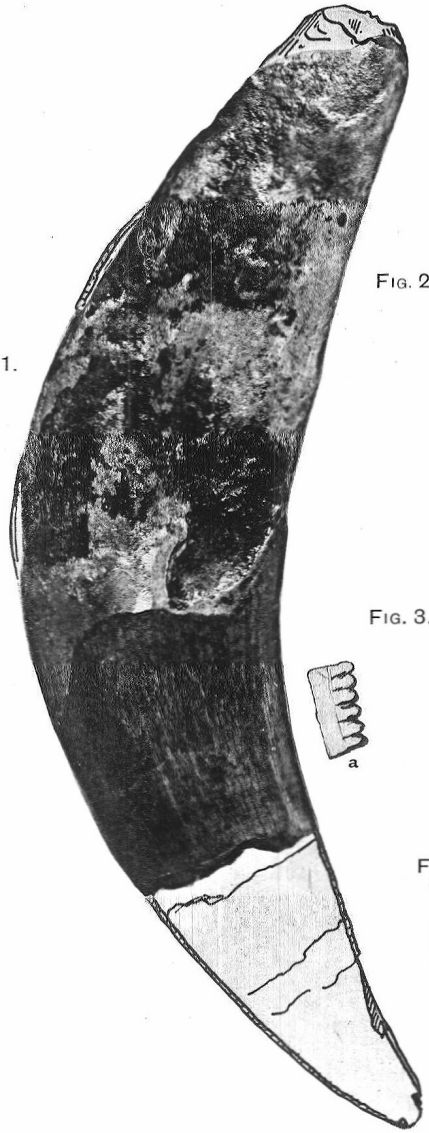
,, 2. *Cervus elaphus:* metacarpal.

,, 3. *Cervus dama:* metacarpal.

,, 4. *Capreolus caprea:* metacarpal.

,, 5. *Cervus giganteus:* astragalus.

FIG. 1.



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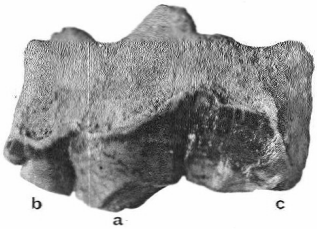

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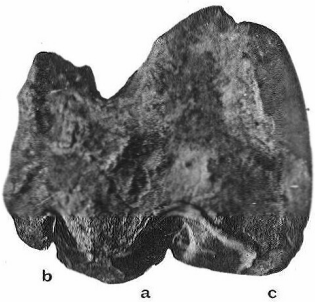

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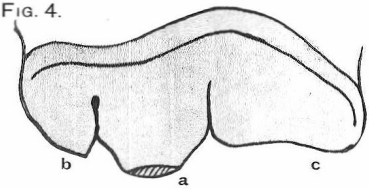

FIG. 5.

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MACHAIRODUS CRENATIDENS AND MASTODON ARVERNENSIS.
From Doveholes Cavern.

FIG. 4.

FIG. 3.

FIG. 1.

FIG. 2.

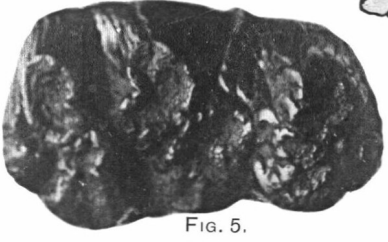

FIG. 5.

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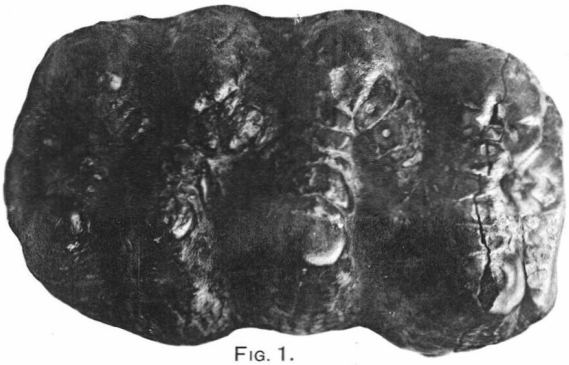
MACHAIRODUS CRENATIDENS AND MASTODON ARVERNENSIS.

From Doveholes Cavern.



