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Contents

EDITORIAL.

Last October a group of cavers from the University of New England Mountaineering Club got together to form a speleological society. This was done because of increasing interest in caving at UNE, and because a number of our cavers' interests had extended to surveying, documentation and research, particularly in earth sciences. We are also acutely aware of the potential threats to karst areas posed by activities such as mining and dam construction. The flooding of Border Rivers karst areas on the north western margin of the New England Tablelands is a case in point. The current proposals for expansion of quarrying activities at Attunga may also threaten caves in this area. Through our newly formed society we hope to contribute more to research and cave conservation. To fulfil these aims we will be applying for associate membership of the Australian Speleological Federation later this year.

This is the first issue of the U.N.E.S.S. Bulletin, which will be published as a quarterly. It contains some general observations on cave and karst geomorphology in New England, together with an article by Warren Jones which presents the results of his geomorphological work at Wee Jasper last year. The main conclusion drawn is that these caves are very much older than previous workers realised. Work in progress at Bungonia is also radically revising earlier geological interpretations, and the latest discoveries are summarised in the Bungonia trip report. Another trip report describes the Devils Chimney, a rather unusual type of non-karst cave in the Ebor area, where caves are reputed to exist but do not appear to have been previously visited by speleologists.

Towards the end of last year Warren Jones began work on cave geology at Isaacs Creek, Timor. An article giving some preliminary results of this study will be published in the next issue of the bulletin. This year Warren will be joined at Timor by Mark Connolly, who is just commencing a geomorphological study of the Isaacs Creek Cave Area for his honours thesis and will be publishing progress reports in the bulletin.

Because so many people were away over the summer vacation, I agreed as a temporary measure to edit the first bulletin. However it would be quite impossible to continue as both secretary of the society and editor of the bulletin. Consequently a new editor will be appointed at the next committee meeting. I would like to acknowledge the assistance of Mark Connolly who typed most of this inaugural issue.

Geoff. Francis.

OFFICE BEARERS FOR 1978

President: Warren Jones

Secretary: Geoff. Francis

Equipment Officer: Mark Dunn

Trip Recorder: Charlie Peters

Caving equipment such as ladders will be held by Mark Dunn at Drummond College.

CAVES AROUND NEW ENGLAND

Geoff. Francis.

The Origin and Distribution of Caves.

In this region sizeable caves are almost entirely confined to limestone, which is more soluble in natural waters than other rock types. They are frequently associated with surface landforms such as closed depressions which also develop partly through chemical corrosion of the limestone. The caves and other features arising from solution are known collectively as karst forms.

New England consists mainly of granitic intrusions and non-calcareous marine sediments, and is less well endowed with limestones than many other regions in the Eastern Highlands. Nevertheless limestones are prominent in two belts of Palaeozoic marine strata which lie on the eastern and western margins of the New England Tablelands. The eastern belt of marine strata extends westwards in an arc from Kempsey to Kunderang, and includes the Moparrabah, Willi Willi and Carrai karst areas. The western belt runs northwards from the Barrington Tops to Manilla, containing the Isaacs Creek, Glen Dhu and Moore Creek karst areas. In addition there are limestone areas such as Ashford on the northern margin of the New England Tablelands.

Regional Karst Characteristics.

Caves and other karst forms are greatly influenced by the local geology. Since the deformed marine strata usually have moderate to steep dips and the individual limestone units average several hundred metres in thickness, the limestones crop out in narrow belts extending along the strike for distances of five to twelve kilometres. Thus these areas are impounded karsts surrounded entirely by relatively impervious rocks. Streams rising on the impervious rocks flow into the karst areas, at times transporting large volumes of foreign sediments and mechanically eroding the limestones. As a result stream passages like Carrai Natural Arch contain much sand and gravel derived from the adjacent argillites. Streams flowing from catchments of non-calcareous rocks are usually capable of dissolving substantial amounts of limestone. The quantities of water available for limestone solution vary considerably from one area to another, being greatest in the scarp rainforest areas like Carrai and least in the semi-arid western areas such as Moore Creek.

