The Deposits of Ballymihil Cave, Co. Clare, Ireland, with Particular Reference to Non-marine Mollusca

By
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(Location: O.S. Clare 6-in. sheet 5, S. 3·3 in. E. 4·6 in., in Ballymihil townland at *ca.* 640 ft. O.D. The cave is marked by name on the 6-in. map)

INTRODUCTION

Ballymihil Cave is located in the heart of the Burren. The prominent cave entrance can be seen on the north side of a steep-headed dry valley which leads west-south-west into the Glensleade Depression.

Table 1

LIST OF NON-MARINE MOLLUSCA AT BALLYMIHIL CAVE

	Examples
Acicula fusca (Montagu)	370
Carychium minimum Müller	426
Lymnaea truncatula Müller	3
Lymnaea peregra (Müller)	1
Planorbis contortus (Linné)	1
Cochlicopa lubrica (Müller)	236
Pyramidula rupestris (Draparnaud)	165
Columella edentula (Draparnaud)	5
Vertigo pusilla Müller	5
Vertigo substriata (Jeffreys)	13
Vertigo pygmaea (Draparnaud)	3
Vertigo angustior Jeffreys	5
Lauria cylindracea (da Costa)	402
Lauria anglica (Wood)	56
Acanthinula aculeata (Müller)	55
Acanthinula lamellata (Jeffreys)	10
Vallonia excentrica Sterki	75
Clausilia bidentata (Ström)	148
Helix (*Cepaea*) sp.	Fragments
Hygromia hispida (Linné)	190
Helicella itala (Linné)	85
Punctum pygmaeum (Draparnaud)	104
Discus rotundata (Müller)	960
Euconulus fulvus (Müller)	37
Vitrea contracta (Westerlund)	1,840
Oxychilus cellarius (Müller)	1,791
Retinella radiatula (Alder)	185
Retinella pura (Alder)	218
TOTAL	7,389

The cave was visited by J. C. Coleman, N. Mathys, C. Reynolds and P. W. Williams of the Speleological Society of Ireland in February, 1964, in

the course of a reconnaissance of uninvestigated cave sites marked on 6-in. O.S. maps of the district. At the occasion of the first visit a deposit of mollusc-rich cave-earth was noticed at the back of the cave, and a sample was collected for later inspection. The cave-earth Mullosca were subsequently examined by R. B. G. Williams of the Department of Geography, University of Cambridge. The assemblage proved to be of considerable interest, and so it was decided to acquire a larger sample for more complete analysis. It is from the last sample that the list of Mollusca in this paper is compiled (*Table* 1).

A preliminary survey of the cave and its site was made in 1964 and a more detailed survey was completed in 1965. A minimum accuracy of C.R.G. grade 5 is claimed.

DESCRIPTION OF BALLYMIHIL CAVE AND ITS SITE

The central Burren is a rocky waste of limestone pavements, small dry valleys, and closed depressions. It is an excellent example of a glacio-karstic landscape (Williams, 1966).

Most of the karst landforms—that is those developed from the interaction of corrosion of limestone and subterranean circulation of water—were produced in the Pliocene and in the non-glacial stages of the Quaternary. During most of the Tertiary, the Burren was covered with mid- and upper-Carboniferous (Namurian) shales and flagstones, and the underlying limestones were protected from erosion. Outlying patches of Namurian seem to have been finally removed from the eastern Burren as recently as the last glaciation (Williams, 1964, p. 42), and erratic remnants of flagstones from these outliers can be found in certain recent boulder clays, as in the Glen of Clab (Farrington, 1965, p. 38). *In situ* outcrops of the Namurian shales and flagstones are now found only on Slieve Elva and Poulacapple ridge in the western Burren and near Noughaval, 2 miles west of Caherconnell, in the south central Burren. The large closed depressions of Carran (3 square miles in area), Caherconnell (2·5 square miles) and Glensleade (1 square mile) started to develop when inliers of limestone were first exposed during the denudation of the overlying shales. This was probably during the mid-Pliocene. It is unlikely that the shale was removed from above the sites of the closed depressions much earlier than this, for otherwise the depressions would be much more extensive.

