**Comparison of Hierarchies**

With the assistance of Paul Munton (who was on the island studying the maternal behaviour of the goats for a Ph.D. thesis) and the memories of various islanders, I constructed a family tree for the same 'South-West' group, thus deducing an age hierarchy.

I observed the travelling behaviour of the goats, both when scared, and when naturally travelling from one feeding area to another, on the precipitous cliff faces of Lundy. From these observations I constructed leadership hierarchies.

Careful noting of occasions when one goat butted another out of the way, or when one jumped out of the way of another, produced yet another hierarchy, dominance.

(For further information on the construction of these hierarchies please consult the original paper, the LFS has a copy).

I compared all possible pairs of these hierarchies. The only significant correlation found was between age and dominance, this with a probability of error of less than 5 in 100.

Stewart and Scott (1947) are among the papers that disagree with this finding. However, I have taken from their data the rank order of age, and the rank order of 'dominance score' they gave each goat in their study. Applying the same statistical test (Spearman's Correlation Coefficient ($r$)) to their data, as I did to mine, the correlation of age and dominance is rather better than that from my data (probability of error less than 1 in 1000).

I therefore conclude that age and 'dominance are correlated in *Capra hircus hircus.*

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Further, I would like to express my gratitude to the Lundy Field Society who gave me a small grant to go back in 1972 to continue my investigations of communication and hierarchy.


## SOME NOTES ON THE PLEISTOCENE GEOMORPHOLOGY OF LUNDY


By C. G. TAYLOR


**1. Introduction**

To date the only paper published concerning the Pleistocene Geology of Lundy is that by G. F. Mitchell of Trinity College, Dublin. It is entitled 'Glacial Gravel on Lundy' and was published as a transaction of The Royal Geological Society of Cornwall, volume XX, part I, 1965-66. The extract deals principally with the gravels and roche moutonees that Mitchell found on the island during a brief visit.

I made several visits to Lundy between 1965 and 1970, and between 1970 and 1973 I was resident on the island. Although the observations I have made

over this period of time are by no means complete, they do shed an interesting light on the rather obscure geological history in the Barnstaple Bay area during the Pleistocene era.

Very simply the island consists of an eroded granite massif approximately 5 km by 1 km with an average height of 90 m. A small area amounting to 6% of the total landmass, at the south east corner of the island, is formed of Devonian Slates. Dyke and Sill rock of Tertiary origin also form about 2% of the total. The granite, dated as being Permo-Carboniferous, is correlated into three basic types. G.1. is an even rained white orthoclase variety, G.2., a variety with phenocrysts of orthosclase and quartz set in a microgranitic groundmass, and G.3., and G.3a., which are microgranites. The plateau surface is almost level and is bounded on all sides by a steeply inclined sideland, at the base of which are vertical cliffs. In some places the cliffs extend to the full height of the island. Small streams drain the island, and in general their erosive activity has been minimal and virtually all the streams have developed along the joint planes in the granite or along the dip and strike of the slates.

**2. The Geomorphology of the Stream Valley Systems**

All visitors to the island are landed on a small beach on the slate at the south east corner of the island and then ascend to the plateau and island community by a steep track. Initially this keeps to cliff edge and then at about 30 m turns inland and reaches the summit by clinging to the side of two entrenched valleys which brings the road out on the plateau surface just below the church. It was not until I came to live on the island that I recognised the geological importance of these two valleys; Mill Combe and St. John's Valley. Apart from a few small rivulets these two valleys drain most of the island south of the Lighthouse Wall. Only in the northern part of the island, north of Threequarter Wall, is there another system of stream valleys. These are known collectively as Gannet's Combe, and consists of an almost dendritic pattern of seven combes which drain eastwards. The volume of water in the main stream in Gannet's Combe is no greater than that in the Punchbowl Stream which is the largest stream on the western side of the island and whose valley is considerably smaller than Gannet's Combe. These large valleys appear to be somewhat of an anomaly, and although there are several explanations of misfit streams, none of them seemed to be applicable to Lundy. This led me to study the geomorphology with greater interest, especially after I had read Mitchell's paper.