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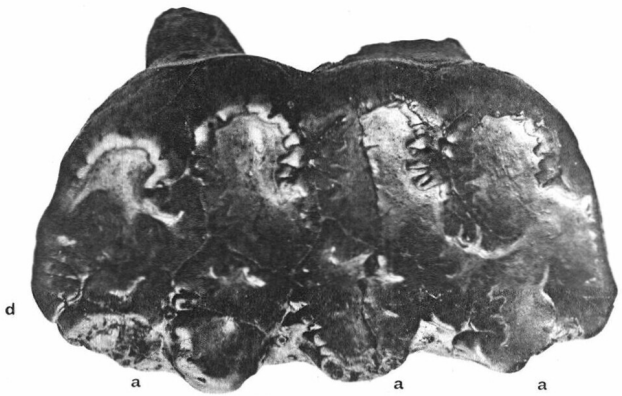

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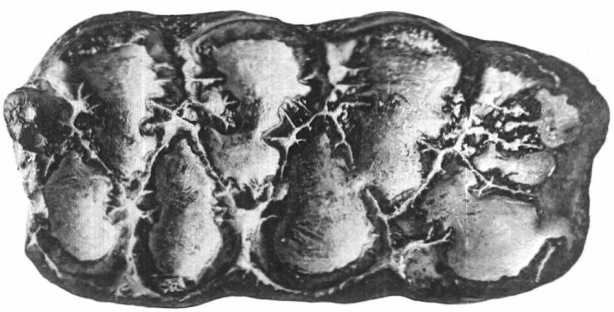

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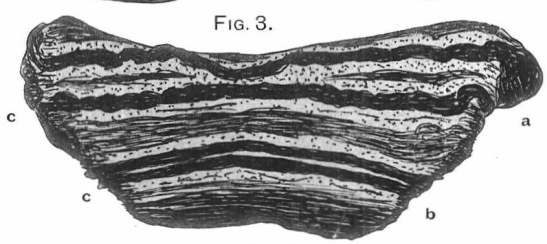

FIG. 4.

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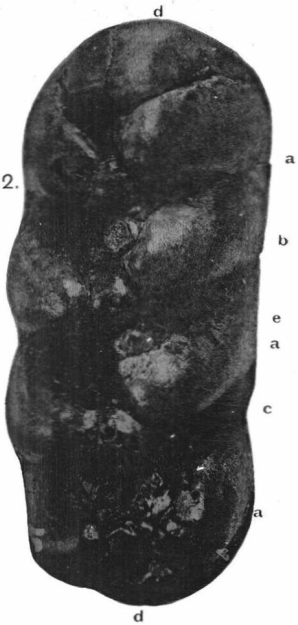
MASTODON ARVERNENSIS AND ELEPHAS MERIDIONALIS.
From Doveholes Cavern.

FIG. 2.



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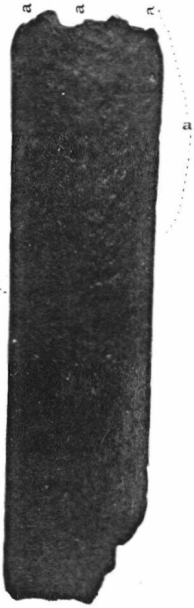

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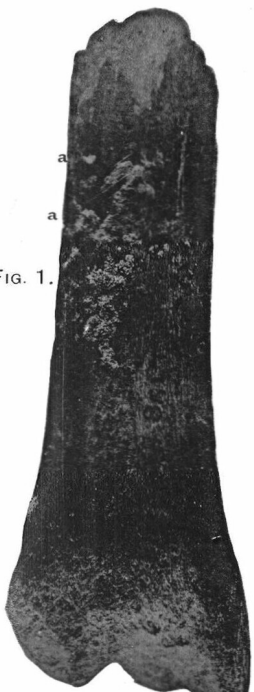

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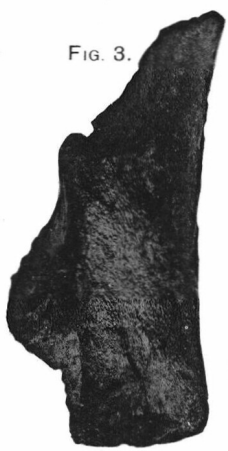

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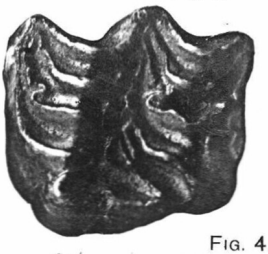
MACHAIRODUS CRENATIDENS AND MASTODON ARVERNENSIS.
From Doveholes Cavern.

a FIG. 1.