The situation of Ballymihil Cave, opening out into the head of a tributary valley of Glensleade Depression, suggests that it functioned originally as a resurgence, although in the cave any scalloping that might have indicated the direction of former water movement is obscured. But this is not surprising, as the cave must be amongst the oldest of the Burren, being at the very least last interglacial in age. The cave has been inactive for a

considerable time, and the water-worn passage—of which only 70 ft. are now penetrable—has been much modified by frost shattering and various types of deposition.

Since the cave lies only about 15 ft. below the surface, it has been particularly susceptible to frost action. The effect of shattering, whilst most

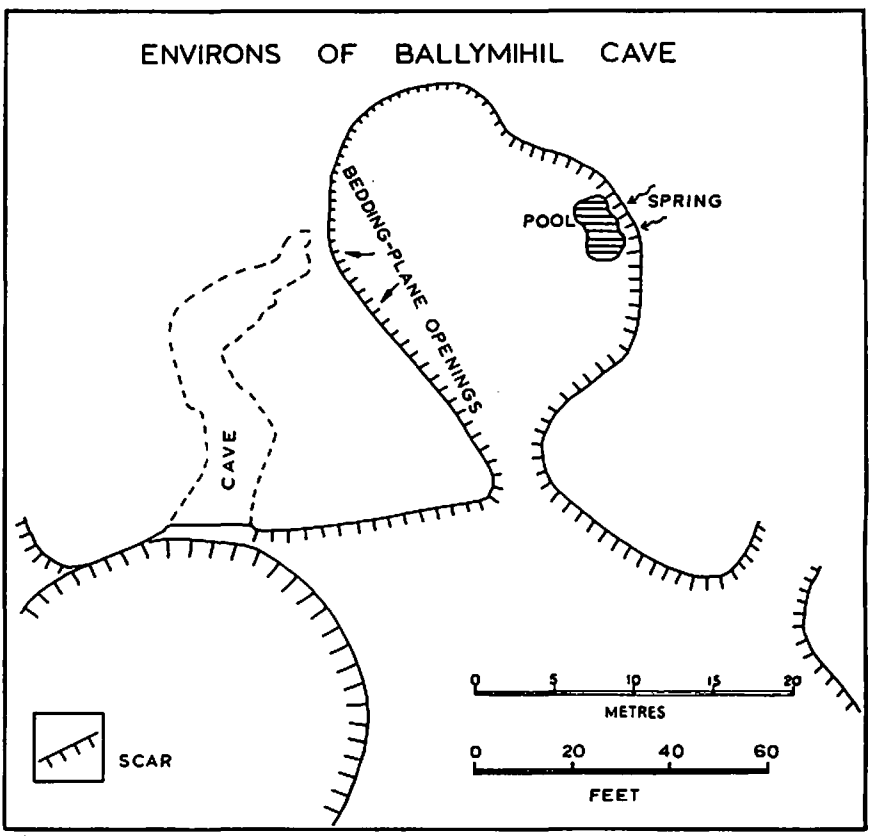

Fig. 16.

noticeable in the overwidened entrance, is always evident because of the liberal scattering of large, angular boulders over the cave floor. The entrance to Ballymihil Cave is 18 ft. wide and 8·3 ft. high (*Fig.* 17). It is therefore reasonably spacious. However, within only 20 ft. of penetration, the passage section is reduced in dimensions to 12 ft. wide by 4·5 ft. high, and 35 ft. from the entrance the cross-section measures 9·5 ft. by 2·5 ft. Then follows a temporary enlargement to 12 ft. wide by 4·5 ft. high at a bend where fallen blocks are particularly prominent. Thirty-five feet further on, the passage