Mitchell reports on the gravels which he found at the north end of the island where much of the granite surface is exposed because of accidental firing of the peat cover in the 1930's. These gravels and the presence of roche moutonees in the area lead him to believe that an ice sheet had passed over the area, and on retreating the outflow had deposited the gravels and had carved the Gannet's Combe valleys. He states that the rest of the island stood up as a nunatak above the surface of the ice and that the none presence of other stream valleys was due to this fact. He somehow failed to recognise Mill Combe, which he must have climbed on his arrival. His paper could not altogether solve the problem of the southern stream valleys as they were a much higher level than those at the north end. Using some 1 : 1,000 maps with a contour interval of 15 ft I began to scour the ground for further geomorphological features.

Both Mill Combe and St. John's Valley begin as U-shaped valleys, but as such they do not extend right down to sea level. St. John's Valley is in a hanging position in relation to Mill Combe at the confluence of the two valleys and Mill Combe ends at 55 m (180 ft) above sea level. Below this the valley is very youthful until it drops over the cliff edge in a small waterfall.

**3. Pliocene Sea Levels**

At various points around the coastal strip of the island there are tors and ridges of granite and many of these have been eroded into almost regular shapes so that they look like steps. Many of these show up on the maps and also occur at the same levels. Afterwards these levels were found to roughly correspond with late Pliocene and early Pleistocene sea levels. On the adjacent North Devon mainland these levels created by the receding Pliocene sea are referred to as the

Georgeham, 131 m (430 ft) and Instow, 85 m (280 ft) levels. It is conceivable that much of the islands plateau surface above the 120 m (400 ft) contour can be correlated to the Georgeham Level. The Logan Stone at the East end of Halfway Wall corresponds to this height. The Instow Level is much more exciting because it is shown up by several physical features, of which the raised cliffs at Jenny's Cove are the most significant. Here all of the upper tors have their bases at 85 m, and one, known as the Cheeses, also extends down to sea level after traversing a step at 85 m. There are also raised beach remnants on the tors on the east side of the island. At Hangman's Hill (139442) there is an odd feature which gives rise to considerable speculation. The hill which is a small eminence on the eastward side of Mill Combe, is separated from the main part of the main slope of the sideland by a col at 85 m (285 ft). The col is also on the line of the dolerite dyke which separates the granite from the slate, and it is also in a direct line with the upper section of the Mill Combe stream.

**4. Interpretation of Pliocene Levels In Relation to Stream Valleys**

Following the change from Georgeham to Instow Levels streams would have established themselves on the new surface in order to drain the enlarged island. With no great catchment areas the small streams would barely have cut furrows in the island's surface and the line of these streams must have been much the same as the higher stream levels today. They have, naturally enough, developed along the joint systems in the granite and down the dip slope on the slates. It would not be unreasonable to suppose that the predecessors of the Mill Combe and St. John's Streams flowed straight down the dip slope of the slate into the sea, and so would be no different to other stream valleys. It is conceivable that a little stream capturing has taken place. The St. John's stream could have developed a tributary along the stike of the slate at a point near to the present Millcombe House gate. As this developed northwards it would have captured the upper waters of the Mill Combe stream, so that the abandoned course through the col by Hangman's Hill would be left high and dry. At this stage the valley systems would still have been V-shaped and not U-shaped as today. While the 85 m level shows up on the coast and in the col, it does not show up in the southern stream valleys, which suggests that some other force has been in action.