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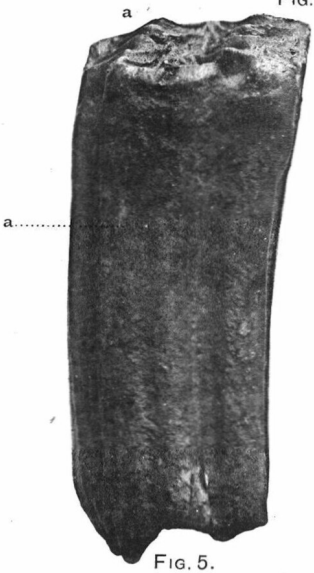

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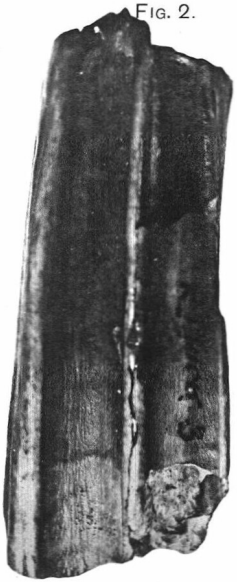

FIG. 3.

FIG. 6.

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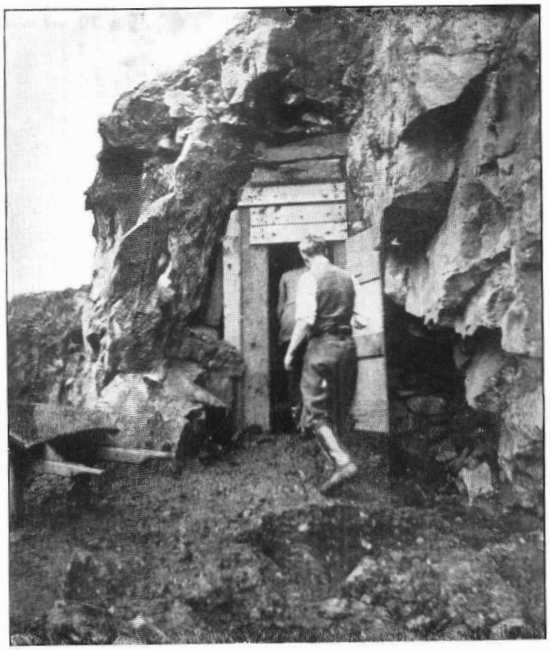
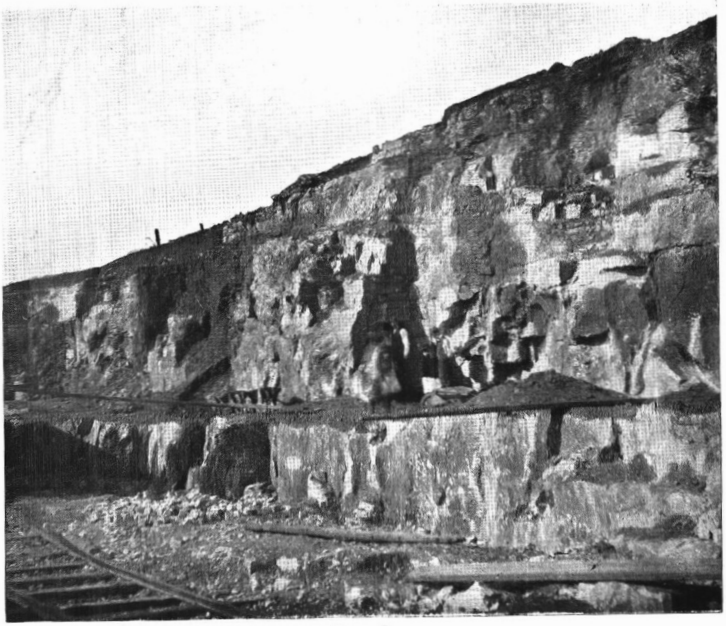
EQUUS STENONIS AND EQUUS CABALLUS.

From Doveholes Cavern.

HOE GRANGE CAVERN, LOOKING N.N.W.



W. Walker, Photo. FIG. 1.



H. A. B., Photo. FIG. 2

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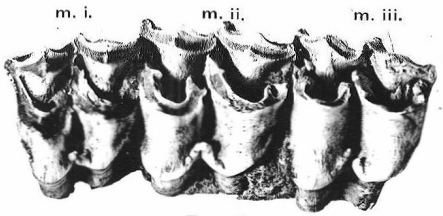
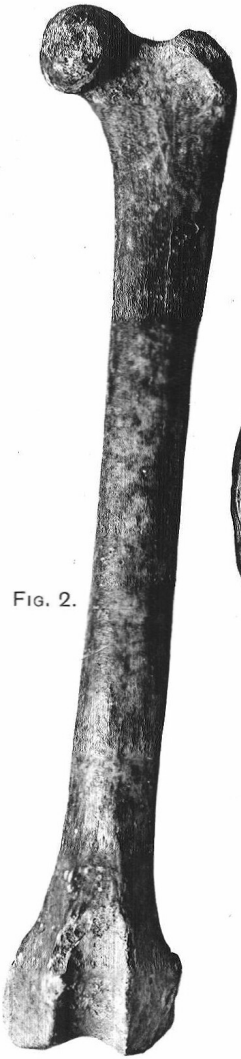


FIG. 6.