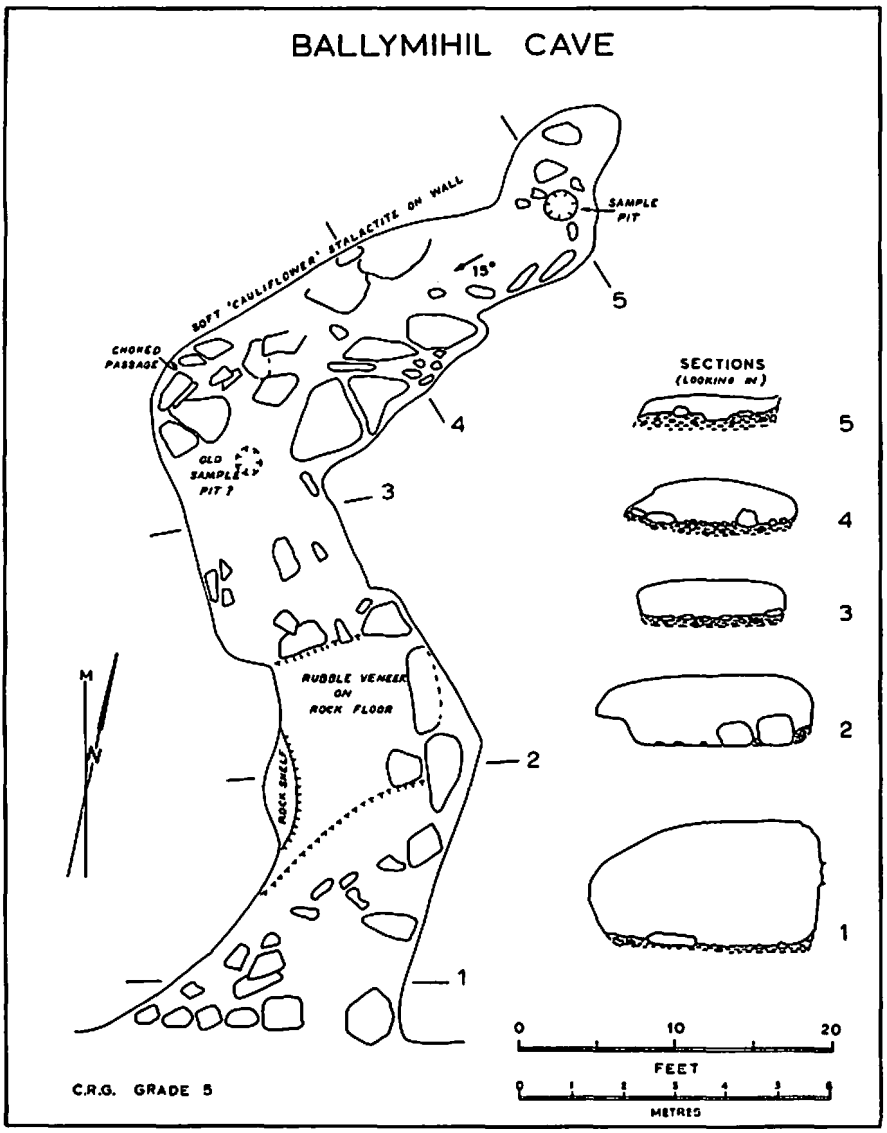

Fig. 17.

finally closes right down as deposits fill it to the roof. Where the cave-earth samples were taken at the end of the cave (*Figs.* 17 and 18), the cross-section is 8·5 ft. wide by 1·3 ft. high. The total penetrable length of passage, comprising one gallery, is only 70 ft. In long profile, it slopes gently towards the entrance (*Fig.* 18).

