VII.

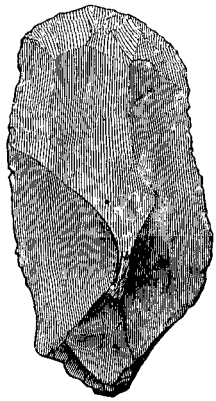
ON HUMAN AND ANIMAL REMAINS FOUND IN CAVES AT OBAN, ARGYLLSHIRE. By Professor Sir WILLIAM TURNER, D.C.L., F.R.S., F.S.A. Scot.

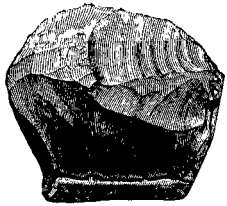
Within my recollection four caves have been opened into in the cliff which overhangs that part of the town of Oban which is built on the ancient raised sea beach. Evidence of human occupation at some previous distant period was obtained, and human and animal bones, with objects worked by man, were discovered. As specimens from each of these caves have been sent to me I propose to give an account of my examination of the remains. It is well to give to each cave a descriptive name.

The Mackay Cave.—This cave was exposed in 1869 by workmen in the employ of Mr John Mackay, who were quarrying for building purposes the north-west face of the cliff, situated at the north end of Oban Bay, near Burn Bank House, at the corner where Nursery Road now enters Strathaven Terrace. I visited the cave in the autumn of that year, when Mr Mackay pointed out to me that the cave consisted of an entrance passage 4 feet high and 9 feet long, and of a chamber 11 feet high and about the same in depth. The passage sloped from the entrance down to the floor of the chamber, which was thus on a lower plane than the mouth. The mouth was closed by an embankment of earth, 8 to 9 feet thick, in which beech trees were growing; none of which had attained much size. It had probably slipped down from the cliff above.

A chink wider below, but which higher up was not larger than would admit the blade of a knife, was in the roof of the cave. The walls were in places covered by a white calcareous deposit from one to two inches thick. The floor of the cave, which was formed of the rock, was covered by about 3 feet of earth, in which bones and other objects were found. Some of the objects were at the surface of the layer of earth, others were in its substance, but no definite stratification was recognised.

In 1871 I gave a short account of the cave and exhibited its contents at the meeting of the British Association in Edinburgh.[1] A number of flint nodules and flakes, with two worked implements, were found, which





Figs. 1, 2. Scraper and Scraper-shaped Knife of Flint.

I recently submitted to Dr Joseph Anderson, who has kindly given me the following note on their characters.

"Scraper of flint (fig. 1), $2\frac{1}{8}$ inches in length by 1 inch in breadth across the flat face, and $\frac{1}{4}$ inch in thickness, increasing slightly towards the butt end, which shows part of the bulb of percussion on its flat face. The rounded nose of the scraper is carefully bevelled, and shows marks of use, and probably of re-touching to bring up the blunted edge.

[1] Report of the Edinburgh Meeting, 1871, *Transactions of Sections*, p. 160. The contents of this cave are referred to in an excellent paper, "On a Cave at Borness, Kirkcudbrightshire," by Messrs Corrie, Bruce Clarke, and Hunt, *Proc. Soc. Antiq. Scot.*, vol. x. p. 476, 1874.

"Scraper-formed knife of flint (fig. 2), about 1 inch square, the rounded cutting edge carefully dressed to unusual sharpness, and the butt end showing the bulb of percussion on the flat face.

"Triangular flake of flint, 2 inches in length by $\frac{3}{4}$ inch in greatest breadth near the butt end, somewhat concave on the flat side and with a corresponding convexity in the direction of the length of the ridged side. Both edges show very distinct traces of use as a side-scraper.

"Thirteen flakes and chips of various sizes, none, however, exceeding 2 inches in length, or showing secondary working."

Limpet shells were also present; also fragments of blackened and calcined bones, which were too small to permit of identification. Bones or teeth of the following mammals have been recognised: roe and red deer, dog, fox, otter, ox, pinemarten, goat, hare, water vole. The long bones of the larger mammals were broken and the marrow cavity exposed. Many of the fragments had pointed ends and sharp margins, but they did not show rubbed or smooth edges or surfaces, such as they would have acquired if they had been in use as tools. Some of the bones were scratched and abraded on the surface, as if they had been gnawed. Probably the bones had been broken to extract the marrow, but none of the human bones had been so treated. A few bones of birds were also present.

Two human skeletons were obtained. They were forwarded to me by steamer, which, unfortunately, was wrecked on the voyage to Glasgow. As the box was submerged in the salt water for some time before it was recovered, the skulls were so softened and injured that I was unable to obtain a proper restoration of the crania. Many of the other bones of the skeletons were also broken.

The skulls were those of an adult man and a child. In the child's skull the milk molars, though much worn, were in place, and the upper and lower first permanent molars had erupted; the age was probably about eight. The skull presented, in the thickness and smoothness of the bones of the vault, and in the comparative simplicity of the sutures, the characters of a child of about that age. The frontal suture had not ossified; some small Wormian bones were in the lambdoidal suture, and an epipteric bone was present in each pterion. The dimensions, so far as the skull admitted of measurement, are given in the following

Table. It will be seen that the cephalic index was 77·8, so that the skull was mesaticephalic.

OBAN CAVES.