FIG. 5A.

FIG. 4.



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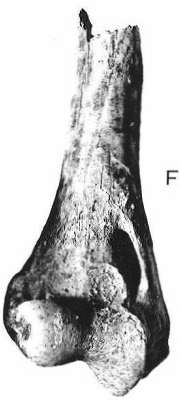

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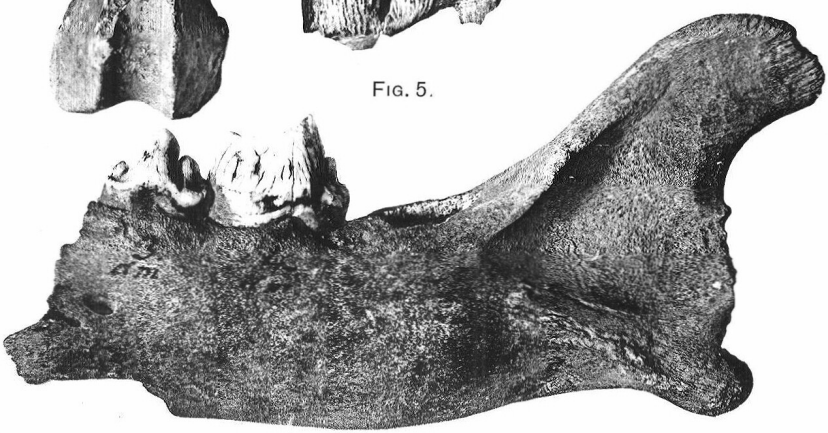

FIG. 1.

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MAMMALIAN BONES FROM HOE GRANGE CAVERN.

FIG. 1.

FIG. 2.

FIG. 5.

FIG. 3.

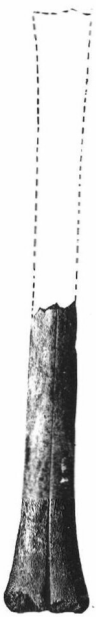

FIG. 4.

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CERVINE BONES FROM HOE GRANGE CAVERN.

About 1894 Dr. Melland, of Manchester, then a student at Owens College, entered the cave and carried off one or more bones, which he presented to Professor Boyd Dawkins, who identified them as belonging to *Lynx*. Up to that time bones of this species had only twice been found in Britain. In 1866 part of a skull and the right ramus of the lower jaw of the *Lynx borealis* were unearthed in Pleasley Vale,[1] on the borders of Derbyshire and Nottinghamshire, and are now in the Nottingham University Museum. And about fourteen years later the late Mr. James Backhouse, of York, found a humerus and metatarsal of the same species in Teesdale.[2]

There appears to be no sort of record of Dr. Melland's find, and the cave was left undisturbed again until 1897. In the spring of that year all the contents of the chamber, or den, were removed. The remains of *Lynx* then found were as follows :—

1 right ramus of the lower jaw, with its teeth ;
1 right upper carnassial tooth ;
1 right premaxilla, containing its 3 incisors ;
3 canines ;
1 humerus—the shaft and distal end ;
1 ulna—proximal end only ;
1 axis vertebra ;
1 left os innominatum—almost perfect ;
1 right os innominatum—a fragment, and evidently from a different individual ;
1 left femur—shaft and proximal end ;
1 left femur—the head only ;
5 tarsal bones ;
6 metapodials ;
11 phalanges, including a terminal one.

These, altogether make up a total of thirty-five specimens as compared with four only which had hitherto been recorded.

[1] "British Pleistocene Mammalia," part iii., pp. 172-176 (Palæontographical Soc., vol. for 1868).

[2] *Geological Magazine*, vol. for 1880, pp. 346-348.

The other animals represented were: Wild cat, fox, dog (or wolf), badger, hare, rabbit, water vole, bank vole, sheep, goat, and ox; also fowl (possibly pheasant), grouse, raven, jackdaw, kestrel, common gull, toad, and frog.

Such little evidence as is given by this cave supports the view that the Lynx lived in Britain in Prehistoric times, in association with animals which still exist in the island at the present day.

In conclusion, it may be well to call attention to the fact that other caves in the county await the necessary funds for working them; and that they will probably disclose facts interesting not only to the palæontologist, but also to the antiquarian.

The Geological Society has kindly permitted the use of the following plates to illustrate this article.