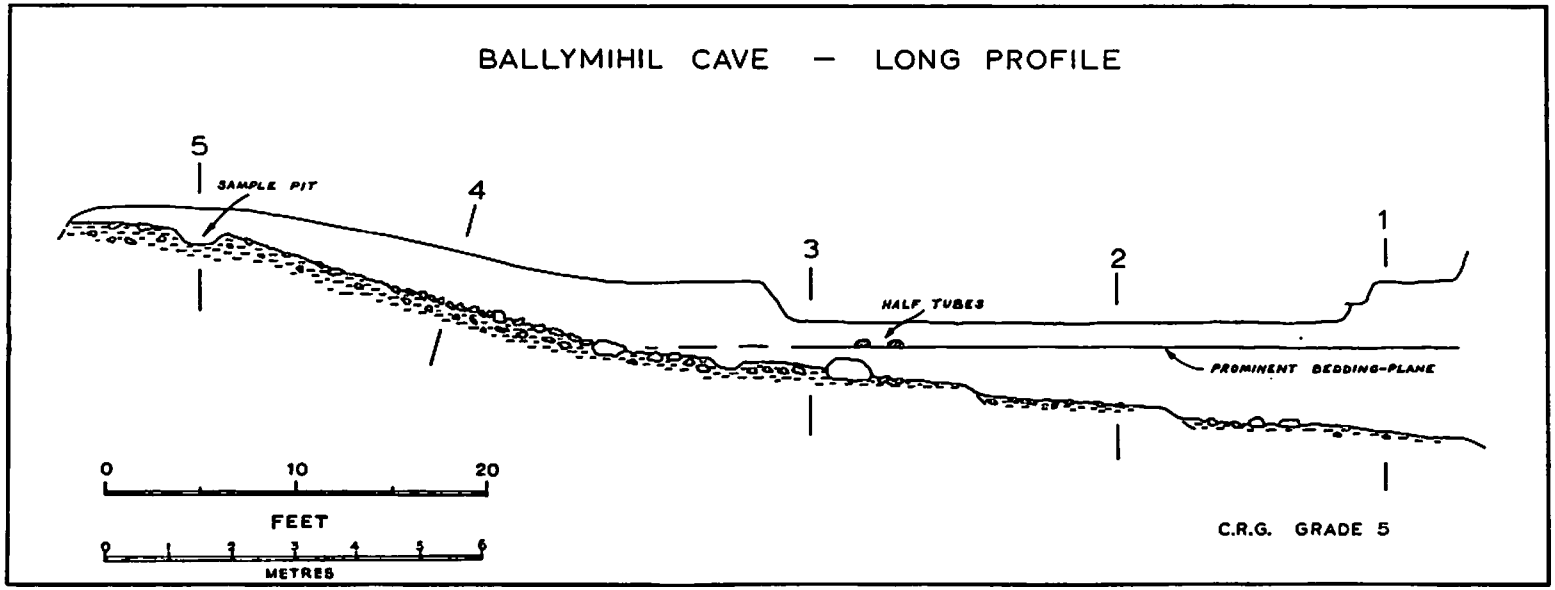
BALLYMIHIL CAVE — LONG PROFILE
5
SAMPLE PIT
4
3
2
1
HALF TUBES
PROMINENT BEDDING-PLANE
0
10
20
FEET
0
1
2
3
4
5
6
METRES
C.R.G. GRADE 5

Fig. 18.

CAVE DEPOSITS

The primary object of this study has been to analyse the fossil non-marine Mollusca and charcoals found intermixed with surface debris at the back of the cave. No attempt has been made to investigate carefully all the sediments present, and no excavation has been undertaken—though it would seem worth while.

Deposits in Ballymihil Cave fall into two major groups:

(1) Autochthonous or internally derived components. These include secondary calcite deposits such as straws and soft cauliflower-like stalactite growths on walls, and also stony debris from the ceiling and walls. Large formations are absent in the cave.

(2) Allochthonous or externally derived components. These include debris such as soil, clay and skeletal remains that have been deposited in the cave. Material such as bones carried in by animals is also included.

The debris at the end of the cave from which the Mollusca-bearing samples were taken is composed of both autochthonous and allochthonous elements. The autochthonous material consists primarily of fallen limestone blocks, and the allochthonous sediment of in-washed calcareous boulder clay and organic remains. The whole deposit, which has been partially cemented by secondary calcite, slopes inwards from the back of the cave. The presumed point of intake of the allochthonous material is an enlarged bedding-plane at the base of a small scar behind the cave (*Fig.* 16).