	MacArthur Cave.			Mackay Cave.		Distillery Cave.		
Collection,	A.	B.	C.	...	...	...	...	...
Age,	Adult.	Adult.	Adult.	Child.	Adult.	Adult.	Adult.	...
Sex,	M.	M.	F (?).	?	M.	M.	F.	...
Glabello-occipital length,	183	205	...	171	...	...	...	...
Basi-bregmatic height,	139	...	...	...	...	..	...	...
Vertical Index,	*76*	...	...	...	...	...	...	...
Minimum frontal diameter,	99	102	...	97	...	...	...	...
Stephanic diameter,	111	121	...	115	...	..	...	...
Asterionic diameter,	...	115	...	103	...	...	...	...
Greatest parieto-squamous breadth,	138 ap.	144	...	133	...	...	...	...
Cephalic Index,	*75·4* ap.	*70·2*	...	*77·8*	...	...	...	...
Horizontal circumference,	520	564	...	490	...	...	...	...
Frontal longitudinal arc,	127	140	...	242	...	...	...	...
Parietal ,, ,,	133	135	...		...	...	...	...
Occipital ,, ,,	112	...	...	...	...	...	...	...
Total ,, ,,	372	..	...	...	...	...	...	...
Vertical transverse arc,	...	316	...	285	...	...	...	...
Length of foramen magnum,	34	...	...	34	...	...	...	...
Basi-nasal length,	103	...	...	...	...	...	...	...
Basi-alveolar length,	97	...	...	...	...	...	...	...
Gnathic Index,	*94·2*	...	...	...	...	...	...	...
Intermalar breadth,	...	123	...	...	...	...	...	...
Nasio-mental length,	114	...	...	...	...	...	...	...
Nasio-alveolar length,	67	...	...	...	...	...	...	...
Nasal height,	48	...	...	...	...	..	...	...
Nasal width,	23	...	...	...	23	...	...	...
Nasal Index,	*47·9*	...	...	...	...	...	...	...
Orbital width,	40	42	...	...	...	...	...	...
Orbital height,	33	31	...	...	...	..	...	...
Orbital Index,	*82·5*	*73·8*	...	...	...	...	...	...
Palato-maxillary length,	53	...	...	...	53	...	...	...
Palato-maxillary breadth,	60	...	...	...	59	...	...	...
Palato-maxillary Index,	*113·2*	...	...	...	*111·3*	...	...	...
Lower jaw. Symphysial height,	30	35	30	...	29	27	30	30
Lower jaw. Coronoid ,,	...	66	...	...	65	61	61	...
Lower jaw. Condyloid ,,	60	...	60	...	67	67	...	52
Lower jaw. Gonio-symphysial length,	85	91	80	...	94	90	...	83
Lower jaw. Inter-gonial width,	91	96	92	...	107	101	...	...
Lower jaw. Breadth of ascending ramus,	35	44	32	...	40	40	...	42

The adult skull was much broken, and the bones had softened during the immersion in salt water, so that many parts of the vault had crumbled away, and could not be restored to permit of the length, breadth and height being taken. The masculine character of the skull was determined by the prominence of the left supraorbital ridge in the part of the frontal bone which had been preserved, by the projection of the inion and occipital and temporal curved lines, and by the size of the lower jaw. The man had apparently been in the prime of life, as the teeth were only partially worn on the surface of the crown and there was no decay. The palate was highly arched.

With the exception of the right tibia, all the long bones of the limbs were imperfect. Sufficient of the left tibia had been preserved to show that it resembled in form the right bone. They were both examples of platyknemia, *i.e.*, the shaft laterally flattened and with a narrow posterior surface. In the right tibia, the measurements being taken in the plane of the nutrient foramen, the index of platyknemia was 63·6, in the left 65·6, figures which closely approximate to the mean index of the tibia from neolithic interments in France. In the right tibia the antero-posterior curve of the external condylar articular surface was slightly convex. Retroversion of the head of the tibia, such as has been seen in neolithic skeletons in France and Belgium, was not observed. The articular surface for the astragalus was prolonged for a short distance on to the front of the lower end of the tibia. Both the right and the left astragalus had a smooth, apparently articular area, for the front of the lower end of the tibia, on the upper surface between the scaphoidal and usual tibial articular surfaces, such as has been described by Professors Arthur Thomson and Havelock Charles in races who assume a squatting attitude when at rest.[1]

The right femur had lost the head, and the left the condyloid extremity. The shafts in both were preserved and showed a very interesting modification in shape. In my Report on the skeletons collected by H.M.S. "Challenger," published in 1886, I called attention[2] to a peculiar flattening of the upper third of the anterior surface of the

[1] *Journal of Anat. and Phys.*, July 1889, Jan. 1890, Oct. 1893, April 1894.

[2] *Report of Challenger Expedition*, part xlvii. p. 97.

shaft in five Maori thigh bones, in femora from Oahu, one of the Sandwich Islands, and in some Lapp and Esquimaux skeletons, and I stated that an infra-trochanteric ridge, which projected outwards, extended downwards from below the outer side of the great trochanter. I also referred to these femora from the Oban cave as possessing similar characters, and stated that the external infra-trochanteric ridge was distinct from, and in front of the gluteal ridge which leads from the great trochanter to the linea aspera. The antero-posterior flattening widens the bone transversely, and obliterates the outer surface of the shaft in the upper third or fourth, so that the bone loses its prismatic form in this region. The external infra-trochanteric ridge gives a defined outer border immediately in front of the gluteal ridge, and the inner border is also more prominent than in an ordinary femur. Since the publication of my Report several Maori femora have been added to the collection in the University Museum in which closely identical characters can be seen. In 1893 my friend, Professor J. H. Scott of the University of Otago, gave an admirable account[1] of the skeleton of the New Zealand Maoris and the Morioris of the Chatham Islands, and recognised this character as common to the femora in both sets of skeletons. In the same year Dr Rudolf Martin of Zurich published a description of the skeletons of the people of Tierra del Fuego,[2] in which he distinguished the same flattening of the shaft of the thigh bone.

The memoir which has, however, the greatest interest in connection with the shape of the femur in the cave dwellers was published in 1891 by Dr Manouvrier of Paris.[3] He describes in it femora from the neolithic burials at Crécy-en-Brie, Nanteuil-le-Houdouin, and other dolmens, and a number of ancient femora from the Canary Islands, which showed the antero-posterior flattening in a very marked form, and to this condition he has given the name platymery (flat femur). He has also proposed a method of obtaining a numerical expression

[1] *Transactions of New Zealand Institute*, 1893, vol. xxvi.

[2] *Archiv für Anthropologie*, 1893, vol. xxii. p. 155.

[3] *La Platymerie, Extrait du Congrès international d'Anthrop. et d'Archéologie préhistoriques*, Paris, 1891. Also *Étude sur les Variations morphologiques du corps du Fémur*, Paris, 1893.

of the extent which this flattening has reached. He takes the antero-posterior diameter of the shaft where it is the least, *i.e.*, 3, 4, 5, or 6 cm., as the case may be, from the small trochanter, and then he measures the transverse diameter at the same plane. If the transverse diameter be regarded as equal 100, the relation of the antero-posterior to it may be obtained by the following formula :—

$$\frac{\text{ant.-post. di.} \times 100}{\text{transverse di.}}.$$

The product is the index of platymery.

The mean index of modern Parisians has been found by Manouvrier to lie between 80 and 100, whilst the neolithic femora of Nanteuil-le-Houdouin were 65·8, those of Crécy-en-Brie were as low as 56·4, whilst some of the ancient Canary Islanders were from 58·8 to 64·9. In the specimens from the Mackay cave at Oban, the shaft of the right femur had an antero-posterior diameter 20 mm.; a transverse diameter 34 mm.; whilst in the left bone the antero-posterior diameter was 22 mm. and the transverse was 39 mm., which gave a platymeric index to the right thigh bone 58·8 and to the left 56·4. These figures are sufficient to show that the platymeria was very strongly marked. Professor J. H. Scott gives 64·3 as the mean index in fifty Maori femora which he has measured, and the range of variation is from 81·3 to 54·8. Dr Rudolf Martin states that the mean index of platymery in the people of Tierra del Fuego was 66·9. In both the femora from the Oban cave, the linea aspera was well marked in the middle third of the shaft of the bone.