As well as providing large inputs of water and sediment, the adjacent impervious rocks also influence the outputs from the karst areas, acting as local base levels for hydrological development in the limestone. Thus streams with shallow gradients like Isaacs Creek are often able to flow through limestone areas without sinking, since impervious barriers further downstream impede the development of underground water conduits at lower levels in the limestone. This is a major limiting factor in stream passage development.

The Palaeozoic limestones in which karst forms have developed are compact microcrystalline or recrystallised rocks with negligible intergranular porosity. Consequently the underground water circulation is controlled largely by joints and faults of tectonic origin, or less commonly by bedding plane partings. Caves such as Helictite and Belfry at Isaacs Creek are dominated by northerly trending vertical fissure passages formed along two conjugate sets of shear joints which intersect at angles of about 30°. Fault Cave at Willi Willi has developed along a high angle fault which brings shale and limestone together. Because most of the limestones are massive or crudely bedded there are fewer examples of bedding controlled passages, but Moparrabah Main Cave contains well developed dip tubes and bedding plane flatteners.

Cave Genesis.

There are four basic types of cave development exemplified in the karst areas of New England. However, many caves show evidence of a complex evolution with more than one type of development occurring over time.

1. Nothephreatic.

This is a term coined by Jennings (1976) which refers to cave development in saturated zones below the water table, lacking strong directional currents. These caves start out as small solution tubes along planes of weakness and may join to form a spongework of variable sized cavities separated by rounded or cuspateeprojections. Spongework of this type can be found in Main and Helictite Caves at Isaacs Creek. Other solutional features developed under sluggish phreatic conditions are hemispherical wall pockets, bellholes in roofs, and elongated joint wall or ceiling cavities. Many of these features are thought to develop by chemical processes in which waters seeping along fissures mix with a larger body of groundwater and become capable of dissolving more limestone (Bögli, 1971). Am important implication of this principle is that nothephreatic caves can form at depth in the limestone and may only develop surface connections at comparatively late stages in their history. Under favourable conditions large passages may develop by nothephreatic solution. The Ballroom in Main Cave at Isaacs Creek is fifty metres long and ten metres high, formed largely by nothephreatic solution with only minor collapse.

2. Dynamic Phreatic.

If groundwater moves quickly through cave passages under an hydraulic head it will dissolve and erode all surfaces of a passage, producing solutional features characteristic of strong current action. This usually gives rise to elliptical passages with shallow asymmetrical scallops on the walls and roofs. Certain parts of Helictite Cave at Isaacs Creek display these forms. Since scallops are more steeply incut on the upstream side they can be used to determine palaeoflow directions.

3. Vadose Flow.

If air space is present then any underground streams will flow through the cave under the influence of gravity. In addition to scallops this vadose flow may form other solutional features, the most notable of which are planed ceilings and channel grooves. Care must be taken in using flat ceilings as evidence for vadose flow, since similar forms can develop through other types of solution operating along subhorizontal joints, or through solution by standing water. Channel grooves are horizontal incuts which are best developed on the outside of bends in meandering or structurally controlled cave streams. As a stream incises its way down into the cave floor a series of channel grooves may develop at successively lower levels on the cave walls. This has occurred in Carrai Natural Arch.

4. Vadose Seepage.

Percolation water seeping down through planes of weakness in the limestone may dissolve the rock to form relatively simple vertical shafts. However these are often blocked by rockfallor earth fill, since there may be no underground stream to remove debris from the shaft. T.R.19 at Isaacs Creek is a shaft of this type.

Complex Evolution.

Although four basic types of cave evolution can be distinguished some caves have a transitional character. Thus parts of Helictite Cave are pressure passages of dynamic phreatic origin, while other parts show channel grooves and planed ceilings indicative of vadose flow. In this case it appears that these two modes of cave development operated simultaneously in different sections of the same cave. Different modes of development can also occur successively. Carrai Natural Arch contains bellholes and other nothephreatic forms inherited from an earlier phase of development, but is now subject to vadose flow. This change has occurred because groundwater levels were lowered by valley incision downstream from the cave.