Examination of roughly 1 lb. of sediment from the end of the cave revealed that 20 per cent by weight was composed of material coarser than 2-mm. diameter. This coarse fraction consisted mainly of angular limestone rubble, although one piece of chert was identified, and so were several small bones, rodents' teeth, shells and occasional small pieces of charcoal. The finer fraction (<2-mm. diameter) that constituted 80 per cent of the sample was comprised almost entirely of angular limestone sand, shell fragments and calcite-encrusted soil or clay. A quantity of this fine material was oven dried at 105° C.; 100 gm. were then weighed and treated with dilute hydrochloric acid. Only 4 per cent was insoluble. The residue consisted of clay and silt, fine quartz crystals and powdered charcoal. The clay and silt were probably derived from boulder clay, the quartz from boulder clay, chert and limestone, and the charcoal from former vegetation.

NON-MARINE MOLLUSCA

About 14 lb. of material were washed down on 0·5-mm. sieves and the shells were examined under a binocular microscope. Broken fragments were counted according to the methods suggested by Sparks (1961). The Mollusca recovered are listed in *Table* 1.

The Mollusca indicate conditions approximately as warm as those now present and therefore are unlikely to date from before the Atlantic period (*Zone* VIIa).

The bulk of the shells consists of a few land genera (*Discus*, *Vitrea* and *Oxychilus*) which are not very selective as to habitat. The remainder fall into three groups.

(1) Species adapted to extremely wet situations are very poorly represented. The *Lymnaea* and *Planorbis* could be derived from the boggy area beyond the back of the cave (*Fig.* 18), or may have been brought in by rodents. Towards the mouth of the cave the deposits contain greater numbers of *Lauria truncatula*, but these sediments have not been examined in detail.

(2) As is to be expected, many of the molluscs are characteristic of the limestone scars and pavements today. *Pyramidula rupestris*, *Lauria cylindracea*, *Clausilia bidentata*, *Helicella itala* can be collected in great numbers. *Lymnaea anglica* and *Vertigo substriata* are found more sparingly.

(3) The assemblage contains a strong woodland element, notably large numbers of *Acicula fusca*. Taken with the evidence of the charcoals, the abundance of *Acicula* clearly indicates some kind of woodland on the site. It might be thought that in areas of bare limestone pavement *Acicula* might find a substitute for woodland conditions in the damp and shade of the fissures. It has not, however, been found in such situations. Richards (1962) made a detailed survey of the fauna of a small area (75 sq. yd.) of limestone pavement on the Burren and did not discover it, nor has other collecting detected it. Several authors (e.g., Stelfox, 1911, 1912; Welch, 1933) have reported *Acicula* in Ireland from open country, but nearly all such finds have been from places on the sea-coast. The ecological factor responsible for these exceptions might be a freedom from killing frosts. Whatever it proves to be, it is most unlikely to have applied to the high Burren plateau or as far inland as Ballymihil. At the present day *Acicula* seems to be extremely scarce in Co. Clare. Grierson (1902) in a note on the mollusca of the county could name only one locality for *Acicula*, and this lay outside the Burren region.

Acanthinula lamellata and to a lesser extent *Lauria anglica* are also typical woodland species (Stelfox, 1911). Apart from *Vallonia excentrica*, which is said to avoid woods (Boycott, 1934), none of the species in the list conflicts with the idea of woodland. *Helicella itala* in England seems to prefer dry open country, but in Ireland it is also abundant in damp scrubby hedgerows and elsewhere.

It is not possible to determine the character of the woodland from the molluscan evidence, but it need not have been very dense.

None of the species in the list is absent from the county at the present day, but the fauna is not identical with the modern one. The dominant forms

have changed. *Pyramidula* and *Lauria* are now found in huge numbers, *Discus*, *Vitrea* and *Oxychilus* in far less abundance. The character of the fossil fauna is quite different with four genera, *Discus*, *Vitrea*, *Oxychilus* and *Retinella*, accounting for 68 per cent of the total numbers. The list is similar to supposed early Holocene faunas such as the King's County tufas (Kerney, 1957) and Dog's Bay, Connemara (Kennard and Woodward, 1917). It is not as rich, chiefly because stream and wet marsh species are largely absent. In the absence of a radiocarbon date, it can be tentatively assigned to the Atlantic or Sub-boreal periods.

CHARCOALS

The material for identification consisted of a large number of small fragments of wood charcoal, often only a few cubic millimetres in size. A representative sample of the material was studied in detail in an attempt to identify the species of wood from which the charcoal was formed.