There can, I think, be little doubt that the flattening of the shaft of the femur in its upper part must have some relation to the attachment of the muscles in this region and to the traction which, in connection with their use, they would exercise on the bone in its plastic and growing state. At one time I was disposed to associate it[1] with the squatting attitude, a position which, as is well known, many savages assume when resting, and to the tension of the gluteus maximus in that position.

[1] "On Variability in Human Structure," *Journ. Anat. and Phys.*, vol. xxi. p. 488, 1887.

Further observations on the shape of the femur in some other races who habitually squat when at rest have, however, satisfied me that a platymeric femur is not necessarily associated with the squatting attitude. Dr Manouvrier attributes this configuration to the development of the fibres of the vasti and crureus muscles attached to this part of the bone, which are brought into especial activity in walking over rough ground, in ascending heights and in hunting. The association of platyknemia, a form of tibia also due to muscular action, with platymery, to which Dr Manouvrier has called attention, is corroborated by this skeleton.

Owing to both femora being incomplete, I can only obtain measurements to give an approximate estimate of the length of the bone (p. 435). The right tibia measured to the tip of the malleolus 368 mm. and to the astragalar articular surface 357 mm.

The right humerus was almost complete, and from the head to the lowest part of the trochlea was 303 mm. long. The deltoid and other muscular ridges were strong, and indicated a person of good muscular development.

Gas Works Cave.—Many years ago, in quarrying away the cliff in proximity to the gas works, for the purpose of providing storage for coals, a cave was exposed which is said to have contained human skeletons, which apparently were not kept. In the summer of 1877 more of the rock was removed for the purpose of enlarging the storage, when additional remains were found. In passing through Oban in the autumn of that year I saw the cave and arranged to have sent to me such objects as had been preserved.[1] I was told that enormous numbers of shells had been exposed during the excavation. The box which I received contained shells of the limpet, cockle, and oyster, a flint chip and fragments of primitive pottery. Dr Anderson has kindly noted the characters of the pottery.

"*Pottery.*—One fragment of the lip of a large vessel, shaped like a cinerary urn without an external overhanging rim, and showing no

[1] In the cliff below the Free Church a cave existed at that time, which was said to be similar to the one exposed near the gas works. A fissure was present in the roof. I did not learn whether remains had been found in it.

ornamentation. The fragment measures only $2\frac{1}{2}$ inches in the chord of the arc of the lip, which is modelled with an interior bevel extending for $\frac{3}{4}$ inch under the brim and made apparently by the thumb. Extending the arc of the chord shows a diameter of 8 to 9 inches for the mouth of the vessel, and this would give probably a height of from 10 to 12 inches. The clay is of the usual coarsely made paste, much mixed with broken stones, and shows a thickness of $\frac{5}{8}$ inch immediately under the bevel. Two other fragments which join on to this one give fully 2 inches in depth of the side of the vessel and show that it had very little vertical curvature and must have been almost flower-pot shaped.

"Another fragment, about 2 inches square and not nearly so dark in colour, is of a somewhat finer paste, and may have belonged to a different vessel of the same character.

"They both resemble in all their characteristics the cinerary urns of the late neolithic period and of the Bronze Age, of which there are so many examples in the Museum."

Animal remains, consisting of teeth of pig, goat, ox, and red deer, were recognised, also the spur of a cock. A few bones of the deer and ox were also present; those of the limbs had been broken and the marrow cavities exposed.

No portion of a human skull had been preserved, but fragments of some of the long bones of the limbs were sent to me. Obviously from their size they formed parts of a man's skeleton. They were, however, so fragmentary that no light was thrown on the character of the skeleton. The shafts of the thigh bones were the least injured, but they could not be restored sufficiently to enable me to determine to what extent there had been antero-posterior flattening of the upper part of the shaft; though from what had been preserved it did not seem as if any marked platymery had existed. The shafts of the tibiæ could not be restored.

Distillery Cave.—In August 1890, whilst workmen in the employ of Mr J. Walter Higgin were removing the rock for the purpose of obtaining a site for a new warehouse in connection with the Oban Distillery a cave in the face of the rock behind the distillery was disclosed.

am indebted to Mr Higgin for the following particulars. In removing some soil and débris from under the face of the cliff many cart loads of shells were exposed and taken away. They are believed to have been either on the floor of the cave, when it was more extensive than it now is, or at the entrance. The cave as it now exists was not exposed until after the excavation and rock blasting were completed; when Mr Higgin's attention was called to a number of shells clinging, as it seemed, to the face of the rock, and which he directed to be removed. The workmen proceeded to clear the shells away, when the cave was disclosed. Shortly afterwards he was told that some bones had been found, some at the bottom and end of the cave, others in the shell-bed which the workmen had cast out. It was too late, however, to recognise if there had been any stratification in the earth and beds of shells, or what had been the exact position of the majority of the bones, some of which, however, still remained at the bottom of the deep end of the cave. The cave was situated about 40 feet above the present sea level. Its mouth was 9 feet wide and 10 feet high, and faced to the N.N.W.; its depth was 12 feet; at the back the height was 4 feet; and the width about the same. Mr Higgin instructed the remains found in the cave to be collected and forwarded to the Society of Antiquaries, by whom they have been sent to me for examination.

The boxes contained a number of shells consisting of oyster, common whelk, limpet, patella, solen, *Venus verrucosa* and *Aixinæa glycimeris*. Several shells of the limpet presented a peculiar appearance. The apex and a large part of the body of the shell had been removed, leaving only the ring-like base. It is difficult to say if this condition of the shells dates from the occupancy of the cave, or has been occasioned by subsequent disintegration. If the former, possibly the rings had been strung together by way of ornament.

Flints and bone implements were also procured, the characters of which are described by Dr Anderson in the accompanying note.

"*Stone.*—Part of a nodule of cherty flint, $1\frac{1}{4}$ inch by $\frac{3}{4}$ inch, having the naturally rounded surface of the nodule on one side and the split surface showing the bulb of percussion on the other, but no secondary working.

"Small flake of flint of triangular section, $1\frac{1}{8}$ inch in length and nearly $\frac{1}{4}$ of an inch in its greatest thickness, but with no secondary working.

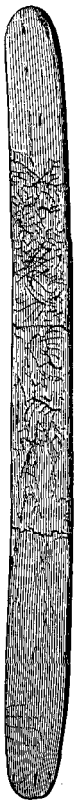


Fig. 3. Tool of Bone. ($\frac{2}{3}$.)