Successive phases of development can also occur on a larger scale within a cave area. Thus Main Cave, Isaacs Creek in of nothephreatic origin but is situated near the crest of a ridge about ninety metres above the present valley floor. It developed prior the formation of the valley and was drained of phreatic water during the earlier stages of valley incision. Helictite, Belfry and Shaft Caves formed later, at a time when the valley floor lay fifteen to twenty metres above its present level. In these cases development was mainly of a dynamic phreatic type. However the lower level caves have in turn been drained by further valley incision. Their functions have been taken over by a younger vadose cave, whose entrances were unfortunately blocked during road construction several years ago.

The lowering of groundwater levels and consequent withdrawal of hydraulic support can lead to extensive breakdown of the cave walls and roof, which may continue under conditions of vadose flow or vadose seepage. In Far Cave at Isaacs Creek breakdown was so extensive that the original bedrock morphology has been obscured.

Cave Chronology.

The valley incision which controls successive phases of cave development arises through rejuvenation caused by the epeirogenic uplifts which formed the New England Tablelands. These movements were formerly attributed to the late Tertiary (Warner, 1970) but evidence based on recent radiometric dating of post-Palaeozoic igneous rocks suggests that the uplifts took place much earlier. This allows a longer interval of time for cave development. At Isaacs Creek hills which rise only ten to fifteen metres above the level of the limestone ridge are capped by Tertiary basalts. Similar basalts in nearby areas have been dated as uppermost Palaeocene to lower Eocene (McDougall and Wilkinson, 1967; McDougall and others, 1969; Wellman and McDougall, 1974). Since Main Cave pre-dates the present valley of Isaacs Creek it may have developed at the same time as the erosion surface whose remnants are preserved beneath the basalt caps. In this case the cave would have formed very early in the Tertiary. However it is also possible that the limestone was formerly covered by basalt, and Main Cave developed later in the Tertiary after the limestone was exhumed from beneath a basalt cover.

At Moore Creek the caves are situated in a low ridge overlooking a tributary of the Peel River which has an alluviated valley of shallow gradient. Along parts of the Peel Valley and several of its tributaries there are deeply weathered river terraces of probable Tertiary age which lie ten to fifteen metres above the present river banks. It thus seems likely that Moore Creek cut the valley down to its present level during the Tertiary. Since the caves pre-date the present erosion level they probably extend well back into the Tertiary. Nevertheless many of the New England cave areas contain much younger caves which are developing actively at the present time.

Cave Sediments.

The caves around New England have been infilled to varying degrees with sediments which can be divided into four main types.

(a) Gravity Fill Deposits.

These are derived largely from surface soil which has moved down into the caves largely under the influence of gravity with little or no transportation by water. The soils have usually formed on limestone but have sometimes developed on other rock types which lie upslope from cave entrances or narrow fissures which extend down into the cave. Cave sediments derived from these soils usually show crumb structure or other features inherited from the soil material. Often they form conical mounds in chambers beneath cave shafts.

(b) Fluvial Deposits.

Fluvial deposits are often derived from nearby soils but have been transported into the caves by streams and thus show some degree of sorting and reworking. In addition they may contain well rounded gravels, generally of rock types other than limestone. Bladed or roller shaped pebbles frequently have a preferred upstream dip. This imbrication can be used to determine the former flow direction. Many of the finer grained sediments show lamination resulting from discrete phases of sedimentation separated by longer intercals of non-deposition. Small scale disconformities produced by erosion occur in all types of cave sediments, but are particularly common in fluvial sequences. Sedimentation is not confined to the cave floors, since channel grooves on the walls of caves such as Carrai Natural Arch have been partially filled with stream gravels.

(c) Chemical Deposits.