In the main, the specimens constituted fragments of diffuse porous hardwoods; probably from two species, although neither was positively identified. A very few pieces were fragments of a softwood and were identified as *Taxus* sp. (yew).

The greater part of the material was characterized by a diffuse arrangement of vessels in transverse section, the vessels being somewhat eliptical in outline and arranged in short radial chains or solitary. The vessels had no spiral thickening, the radial walls were well pitted, but scalariform perforation plates were not seen. Fibre tracheids were present, the bordered pits being clearly visible. The rays were homogeneous, narrow, multiseriate (1–5) and not aggregate. In spite of the apparent absence of scalariform perforation plates, the wood resembles *Betula* sp. (birch) in many respects.

The remainder of the hardwood fragments examined were characterized by a diffuse arrangement of vessels in transverse section, the vessels being more or less circular in outline and almost exclusively solitary, with an occasional short radial chain. The vessels had no spiral thickening and no perforation plates were seen. Fibre tracheids were present. The rays were homogeneous, narrow, multiseriate, short, not storied and not aggregate. A tentative identification suggests affinity with the *Prunus/Pyrus* species of the Roseaceae.

The softwood fragments were characterized by the presence of tracheids with large bordered pits on the radial walls. Resin ducts were not seen. The latewood was not conspicuous and the growth ring somewhat uniform in transverse section. The rays were uniseriate and no horizontal resin ducts were seen. Spiral thickenings were present on the inner surface of the tracheid walls. The cross-field pitting was not seen clearly. The fragments are identified as *Taxus* sp. (yew).

DISCUSSION

The Burren today is remarkable for the scarcity of trees. Large areas are grassland or almost bare limestone pavement. Dense hazel scrub grows in sheltered places even in the higher parts. A variety of shrubs is associated with the hazel, such as *Viburnum opulus*, *Cornus sanguinea*, *Eunonymus europaeus* and sometimes *Juniperus communis*. Only a few small areas of semi-natural woodland are left, as round Slieve Carran and the Glen of Clab, mostly composed of hazel, ash, birch, rowan and perhaps blackthorn.

Yew is found frequently on the limestone crags and pavements as isolated trees (Webb, 1962), and in greater amounts as a constituent of the hazel thickets, especially on the Gort Lowland. Woods of yew occur in places outside the Burren on the Carboniferous Limestone, as at Killarney. Praeger (1934) mentions woodland of yew and tall juniper on the shores and islands of Lough Derg.

The charcoals and Mollusca of Ballymihil Cave give grounds for believing that the vicinity was once covered with some form of woodland, although it is difficult to establish its exact composition. Godwin and Tansley (1941) have emphasized that charcoal when found alone has serious limitations as evidence of former vegetation. The charcoals at Ballymihil Cave probably originated from a few trees as fallen twigs and dead wood. It is most unlikely that these charcoals represent all the woody species formerly growing, and certainly they give no idea of the species' true proportions. All that the charcoals definitely establish is that yew and birch were present.

The charcoals are completely mixed with the molluscs and there is no stratification in the deposit. Since the snails have evidently been washed into the back of the cave from outside, it is reasonable to suppose that the charcoals were introduced in the same way. The trees represented by the charcoals would be limited to those species overhanging the scar at the back of the cave. This may be one reason why only three types of charcoal are present. There is no evidence that the charcoals came from a camp-fire inside the cave, which in any case would have been lit near the entrance to allow the smoke to escape, rather than at the confined inner end of the cave. It is also unlikely that the charcoals were brushed or carried so far back.

If trees once grew on the plateau about Ballymihil Cave, it is likely that woodland once extended over much more of the high limestone plateau. On the Namurian shales and flagstones, tree remnants in the peat are well known up to about 600 ft. On the shale outlier of Poulacapple, near Lisdoonvarna, an early Bronze Age dagger was recently uncovered in a basal spit of peat immediately above grey clay (Dr. E. K. Tratman, personal communication, September 20th, 1964). In the basal spit were also many tree remains; thus there was woodland at least on Poulacapple (*c.* 900 ft. O.D.) at the beginning of the Bronze Age. Ivimey-Cook and Proctor (1966, p. 262) note that in the

eastern Burren, "the picture of the vegetation cover given by pollen analysis (Watts, unpubl.) is remarkably 'normal' "; and that "During the Boreal and Atlantic periods, the pollen diagrams suggest a more-or-less complete cover of pine, with subsidiary hazel and yew". Nothing, apparently, indicates large expanses of grassland or bare pavement prior to clearance by Man.