Fig 4. Borer of Bone. ($\frac{1}{1}$.)

"Three small, thin and irregularly shaped chips of flint, varying from $\frac{1}{2}$ an inch to $\frac{3}{4}$ of an inch in diameter, the edges unworked.

"*Bone.*—A long, narrow, spatulate-ended tool of deer-horn (fig. 3), 6 inches in length, barely $\frac{1}{2}$ an inch in breadth throughout, and scarcely

more than $\frac{3}{16}$ of an inch in greatest thickness, the ends rounded off and worn by attrition, as if in rubbing against some rough substance, the middle part smoothed and somewhat polished on the one surface showing the dense exterior table of the horn, while the other surface shows the cancellated structure of the interior. It closely resembles a modelling tool such as is used for modelling in soft clay, and that this was a possible use is shown by the fact that fragments of two clay vessels were found in the neighbouring cave behind the gas works.

"Borer of bone (fig. 4), $2\frac{1}{2}$ inches in length, and nearly $\frac{1}{2}$ an inch in greatest diameter at the butt end, tapering to quite a sharp point, polished and marked on the surface near the point with slight striations resulting from use. Such a tool may have been employed to bore holes in hides, either for the purpose of sewing the skins together, or for fastenings of any sort, by means of sinews passed through the holes."

Only a small number of animal bones had been forwarded from this cave. Amongst them was a fragment of the lower jaw of a young seal (*Phoca vitulina*), the lower jaw with teeth of a young ruminant animal, the tooth of a pig, bones of small birds, and vertebræ of fish.

The human remains from the Distillery cave gave evidence by the presence of eight lower jaws of no fewer than eight persons. Three of these, judging from the dentition, were adults, two of whom were probably men and one a woman. In a fourth all the permanent teeth were present in the lower jaw except the wisdom, which had not erupted, and the age was probably about twenty-four. In three others the first permanent molars had erupted, but the milk molars had not been shed. In the eighth specimen, which consisted of little more than the symphysial region, only the milk sockets were seen. In the adult jaws the crowns of the teeth were flattened by use, but not decayed; in one, however, the sockets of the first and second molars were partially absorbed, and the teeth had been shed possibly from decay. Measurements of the three largest jaws are given in the Table (page 413).

The presence of several skeletons in the cave, some of which were immature, was also shown by the limb bones and vertebræ which reached me. Notwithstanding that the skeletons were very imperfect and the majority of the bones broken, I recognised four left femora at different

stages of growth, in which the epiphyses were ununited: the smallest of these was a child apparently between one and two years of age, and to whom the youngest lower jaw had doubtless belonged. The tibiæ and other long bones, the clavicles, innominate bones, scapulæ, and vertebræ had also immature representatives.

Unfortunately the skulls had all been so much broken that only fragments reached me, and these were so imperfect that I could not restore a single cranium; but the frontal and larger part of the left parietal of a child from eight to ten years of age had been preserved. In none of the adults had the frontal bone been recovered, so that I can say nothing of the arch of the forehead, or of the amount of projection of the glabella. It is obvious from the remains that some of the bones had belonged to young skulls, others to adults.

As regards the long bones one adult left tibia was sufficiently perfect in the upper third to enable me to recognise the characters of the head and of the shaft immediately below it. The head was 81 mm. in transverse diameter across the articular areas, whilst the antero-posterior diameter in the middle of the head was 51 mm. The head was not retroverted, neither was the external articular surface convex antero-posteriorly in any special degree. The index of platyknemia in the plane of the nutrient foramen was 70·2. In an immature tibia which, without the epiphyses, was 274 mm. long, the index of platyknemia was 68. Only one adult femur had the shaft sufficiently entire to enable me to determine the shape of the upper third. Compared with the corresponding left bone from the Mackay cave neither the antero-posterior flattening nor the external infra-trochanteric ridge was so strongly marked. The antero-posterior diameter was 21 mm. and the transverse 30 mm.; the index of platymery was 70. Four imperfect adult humeri had well-marked muscular ridges. The bones of the left forearm of an adult were entire. Their length was as follows: radius to tip of styloid process, 223 mm.; ulna to tip of styloid, 251 mm.; another left radius was 231 mm. long.

A left os calcis had a strong peroneal tubercle on its outer surface, and a deep concavity with very prominent sustentaculum on the inner surface. The superior articular surface for the astragalus was divided

into three quite distinct areas by intermediate non-articular bone. In each of two astragali, a smooth, apparently articular, area was present on the upper surface behind the scaphoid convexity, similar to that referred to in the corresponding bones from the Mackay cave, as associated with the acute flexure which is assumed by the ankle-joint in the squatting posture. The lower ends of the corresponding tibiæ had not been preserved.

The MacArthur Cave.—In February 1895 I received from the Society of Antiquaries three boxes, which contained human and other bones and shells collected from the cave at Oban, which Dr Anderson has described in the present volume of the *Proceedings of the Society*, p. 211.

I entrusted the animal remains for identification to my assistant, Mr James Simpson, who reports as follows:—"(1) In the upper layer of black earth were bones or teeth of the red deer and of a species of ox; also of the pig, dog, and badger (*Meles taxus*). Some bones of birds, fish, claws of crabs, and shells of patella, solen, and whelk were recognised. (2) In the shell bed underneath the black earth, in addition to bones of badger, red deer, and ox, a part of the jaw of a roe deer (*C. capreolus*) was recognised; also bones of small birds and of fish, claws of crabs, and shells of patella, pecten, and solen. (3) In the deeper shell bed and pockets under the gravel below No. 2 were portions of two frontal bones of an ox, probably *Bos longifrons*, antlers, and bones of red deer, one of which had been a large stag, the burr being 80 mm. (about 3 inches) in diameter, bones of roe deer, the humerus of an otter (*Lutra vulgaris*), the humerus of a cat, the lower jaw of a young pig, the upper jaw of a badger; also bones of small birds, jaw and vertebræ, of fish, crabs' claws, and shells of molluscs. Some of the bones were blackened and calcined from the action of fire."

The human bones in box No. 1 were obtained, either on the surface of, or in the black earth and débris which covered the floor of the cave. They consisted of two adult skulls, unfortunately not quite perfect. The one most damaged, A of this description, was found on the surface of the black earth immediately below the air shaft which

communicated with the external atmosphere. The other skull, B, was at the bottom of the black earth, where it rested on the shell bed. Three lower jaws, which, judging from the dentition, were adult, were found in proximity to the skulls. Numerous separate vertebræ, a sternum, and several ribs were also in the box. Three axis vertebræ were distinguished. A number of limb bones, most of which were in fragments, had been obtained: portions of two scapulæ, four clavicles, six humeri, six ulnæ, three radii, several metacarpals and phalanges, a fragment of an ilium, portions of three femora, one tibia, three fibulæ, a patella, four calcanea, two astragali, and some of the smaller tarsal bones were present.