In New England caves these consist almost entirely of calcite which has been chemically precipitated by percolation water entering the cave. The main types are stalactites, stalagmites and flowstones. However pool crystal may be precipitated from small pockets of supersaturated waters ponded above the main groundwater body, as has occurred in Helictite Cave, Isaacs Creek. The helictites from which this cave takes its name are delicate rods of calcite, generally horizontal but rather irregular and often branching. They have unfortunately been almost entirely destroyed by vandals. The flowstones may have considerable primary dips and frequently consist of prismatic calcite crystals elongated normal to the bedding.

(d) Breakdown.

Breakdown of the limestone walls and roofs can litter cave floors with large blocks of limestone. These are usually bounded by planar joint surfaces separated by angular corners.

Composite Deposits.

Although four main types of cave sediment can be distinguished, many composite varieties occur. Thus blocks formed by breakdown can be cemented by flowstone, as in Far Cave, Isaacs Creek. Elsewhere layers of flowstone may be interbedded with fluvial or gravity deposits. In Carrai Natural Arch a layer of red-brown sandy clay is overlain by flowstone, which is in turn overlain disconformably by yellow- brown clay. Since these clays were fluvially transported the flowstone band is thought to have formed during a drier interval when vadose seepage was dominant over stream flow. The differing colours in the clay materials above and below the flowstone probablyreflect a change in sediment source areas over time.

Periods of erosion can cause further complications in cave sediment sequences. A flowstone canopy projecting from the western wall of the Ballroom in Main Cave, Isaacs Creek is underlain by weakly cemented red-brown sandy clay. Both of these units are underlain by younger dark brown clay loam. This stratigraphic inversion has occurred because part of the older cemented fill was removed by erosion prior to the deposition of the clay loam. Similar inversions are known to have occurred in other caves of Eastern Australia but appear to be comparatively rare. Since there are relatively few speleoligists active in the New England area, it seems likely that many other feature of scientific interest present in New England caves have not yet been identified or investigated.

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The Age of Wee Jasper Caves.

Warren Jones.

Introduction.

Recent evidence for the nature and timing of the Kosciusko Uplift has resulted in a radical change in thinking by research workers who deal with landscape evolution.

W.R. Browne's (1969) account best sums up the traditional attitudes that geologists and geomorphologists until recently held. In this paper he related the physiographic history to five stages:

1) Elevation of a Cretaceous peneplain during the Kiandra Epoch (Oligocene/Eocene);

2) Alluviation of valleys followed by the extrusions of vast flood basalts (Oligocene);

3) Peneplanation and duricrusting in the Miocene;

4) Moderate differential uplift at the close of the Miocene followed by a Pliocene stillstand;

5) Repeated differential uplift, mainly during late Pliocene/early Pleistocene (Kosciusko Epoch) and subsequent rejuvenation of streams and rivers.

This discussion will relate the evolution of the Wee Jasper Creek valley to the new data and ideas in this field of study and establish a chronology for the two major cave systems in the area.

Geology of the Wee Jasper Area.

About twenty kilometres to the south and southeast of the Wee Jasper township are found upper Ordovician sandstones, greywackes, shales and limestones. These sediments are overlain unconformably in the south by late to middle Devonian porphyries and in the southeast by lower Devonian tuffs, dacites and rhyolites. The boundary of these two Devonian sequences occurs along a fault which coincides approximately with the course of the Goodradigbee River, along which upper Silurian coralline limestones outcrop at two places (Edgell, 1949).

To the northwest of Wee Jasper there are lower Devonian rhyolitic tuffs. These are unconformably overlain by the fossiliferous and tuffaceous limestones of the Goodradigbee group (including the Wee Jasper Limestone).

During the late middle Devonian earth movements folded the entire lower and middle Devonian rock sequence into a syncline (Edgell, 1949). A northwest trending fault cuts this syncline obliquely. The Wee Jasper limestone curls about the nose of the plunging syncline and strikes a short distance up Wee Jasper Creek. The beds are vertical or steeply dippingin a northerly direction and thus dip into the syncline. Above the Wee Jasper limestones lie tuffaceous shales, sandstones and conglomerates which are also a part of the Devonian folded sequence. Further west lie late middle Devonian granites and granodiorites which extend northwards to form the valley walls of the Murrumbidgee River at the site of the Burrinjuck Dam.