On the Gort Lowland, large tree roots are frequently exposed by peat cutting, and many tree stumps can be seen below water level in a number of lakes. Pollen analytical evidence (Watts, 1963) has also shown that *Juniperus*, *Betula* and *Corylus* were well established in the area by early Post-glacial time.

It was suggested by Ivimey-Cook and Proctor (1966, p. 262) that the widespread occurrence of hazel scrub, even close to the west coast, indicates that the Burren could become scrub covered, or even wooded, at the present time. And in this context, it is significant to note that recent afforestation with conifers on the shale upland round Lisdoonvarna appears to be quite successful.

The Burren is one of a number of areas in the British Isles having an unusually rich arctic-alpine flora (Ivimey-Cook and Proctor, 1966; Webb, 1962). Whilst not possessing as many species as for example Ben Lawers or Teesdale, it is nevertheless richer than surrounding districts. The richness of the flora undoubtedly owes much to the limestone soil, the deep grikes and the present open habitat; but if woodland formerly clothed even the highest hills, these open conditions would have been very scarce. This raises the question of the history of the arctic-alpine plants, an important problem which far exceeds the scope of this paper. It must suffice to comment that Raven and Walters (1956, p. 82) consider the Burren to be "an odd corner of Northwest Europe over which the forest has never completely closed". Thus, if this be true, then the arctic-alpine plants could have survived in a few forest clearings on the plateau and on some of the steepest cliffs which were probably never wooded.

NOTES ON CERTAIN SPECIES

Carychium minimum. The Ballymihil shells belong to this species despite the greater number of whorls more characteristic of *C. tridentatum.* The identification was checked by breaking open the last whorl of a number of specimens to observe the parietal fold.

Cochlicopa lubrica. The shells show a large variation of form and at first sight both *C. lubrica* and *C. lubricella* seem to be present. However, a histogram of the length–breadth ratios of adult shells (that is those having between five and six whorls) shows a seemingly normal distribution (*Fig.* 19). Accordingly, the shells have been counted as *C. lubrica.*

Lauria species. The greater part of the material is highly fragmentary and difficult to separate into the two species, *L. cylindracea* and *L. anglica*. Consequently the apical fragments were counted and divided in proportion to the number of adults.

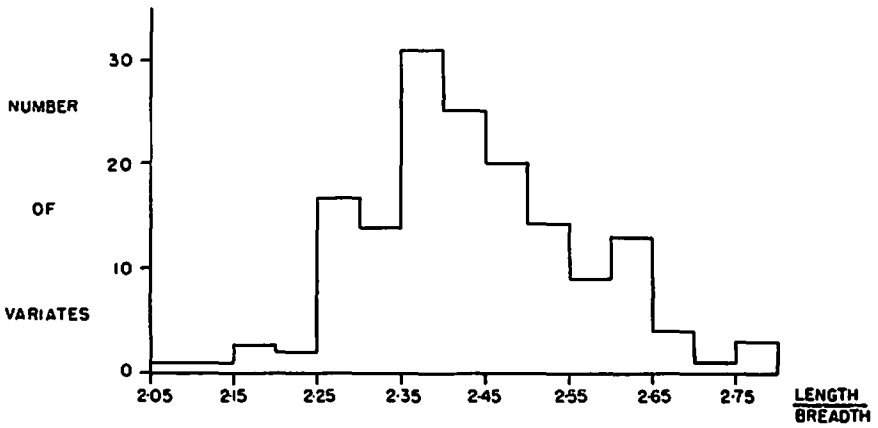

Fig. 19. Histogram of the length–breadth ratios of adult shells of *Cochlicopa Lubrica*.

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