Box No. 2 contained human remains obtained in the shell bed below the layer of black earth. They consisted of eight vertebræ, a first rib, part of a scapula, some metacarpals, left os calcis, right astragalus, the upper end of a right and the lower end of a left femur.

Box No. 3 contained "bones from the shell beds and pockets in and under a layer of gravel, situated below No. 2." The human remains consisted of two dorsal vertebræ, a patella, left astragalus, fifth metatarsal and two metacarpal bones. In an envelope marked "upper section, S.E. corner," was an adult axis vertebra.

The contents of the boxes gave ample evidence of the remains of three human skeletons, but from the presence of four axis vertebræ it is clear that at least four persons had been entombed in the cave. That three of the individuals were adults is certain from the dentition in the lower jaws, and by the bones of the limbs being fully ossified. One of the axis vertebræ was much smaller than the other three, although so much broken that its external measurements could not be taken; the "ring" was only 19 mm. in antero-posterior by 22 mm. in transverse diameter, as compared with 24 and 26 mm. in one of the adult bones. Possibly it was the second vertebra of a child, but no other bones of a child were recognised.

That one of the adults was a man is proved by the size and massiveness of the skull B with its lower jaw, and by the size and muscular markings on some of the bones of the limbs. The skull A was distinctly smaller than B, and its muscular ridges were not so strong,

so that it had more feminine characters, but it was younger than B, and was possibly also a male. The third lower jaw C, with which no skull was associated, was possibly a female. In packing the specimens in the boxes the bones of each skeleton had been mixed with their neighbours.

The skull B was especially interesting, as the most perfect specimen which I have seen in this series of caves. The man had probably been in the later stage of adult life, for the sutures of the cranial vault were to a large extent obliterated. The glabella and supraorbital ridges,

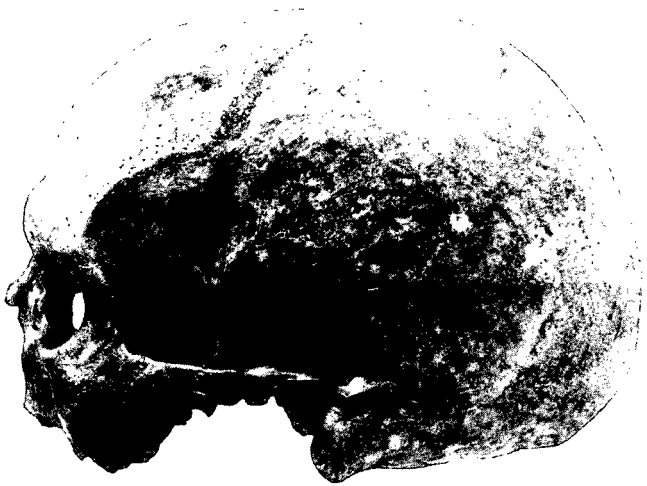


Fig. 5. Profile of Skull B.[1]

although not nearly so projecting as in the Neanderthal and Spy crania, were yet sufficiently strong to have given a definite physiognomy at the junction of the forehead and face. The alveolar border of the upper jaw was broken off in front, and the degree of prognathism could not be ascertained, but from what is left of the upper jaw I do not think that it could have been marked. Two teeth were lost in the lower jaw, but the sockets were entire: the remaining teeth, though without decay,

[1] For the excellent photographs of the crania from which the figures are reproduced, I am indebted to Mr W. E. Carnegie Dickson.

were in part worn by use, though not to the extent one might have anticipated from the age of the skull, as inferred from the condition of the sutures. It is possible that in these ancient cave dwellers, as is not unfrequent in existing savage races, the sutures ossify earlier in life than in civilised man. The lower jaw was massive, with a strong chin, and indicated the possession of good power of mastication.

Fig. 6. Facial View of B.

Owing to the base of this skull having been broken away I cannot give its height, but the measurements of its length, breadth, and circumference show it to be a skull of large dimensions, as may be seen from the Table. In an unpublished research on the cranial characters of the people of Scotland, on which I am now engaged, only

four out of eighty-four male skulls reached 200 mm. in glabello-occipital length, and the longest of these was 204 mm., whilst the mean of the series was 186·2 mm., but this Oban skull measured 205 mm.[1] In its breadth, however, of 144 mm. it was about the mean of the male Scottish skull, which I have found to be in eighty-three adults 144·6 mm. The horizontal circumference was amongst the largest that I have measured, though many crania surpass it in the vertical transverse arc. Owing to the nuchal and basilar parts of the occipital bone having been destroyed, I could not take the full internal capacity, but the cavity of the cranium, although imperfect, held 1715 cubic centimetres of water, which is greatly in excess of the average capacity of the skull in Scotsmen; for the mean of fifty male crania which I have measured was 1492·8 c.c., and the range of variation was from 1770 to 1240 c.c. The brain which it had contained had been therefore much above the average magnitude of that of the modern Scot. In the relation of length and breadth the index, 70·2, placed it distinctly in the dolichocephalic group. In its general form, as seen in the norma verticalis, the cranium was an elongated oval; cryptozygous, with vertical side walls; not bulging in the parieto-squamous region, for the widest part of the cranium was at the parietal eminences which is not the rule in a man's skull; a slight elevation was seen in the sagittal

[1] Examples of skulls having a length of 200 mm. and upwards have been recorded by several observers in the men of both neolithic and palæolithic times. Of the twenty-five ancient British male crania from the long barrows described by Dr Thurnam (*Memoirs Anthropological Soc.*, London, vol. i. Table 1), nine exceeded 200 mm. in length. The Neanderthal skull was 200 mm. The Spy cranium No. 1 was 200 mm., whilst No. 2 was estimated to be 198 mm. In two skeletons found in 1843 in a kitchen midding at Staegenaes, Bro, Sweden, and described by Sven Nilsson (*Actes du Congrés des naturalistes Scandinaves*, Stockholm, 1844), one skull was 200 mm., the other 196 mm. A skull found at Olmo, near Florence, 15 metres deep in the blue lacustrine marl, and described by Cocchi (*Mem. della Soc. de Sc. Nat.*, Milan, 1867), was 204 mm. long. Two of the crania from Les Eyzies described by Broca (*sur les ossements des Eyzies*, Paris, 1868) had each an antero-posterior maximum 202 mm., whilst a third was 191 mm. The Borris skull from the bed of the Nore, Ireland (T. H. Huxley, *Prehistoric Remains of Caithness*, 1866), was 204 mm. long. The skull recently discovered at Galley Hill, Kent, and ascribed to palæolithic man (E. T. Newton in *Quarterly Journal Geolog. Soc.*, August 1895), was 205 mm. in maximum length and 203 in the ophryo-occipital diameter.

region and the slope from it to the parietal eminences was distinct; the parieto-occipital region sloped gradually backwards from the obelion to the occipital point. The forehead, though sloping backwards above the glabella and supraorbital ridges, was not low as in the Neanderthal and Spy crania. The nasion was depressed; the nasal bones were short and moderately projecting. In the norma occipitalis the outline

Fig. 7. Vertex View of B.

of the skull, owing to the slope of the roof downwards to the parietal eminences and the side walls being vertical, was pentagonal. The broken palate prevented me from seeing its general form; but it possessed a broad mesial ridge in its posterior half.