Denudation Chronology.

In the Wee Jasper Creek valley at a height of about sixty metres above the present floodplain, there can be found remnants of a bench. This consists of Tertiary iron cemented quartz pebble river terrace conglomerates which are capped by Tertiary basalts. These deposits which are remnants of a former valley floor are important in determining the age and nature of the Kosciusko Uplift. Until recently workers such as Craft (1933), Edgell (1949) and Browne (1969) had assigned the final major uplift of the Eastern Australian Highlands to the Plio-Pleistocene, and believed that the extrusion of the younger Tertiary basalts occurred during the later stages of uplift. Wellman and McDougall (1974) dated these basalts using K-Ar methods and found them to be from 22 to 18 million years old (lower Miocene). In the Wee Jasper area, the basalts lie only about sixty metres above valley floor levels in the Monaro province. Wellman and McDougall (1974) used this sort of evidence to support the view that there had been differential uplift between provinces. That is, since the lower Miocene basalt extrusion 600 to 650 metres of additional uplift had occurred in the Monaro province, but only about sixty metres of post basalt uplift had occurred in the Wee Jasper area.

This interpretation by Wellman and McDougall was based on the assumption that, as an area is uplifted, the streams and rivers in the area will incise into the rock at a uniform rate along their thalweg, however Lester King (1967) showed that when an uplift occurs, the streams of the older landscape are then rejuvenated, and incise themselves in the form of youthful, second cycle valleys below knick-points (rejuvenation heads) which gradually pass upstream from the base level. Thus a more plausible interpretation of the benches would be that, in the Monaro province, the rejuvenation of streams due to uplift has occurred, and the rejuvenation heads have progressed upstream to their present positions, meeting geological obstacles while doing so.

In the case of the Wee Jasper area, the rejuvenation head has moved up-stream along the Murrumbidgee River, but has met resistance at the granitics that occur in the area of Burrinjuck Dam. These late middle Devonian granites and granodiorites are more resistant to stream incision than the stratified rocks, and so the full extent of the rejuvenation head was not able to progress further upstream (Jennings, Reider and Francis, in press). This means that the granitics act as a local base levelso that a second smaller knickpoint developed upstream of the granitics and progressed further upstream along the Goodradigbee River. The 60m difference between the basalt capped benches and the present level of the flood plain indicates that only about 60m of post basalt incision into the granitics has occurred. Thus the difference in heights between the valley fill basalts that cap the bench and the present floodplain levels between the Monaro and Kosciusko provinces is not the result of differential uplift after the extrusion of the basalt as previously thought, but rather the product of differential stream incision.
The basalt extrusion thus occurred after the last main uplift, which may have taken place as early as the Cretaceous.

Cave Genesis.

Dip Cave lies about 150m up the eastern side of the Goodradigbee River valley about 5km south of the Wee Jasper township. It is found near the top of the limestone which outcrops on the spur, Below the cave is a valley side bench, while further up the spur impervious shales crop out (Jennings, 1963). The nature of this inactive cave is a response to two major factors: the character of the limestone; and the nothephreatic (Jennings, 1976) nature of the underground water which formed the cave.

Jennings (1963) observed bell holes, roof blades, rock pendants, and spongework in Dip Cave. He also noted that the cave exhibits no signs of a branching river system but rather shows an integrated network origin, and also that the connection between many of the series is one of collapse rather than a water eroded one. Jennings concluded that the water that formed this cave was slow moving or sluggish, and beneath the water table.

The extremely geometric plan view of this cave is due to the pronounced variability on the solubility of different limestone beds. These beds, which dip vertically and strike 115°, are intersected by a joint set and the nothephreatic nature of the solution has allowed these structures to govern the development of this cave.

The Punchbowl-Signiture Cave fails to show the strict structural control that is evident in Dip Cave. The overall trend of the cave is west to east, and this is at an angle to the strike of the limestone beds. Some bedding and joint control (Jennings, 1964) is evident in the orientation of passages and chamber walls, but this is not pronounced.