**5. Glacial Activity in Relation to the Present Geomorphology**

Mitchell (1965) believes that the ice which reached the Isles of Scilly also passed Lundy, though they only reached the 106 m (350 ft) contour. He suggests that the part of the island above this height stood up as a nunatak, even though it would have been a very low one. His evidence for this is based on features found at the north end of the island, and does not take into account the valley systems at the south end of the island. These features consist of roche moutonees, erratics and the Gannets Combe valley system which Mitchell believes were cut by meltwater. The types of erratics found suggest that the ice came from the Irish Sea area, which means that it would have been coming from the north west towards Lundy. Some of the ice would naturally pass over the lower parts of the island, but some would be deflected south by the mass of the island and the ice would have become progressively thicker until it was possibly thick enough to traverse the southern end of the island. The area south of Beacon Hill where the ice could have passed over to the east is almost flat being just above the 122 m (400 ft) contour. In part it is homocky ground and one area just to the west of the church has been the site of sand excavation in the last century. The greater part of this area is drained by the Mill Combe and St. John's Valley streams and it would have been quite straightforward for the ice to pass down these valleys and widen and overdeepen them. As any ice passing over this area would have reached Mill Combe before St. John's Valley, the latter would have been excavated to a lesser extent which would also explain its hanging character.

In addition to the roche moutonees and erratics which Mitchell mentions there are also several large perched blocks of granite at high levels on the west coast. They really need further investigation to determine how far they have been moved.

The Devil's Slide may also owe its origin to glaciation. This feature is a 91 m

300 ft) long smooth granite face, inclined at about 60 degrees and which has an overhanging summit. The face is not coincident with the joint planes in the granite as it cut these at about 30 degrees. Neither is there any evidence that the face is that of a joint plane with an eroded dyke.

**6. Other Pleistocene Geomorphological Features**

During the Pleistocene era there were three principal interglacial periods during which a certain amount of marine erosion took place on the island. All around the coast of the island remnants of the former shorelines can be traced in the form of caves, cliffs, stacks, and small sculptured features. Some of each of these features can be seen at each of the three levels; Cromerian; 60 m (197 ft), Hoxnian; 32 m (105 ft), and Ipswichian; 15 m (50 ft).

Several remnants of raised beach can be traced on the east sideland north of threequarter wall at both the 60 m and 32 m levels. The Mousehole and Trap (137469) is a short tunnel and on the 'beach' nearby is a small arch and a perched block which give rise to the descriptive title. Just south of Gannets Bay is an under eroded block of granite on the 32 m beach. The three main promontories of the island; Surf Point, Shutter Point and North West Point were probably lowered to their present levels during the Hoxnian Interglacial period which was the longest. On the west coast the 'Double Decker Cave', just north of the 'Devil's Slide, is the most obvious feature illustrating a higher sea level. Very obvious stepping of the most of the tors and promontories on the west coast illustrate the effect the higher sea levels have had on degrading the coast line. It is possible that a more detailed and accurate survey of these levels could be made all around the island. This is especially true on the east coast where it might be possible to date the time of the ice eroding the stream valleys, by determining if there are any post date beaches across the valleys.

**7. Conclusion**

Positively identified features show that at some stage during the Pleistocene period ice played a part in the shaping of Lundy, and proves almost beyond doubt that there was ice in Barnstaple Bay. Other geomorphological features have been mentioned and their possible relation to glacial activity noted. A suggestion has been made to the way in which the age of the ice erosion can be determined, and this is hoped to be the subject of future work.

## ATLANTIC COLLEGE LUNDY PROJECT ANNUAL REPORT FOR 1974

By M. A. McAvity and J. M. Mendelssohn

During 1974 Atlantic College managed to systematise its visits to Lundy, laying the groundwork for future work there. Although there has been no completely definite work done in the course of this year, a good deal of preliminary work was accomplished and a number of difficulties overcome.

In all the College made seven successful expeditions to the Island, which included 54 days in residence or about 700 man days. Before the first expedition, in March, the Lundy boat, X-23, was launched and it has been the backbone of all these expeditions; indeed after this first year of trials we are poised to make full use of this craft's potential. In its speediest passage X-23 made the journey from Atlantic College to Lundy (40 n.m.), fully loaded and with a 12 man team, in 1 hr 35 min.

The seven visits to Lundy can be divided into three categories—weekend excursions, project weeks and one special ex-student expedition. There were three weekend trips, one in April and two in November. These excursions (we normally aim at 4 or 5 days) are primarily to familiarise the new students with the Island and with the open water diving conditions there. These trips have been enormously helpful in regularising our activities and smoothing out our procedure.

The College has three projects weeks a year, two of them consecutively in the first half of September and the other in March. In addition, for the purpose