The skull A was more fragile in the cranial region than B, but the face was better preserved. Although the sexual characters were not so

strongly marked in it as in B, I am inclined to think that it was that of a man. The sutures of the vault were unossified and the glabella and supraorbital ridges were comparatively feeble. The teeth were not decayed either in the upper or lower jaw, but they were more flattened from use than in B. This skull was smaller than B and broader in relation to the length. Owing to the right parieto-squamous region being imperfect, the breadth given in the Table is approximative, and so also is the length-breadth index, 75·4. In their general form A and B

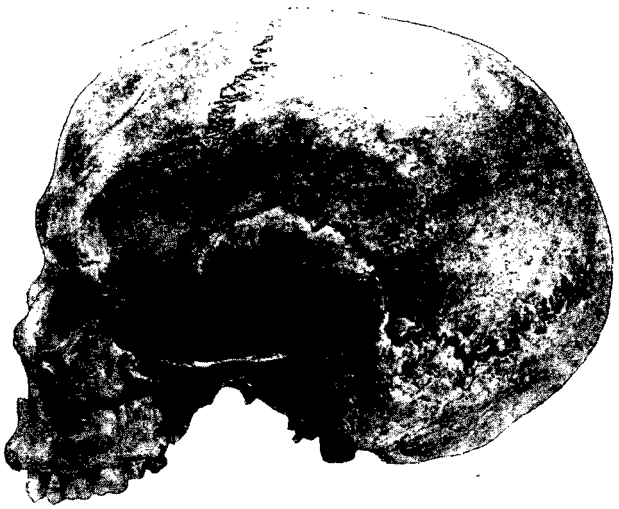


Fig. 8. Profile of Skull A.

were not unlike, and might well have been members of the same family. The upper jaw was orthognathic. The length and breadth of the nose was on the boundary between the leptorhine and mesorhine groups. In A the orbit was not so wide in relation to the height as in B, and the palate was well formed and mesuranic in its proportions. The basi-bregmatic diameter of the skull was almost the same as the greatest transverse diameter, and the length-height index, 76, places it in the hypsicephalic group. In Scottish crania generally the breadth exceeds

the height. The lower jaw, although less massive than in B, had a well-defined chin, and a keel projected forward at the lower half of the symphysis. This skull was not depressed at the nasion, the nasal bones did not project so much as in B. Owing to the vault of the cranium sloping outwards to the parietal eminences more gradually than in B the pentagonal form was not so marked in the norma occipitalis. The palate was symmetrical and there was no mesial ridge.

The only part of the skull C which had been preserved was the lower jaw, the measurements of which are given in the Table. The sockets of the teeth were intact, although only the right wisdom tooth was in place and the surface of its crown was flattened from use. The jaw was well formed and with a distinct chin.

The two scapulæ were so much injured that their dimensions could not be taken, but one had obviously belonged to a strongly muscular man, and certain of the long bones had corresponding characters.

None of the six humeri was perfect; one pair was more slender than the others and had feminine characters. Three ulnæ were well preserved, and their maximum lengths were 260, 277, and 280 mm. One of these, a left bone, was much abraded on the front and inner side as if it had been gnawed by the teeth of an animal. Another, a right ulna, had sustained a considerable time before death an oblique fracture in the lower fourth of the shaft; the broken ends had united and were surrounded by a thickened growth of bone. The radii were all imperfect. The vertebræ were much broken and many were lost. The innominate bone was a fragment. A left femur possessed the shaft and condylar articular end; two others had imperfect shafts. The best preserved was probably that of a woman from its slenderness, smoothness, and short length. The antero-posterior diameter in the upper third of the shaft was 22 mm., the transverse 28, the index 78·6; no special flattening was therefore present and the external infra-trochanteric ridge was faintly marked. The linea aspera in this bone was feeble. In the right bone of probably the same woman the antero-posterior diameter of the shaft was 21 mm. and the transverse 29 mm., the index 72·4; in this femur a slight amount of flattening was observed. In a third femur, evidently from its size that of a man, the antero-

posterior diameter was 23 mm. and the transverse 33, index 69·7 ; the platymeric form was more recognisable and the linea aspera was much stronger. A portion of only one tibia had been preserved and it belonged apparently to the female skeleton ; the antero-posterior diameter of the shaft at the nutrient foramen was 31 mm., the transverse 21 mm., index 69·7, showing a moderate degree of platyknemia.

Concluding Remarks.—From the fact that four caves containing human skeletons associated with implements and animal remains have been found, within a distance of half a mile, in the cliff which fronts the bay at Oban, one may safely conclude that the primitive inhabitants of that district made use of the natural recesses in the rock bounding the ancient sea beach. As the implements which have been found in these caves are formed of stone, bone and horn, and are unaccompanied by any trace of metal, it is obvious that the occupancy of the caves must date back to the præmetallic period in the north-west of Scotland—a conclusion which is confirmed by the character of the pottery found in the Gas Works Cave. A precise date cannot, of course, be given ; but if the primitive people of the Scottish Highlands had attained a knowledge of the use of metals contemporaneous with, or even some time after, their manufacture into implements by the natives of Southern Britain, the people, whose remains we have been examining, would necessarily date back to a period antecedent to the invasion of Britain by Julius Cæsar, at which time both bronze and iron had evidently been long in use.