Many of the passages are elliptical in cross section, characteristic of passages that were completely filled with water which was moving under hydrostatic pressure. The wide flat roofs of many of the chambers and some of the passages are the result of meandering in the underground stream when the level of its outflow to the surface was fixed for a period of time. This is the result of epiphreatic (Glennie, 1958) or fairly fast water table surface flow. The flat roof represents the surface of the water table at that time, so that this feature represents a period of development of the cave which is related to a stillstand in the surface of the stream with which the water table was associated. A number of tall narrow passages also occur in this cave. These are vadose passages which the stream has rapidly incised down through the limestone. Jennings (1964) used these flat solution roofs and tall narrow passages to obtain a history for the development of the cave which involves four levels of epiphreatic flow separated from each other by periods of vadose downcutting.

Age of the Caves.

The entrance and roofs of upper levels of the Punchbowl-Signature Cave lie topographically only about 12m higher than those of the Dip Cave. Because of the nature of the processes forming the two cave systems (Punchbowl-Signature Cave was formed by the action of water close to the surface of the water table while Dip Cave was formed by water at greater depths in the water table) it is evident that Dip Cave started to form before the Punchbowl-Signature Cave. However minor current markings found in Dip Cave indicate that some water flow was occurring. This indicates that while Dip Cave was the first to start developing, there was probably not a great deal of time between the two.

The bench mentioned earlier occurs approximately 60-70m above the floodplain of the Wee Jasper Creek (Jennings, 1967) and corresponds very closely with the entrance and upper levels of Punchbowl-Signature Cave. Because of this close relationship between bench and cave the 20 million year dating by Wellman and Mc Dougall (1974) for the basalt lying on the former valley floor may be applied to the Punchbowl-Signature Cave. This would mean that, during the lower Miocene, both the extrusion of the basalt and the development of the upper levels in the Punchbowl-Signature Cave were occurring. As seen earlier, Dip Cave started to develop before Punchbowl-Signature, so that the Dip Cave was probably forming early in the lower Miocene, or possibly in the late Oligocene. This is much earlier than suggested by Jennings (1976).

Some 20m below the entrance of Dip Cave is a valley side river terrace. This terrace, which represents a period of no downcutting by the river, must correspond to one of the epiphreatic phases shown by Jennings (1964) to represent a vertical stillstand in cave development. In terms of elevation this terrace corresponds very closely with the lowest level of Punchbowl-Signature, and may be a product of the same event. Unfortunately no age is available for this terrace and so it is not possible to establish the time of cessation of development of the Punchbowl-Signature system.

The new ideas about the evolution the Southern Tablelands are leading to fuller and more meaningful interpretations of the geological and geomorphological features in cave areas. Earlier works such as those of Jennings (1963; 1964) on Punchbowl-Signature Cave must now be reinterpreted in the light of the new denudation chronologies. It seems likely that many of our caves may be much older than previous workers realised.

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TRIP REPORT.

The Devils Chimney, Ebor, 29/10/77.

Charlie Peters

We set out to locate and explore a hole known as the Devils Chimney which was reputed to lie west of Ebor Falls. After some walking and finding nothing we were finally able to contact a local resident who gave us accurate directions to the hole. This hole was located about 2.5km west of the falls. Several small holes and a large chasm have developed along a fracture in basalt which runs to the northwest. The fracture is about 80m long, up to 4m wide and in places about 25m deep. It lies 15m back from the edge of a large cliff and runs parallel to the cliff. A second smaller fracture of similar trend lies between the main one and the cliff. The wall of the large fracture on the cliff side dips away from the cliff, while the other wall is near vertical. Geoff. Francis has suggested that that the fractures probably formed through tension caused by slumping along the cliff line.

The chasm has been known to the local people since the late 19th century when chinese people had market gardens on the basalt flow bench near the cliff, but the site does not seem to have been previously recorded in the speleological literature. A further trip should be run to this area to survey the chimney and take a closer look at the local geology.

Those Taking Part: C. Peters, M. Dunn, L. Bertoggi, S. LEE, G. Lee.

TRIP REPORT.

Some Hot Dry Geologising at Bungonia, 5-11/12/77.

Geoff. Francis

Present: G. Francis, W. Jones, T. Whyte, and A. Osborne (SUSS), accompanied by hordes of friendly flies.

With heat wave conditions and a bushfire burning near Tolwong Mines we could hardly have chosen worse conditions for surface work. Nevertheless we completed geological traverses of the area between Adams Lookout and College Cave, the floor of Bungonia Canyon and the upper slopes of the canyon, together with some underground work in B 4. The trip was intended to finish on Sunday 12th but the reserve was closed because of the approaching bushfire on Friday 10th. The following day we went with Julia James to the slopes below Frome Hill and could see flames leaping from ledge to ledge on the opposite side of the gorge near Cooeeing Point.

The main results of the geological work are summarised below:

1. The Bungonia Caves area has a simpler stratigraphy but a much more complicated structure than previous workers realised. There has been considerable repetition of strata by strike faulting, with both the eastern and western contacts of the Lookdown Limestone being faulted. The strata which were termed Cardinal View Shale by Counsell(1973) and thought to post date the Lookdown Limestone are actually part of the Ordovician Tallong Beds. The Folly Point Limestone which lies to the west appears to be a repetition of the upper part of the Lookdown Limestone.

2. A major thrust fault is exposed on both walls of the gorge. The fault has an average westerly dip of about 20° but is gently curved in section. Thus the argillites which crop out between the two belts of cavernferous limestone are cut off by the thrust and do not extend down to the level of the gorge floor. Consequently the underground drainage which is known to flow from Drum Cave to Odyssey Cave can pass beneath the impervious barrier, probably following younger cross faults extend down into the limestone on the footwall of the thrust.

3. The Lookdown Limestone and the Sawtooth Ridge Limestone do not extend as continuous belts through the caves area but are broken by faulting. To the southeast of Adams Lookout the Sawtooth Ridge Limestone is offset by the Odyssey Fault and two other cross faults. (The straight, easterly trending reach on Bungonia Creek has developed along one of the latter faults). With each successive strike separation the outcrop width of the limestone is drastically reduced, until it is finally cut off by a fault along the gully to the west of Odyssey Cave. Narrow outcrops of limestone reappear on the same strike line to the west of Serpentine Cave but these must be small lenses or fault slivers.

TheLookdown Limestone is cut off by faulting between Drum and Grill caves and between Phoenix Cave and Becks Gully. Counsell(1973) believed that the limestone extended continuously through this area and was locally concealed by a cover of ferruginous sediments. Closer examination of the ferruginous rocks has revealed that many of these are Tallong Beds which have been weathered but still show traces of structures such as bedding and cleavage. Relatively unweathered argillites and siliceous mudstones crop out between B 11 and Drum Cave and in the lowest part of the Grill Cave doline. Consequently the underground drainage from Grill to Drum also passes beneath impervious rocks, probably following younger high angle faults. In Drum Cave the Railway Tunnel has developed in an extensive stylobreccia zone which probably lies immediately below the thrust. In places pressure solution has been so intense that all the carbonate has been removed from the limeston. X-ray diffraction analyses carried out on samples collected on a previous trip (Handel,1977) have shown that this stylocumulate consists mainly of illite, quartz and plagioclase with traces of pyrolusite, pyrite and apatite.

Apart from these complete breaks in the belt the limestone is also offset by a cross fault at B 4. In one spot the impervious rocks to the east and west of the limestone lie only60m apart. Since the faulted eastern contact of the limestone dips about 60° west and the faulted western contact has a near vertical dip, the limestone at this point is cut off by faulting at a depth of approximately 100m below the plateau surface. Further down limestone would again be found on the footwall of the thrust but at a particular level within the B 4 area there is a geological barrier to underground drainage which could have prevented it from going northwards to the gorge.