In considering the implements and weapons manufactured and employed by man living in a savage or barbarous state, we must take into consideration both the nature of the materials fitted for their manufacture provided by the country in which he lives, and the opportunities which he may have of obtaining materials of a better quality from other countries and more civilised races. As regards the people of the Highlands in the period now referred to, even if we suppose that metals had come into use in other parts of Northern and Western Europe, the opportunities of obtaining them, on account of difficulties of access, had doubtless been so small as to interfere with their introduction and

employment. The people, therefore, would necessarily be limited in their choice to such materials as they had around them. In the absence of minerals from which metals could be extracted, and in the consequent want of any opportunity of acquiring by practice the methods of treating ores, bone, horn and stone supplied the most appropriate substances. Oxen and deer, as their remains show, were without doubt sufficiently numerous to provide them both with food, and the raw material out of which tools could be made (see figs. 3 and 4, and the illustrations to Dr Anderson's description of the MacArthur Cave). Stone also was in abundance, but no stone implements, except three hammer stones made of sandstone, quartzite and a porphyritic stone, described in Dr Anderson's account, and a few made from flint, were found in any of these caves. The best specimens of manufactured flints were obtained in 1869 in the Mackay Cave (figs. 1 and 2). There can, I think, be little doubt that flints were the tools used in the manufacture of the horn harpoons found in the MacArthur Cave (figs. 11, 12, 13 of Dr Anderson's paper). As flint is by no means common in Scotland I asked my colleague at that time, now Sir Archibald Geikie, to tell me the nearest locality from which it could have been procured. He kindly wrote to say that a few years previously he had found a bed of chalk flints, 20 feet thick, underlying the great basaltic cliffs of Carsaig, on the south shore of the Island of Mull. As the cliffs are about 20 miles only from Oban, there can, I think, be little doubt that the supply of flint for the manufacture of stone implements had been derived from this locality. If one may judge of the size of the flint nodules in this bed from a few specimens which were found in the Mackay Cave, the implements which it was possible to make from them could not, as figs. 1 and 2 show, be of large size.

The animal remains associated with the human skeletons belong to existing species.[1] From the large quantities of shells removed in excavating the Gasworks and Distillery Caves, sea molluscs must have formed an important article of food, and were perhaps also used as bait; and the empty shells, although to some extent within the

[1] *Bos longifrons*, remains of which were found in the MacArthur cave, is regarded as represented at the present time by the small Scotch and Welsh cattle.

caves, had been thrown into heaps or "kitchen middings" at their mouths.

Fish had also formed an important article of diet, and the harpoons from the MacArthur Cave were the ingeniously constructed weapons with which they were caught. The bones of the larger mammals had been broken to extract the marrow, and to be made into bone pins and rubbers, of which so many examples were got from the MacArthur Cave, as to indicate the employment of these primitive tools for the preparation of skins as articles of clothing. There can be no doubt from the barbed harpoons and the animal remains that the men had been expert hunters and fishermen.

We may form some conception of the physical characters of the cave-dwellers from the remains of their skeletons, imperfect though they unfortunately are. The adult skulls A and B from the MacArthur Cave prove them to have been people with well-developed crania, dolichocephalic in form and proportions. Although skull B possessed projecting glabella and supra-orbital ridges, yet these were not so prominent as to have given the beetling eyebrows, which must have been so marked a feature in the men of Spy and the Neander Valley; whilst in A their projection was slight; neither had they possessed the low arch of the frontal bone and forehead which is so striking a character in the Spy and Neanderthal crania. The jaws were not prognathic. The teeth, although partially worn down on the surface of the crowns, were not so flattened as one sees in the skulls of some savages. One is therefore disposed to infer that the food of the cave-dwellers was cooked before being eaten; an inference which is strengthened by evidence of the action of fire in the blackened, calcined bones in the Mackay and MacArthur Caves.

The great capacity of the skull B, which, in its uninjured state, had doubtless been capable of containing not less than 1730 c.cm. of water, places it on a level with some of the most capacious skulls of modern Scotsmen which I have measured. Notwithstanding the primitive conditions in which these men lived, a potentiality of cerebral and mental development is indicated much beyond what is possible in the aboriginal Australians or the Bush race, in whom the cranial capacity is very much lower.

It is indeed remarkable that of the human skulls of undoubted antiquity, which have been sufficiently preserved to enable the cranial capacity to be taken, so large a proportion should have been almost equal to, and in many specimens even greater than the 1500 c.cm., which is the mean of numerous measurements of skulls of modern European men. Dr Thurnam records, in his Memoir on Ancient British and Gaulish Skulls,[1] the capacities of eighteen crania, apparently those of men, from English long barrows, in which the mean was 1622 c.cm. (99 cubic inches), and the range was from 1474·6 c.cm. (90 c. i.) to 1835 c.cm. (112 c. i.). In eighteen Bronze-age skulls from the round barrows, which are of later date than the long barrow crania, he states the mean capacity to be 1605 c.cm. (98 c. i.), and the range was from 1442 c.cm. (88 c. i.) to 1786 c.cm. (109 c. i.). The series of crania obtained by Mr Samuel Laing at Keiss, Caithness, along with stone implements, which were so carefully studied by the late Mr Huxley,[2] do not appear to have had their cranial cavities measured by that anatomist, but a female skull from the same burying-place, which was given to me by Sir Arthur Mitchell, has a capacity of 1458 c.cm., *i.e.*, 89 c. i.[3] Six male skulls from the Caverne de l'Homme Mort in the Lozère, associated with animals of the present epoch, and belonging to the polished stone period, had, according to Broca, a mean capacity of 1606 c.cm. Several adult male crania from other localities in France, which are regarded as belonging to the polished stone epoch, had an average capacity of 1568 c.cm., and the average of twenty-five men's skulls from the Grottos de Baye was 1534 c.cm.[4]

Examples of skulls, possessing a capacity above the average of modern Europeans, have also been met with amongst the few specimens of crania belonging to Quaternary man, which have been preserved. The dolichocephalic skull of an old man, apparently cotemporaneous with the mammoth, from the rock shelter of Cro-Magnon near Les

[1] *Memoirs, Anthropological Society of London*, vol. i., Table 1, 1865.

[2] *Prehistoric Remains of Caithness*, London, 1866.

[3] From my measurements of the crania of twenty-three Scotswomen, I have obtained an average capacity of the present female population of 1325·5 c.cm. and only three of these were above 1450 c.cm.

[4] Topinard, *Elements d'Anthropologie generale*, p. 611, Paris, 1885.

Eyzies, has, according to Broca,[1] a capacity of 1590 c.cm. The dolichocephalic skull of a man about thirty, associated with the diluvial loam at Hussowitz near Brünn, is said by Alex. Makowsky[2] to have a capacity of 1648 c.cm. Although he cannot say positively that it was cotemporaneous with remains of the mammoth, teeth of the fossil wild horse were found along with it, and he believes[3] it to be undoubtedly a very old skull. Professor Testut has described a dolichocephalic man's skull found, along with flint flakes and implements of reindeer's bones and horns, at Reymonden in the Dordogne, as possessing a capacity estimated by Broca's method of 1730 c.cm. From the interments of these ancient people having been so carefully undertaken that their skulls had been preserved during many centuries, it is not unlikely that they had been the chiefs of their respective tribes, and that the large capacity had been associated with superior mental attainments.

The data for determining the stature of the Oban cave-dwellers are, owing to the imperfect condition of the long bones of the thigh and leg, unfortunately very imperfect. No thigh bone was entire. The right femur without its head, from the Mackay Cave, measured from the top of the great trochanter to the most depending part of the inner condyle 426 mm., and to the plane of the two condyles 420 mm.; in the left femur the head had been sufficiently preserved to enable one to see that it projected 20 mm. above the upper border of the great trochanter. If, in the right femur, the head had had a similar amount of projection, that bone would have measured 440 mm. when placed in the position of a man standing erect, which is slightly below the average length of the thigh bone in modern Europeans. If we were to adopt the somewhat rough method of estimating the stature of an individual as double the length of the femur + tibia, with 35 mm. added as equivalent to the soft parts, the stature of the man in the Mackay Cave would have been, femur 440 + tibia 357 = 797 × 2 = 1594 mm. + 35 mm. for soft parts = 1629 mm. or 5 feet 4 inches. If, again, we were to employ the method recommended by M. Manouvrier in his

[1] *Mémoires sur les ossements des Eyzies*, p. 23, Paris, 1868.
[2] *Verhand. Naturforsch. Vereins in Brünn*, Bd. xxvi., Brünn, 1888.
[3] *Bulletin de la Soc. d'Anthropologie de Lyon*, t. viii. 1889, Lyon, 1889.

important memoir on the determination of the stature,[1] and employ co-efficients based on the data given in his first Table, the estimated stature would have been 1654 mm. or 5 feet 5 inches. By both methods of computation the stature is distinctly below the average height of the present male inhabitants of Great Britain.

As has been stated in the description of the skeleton found in the Mackay Cave, the thigh bones were strongly platymeric and the tibia was platyknemic. In a skeleton from the Distillery Cave these characters were much less strongly marked, and in bones from the MacArthur Cave they were also moderate. The Mackay Cave skeleton was the only one which in degree corresponded with the form of the femur and tibia of the French neolithic interments. The presence of additional tibio-astragalar articular surfaces anteriorly leads one to conclude that the squatting attitude had been the habitual posture when resting.

From a certain community of character in all the four caves and their contents, more especially in the tools and implements found in them, one is led to the inference that the people who had occupied them belonged to the same epoch and were of the same race. Although both the pottery and the implements were rude and simple in material and shape, yet, from the absence of all remains of extinct animals, their inhabitants cannot be referred to palæolithic times, but are much later in date. It would seem appropriate to class them alongside of the men —whose remains are associated with the dolmens in France and with the long barrows in England—for the adults agree in possessing dolichocephalic crania, a moderately low stature and not unfrequently platyknemic tibiæ.

There can, I think, be no doubt that the caves were used as dwelling-places. The remains of animals good for food, the long bones splintered for the extraction of the marrow, the quantity of shells of edible molluscs, both in the caves and in some cases in heaps near the cave mouth, prove that the people had congregated in these recesses, and from the presence of both adults and children, it is probable that a family had been associated with each cave. The implements testify to the preparation of skins

[1] *Mémoires de la Société d'Anthropologie de Paris*, 1892.

for clothing. The blackened bones show that fires had been lit within the caves for cooking purposes, and there is every reason to think that they had been made use of as shelters for the night. The fact that each cave contained human remains, and that bones of no fewer than fifteen skeletons were collected within them, shows that they had also become places of entombment. There is a want of specific information of the exact position of the human bones in the earth and débris on the floors of the caves, except in the MacArthur Cave, in which the skull A, with other bones, was situated on the surface of the black earth, and the skull B was found where the black earth rested on the upper shell bed. As the earth had probably, to some extent, found its way into that cave through the air-shaft in the roof, these two skeletons clearly belong to the latest period of human occupation. In the course of time, the mouths of the caves had become closed in by an accumulation of earth, so that their existence only became known to us during the quarrying operations connected with the growth of Oban during the past thirty years. The closure had been without doubt brought about by a considerable fall of superincumbent rock, and of loose earth from the top of the cliff, which had blocked up the mouth and had led to the concealment and preservation of the caves and their contents.

One might hazard the supposition that, after the caves had ceased to be occupied as dwellings and before they were closed in, the people had utilised them as places of interment, but this is not, I think, a very credible hypothesis. A more likely explanation may be sought for in the intertribal feuds, which doubtless then, as in times not very remote in the West Highlands, led to the massacre by a hostile clan of members of another clan, surprised and perhaps suffocated by smoke, it may have been at night when resting peacefully in their cave dwellings. Possibly steps had then been taken to close up the entrance.

In passing under review the Oban caves and their occupants, we have to keep in mind that a considerable change in the relative level of land and water has taken place around the coast of Scotland—a change, there is good reason to believe, which occurred subsequently to the time when Britain first acquired human inhabitants. The caves, without doubt, were originally hollowed out by the sea, when the waves

washed the cliff in which they are situated, and before the present raised beach was formed.

The existence of a layer of gravel some feet in thickness in the MacArthur Cave, composed of clean-washed, small-sized pebbles, testifies to the action of the waves. Dashed about by the movement of the water the pebbles would act as agents, which assisted in wearing away the rock and hollowing out the recess. At that time the cave could not have been inhabited, and its human occupants could not, I consider, have taken possession of it until the land was sufficiently elevated above high-water mark, and the cave was placed above the influence of the tide. The presence of bones in both the earth and in the shell bed on the surface of the gravel, and to a less degree in the imperfect shell bed subjacent to it, naturally, however, raises the question if there had not been two distinct periods of human occupation separated by a considerable interval, in which the waves had sufficient access to the cave to admit of a thick layer of gravel being deposited within it, and to lead to its being deserted by the first set of inhabitants.

Dr Anderson, who had the advantage of a personal inspection of the cave at the time when the excavation was going on, has carefully discussed this question in his descriptive memoir (p. 228). He states, with judicial fairness, the arguments based on the form of the cave and the arrangement of the gravel and shell beds, which may be advanced both against and in favour of two distinct periods of occupation, with an intermediate wave-washed interval. In my opinion, those facts and arguments which favour a single occupation after the sea had retired, and when the new sea-beach had either begun to form or been completed, have the greatest weight, and his explanation of the manner in which the bones became mingled with the shell beds seems to be satisfactory. There can be no doubt that the remains found in the caves have no claim to be associated with palæolithic times, but are neolithic both in age and character.