4. An examination of B 4 has shown that there are scallops indicating northward current flow in the passage which runs south to connect with B 5. Current markings indicating a similar flow direction in B 5 have previously been noted by Jennings and others(1972) who suggested that water from B 5 formerly joined southerly flowing water from B 4 near the 10m pitch. From the new structural data now available it seems likely that both B4 and B 5 formerly drained northwards to the old springs at Cooeeing Point which have been described by Francis(1977b). However the development of new underground conduits to the gorge at lower levels was hampered by the geological barrier and subsequently the drainage from Drum Cave found a flow route to Odyssey Cave in the limestone beneath the thrust. With the development of the B 4-5 Extension the Drum-Odyssey system captured the waters from B 4 and B 5, partly reversing the older underground drainage system.

5. The belt of limestone which extends north from Odyssey Cave is cut off by faulting at the Efflux. In this area the trend of the Folly Point Fault swings back to the west of north and the fault runs down to the bend in Bungonia Creek which lies just upstream from the confluence with Bretons Creek. The southeasterly flowing reach of Bungonia Creek upstream from this bend has formed along the fault. The fracture at Rift Cave is a splay fault which branches off the Folly Point Fault and itself appears to be braided.

6. B 29 which is situated on Folly Point is an old spring site. The cave has developed on shears associated with the Folly Point Fault, and contains a muddy calcite cemented pebble conglomerate with rounded clasts of vein quartz, quartz-veined sandstone and ferricrete. This spring lies more than 350m above the gorge floor and must have been active prior to substantial development in Odyssey and Spider caves. Chalk Cave lies nearby at a slightly lower level and contains wall pockets suggestive of nothephreatic solution. It may have formed prior to or about the same time as the B 29 spring. The discovery of yet another old spring located in a fault zone implies that the development of underground drainage at Bungonia has been largely fault controlled.

7. Acloser examination of the top waterfall on Bungonia Creek has revealed that the quartz porphyrite dyke previously noted by Francis(1977a) is cut off by a fault which was overlooked in the earlier reconnaissance. Thus the dyke does not extend across the creek and the waterfall lies on the fault face itself.

8. The section of Lookdown Limestone exposed at the base of the inner canyon shows that the entire unit has suffered considerable pressure solution. The breccia on the eastern contact with the Tallong Beds which was previously interpreted as an intraclastic sedimentary feature by Flinter(1950) is actually a stylobreccia formed by faulting. Further to the west in the section there is a zone of thinly stylobedded to stylolaminated limestone associated with the Cooeeing Point Fault, and this passes upstream into massive, heavily recrystallised limestone with several generations of sparry veins and areas of manganiferous stylolites. The observation made by Jennings and others(1972) that "Stylolites are occasionally encountered." is a masterpiece of geological understatement.

References.

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TRIP REPORT.

Crawney Pass, 5/2/78.

Geoff. Francis

Present: G. Francis, C. Peters, M. Connolly, N. Connolly, A. Connolly.

The purpose of this trip was to carry out a quick reconnaissance of the Crawney Pass area to see whether it was a suitable site for the research project in karst morphology that Mark Connolly will be doing for his honours thesis. Initially we descended Suicide Hole, which contains spongework and rock pendants indicating a nothephreatic origin for the cave. Nevertheless the cave is too small to provide an interest comparable with those at Timor and in the Macleay Valley. We also intended to have a look at a nearby cave which Charlie had previously visited, but the entrance was overgrown with blackberries and would have required clearing with a machete.

The remainder of the day was devoted to surface trogging. The area of limestone outcrop is comparatively wide but does not extend along strike for any distance. It appears to consist of a gently folded anticline but the structure is complicated by faulting. The southern and eastern contacts between the limestone and adjacent mudstones are faulted and there are several shear zones running through the limestone which may be associated with strike faults. Although solution flutes are relatively abundant larger scale forms such as dolines appear to be almost entirely absent. After the reconnaissance we concluded that the area had far less to offer for a detailed karst research project than other parts of the Timor Karst Region.

FUTURE ACTIVITIES.

28th February: Robb College at 5.30pm- Speleosports.
A simulated caving obstacle course will be set up for members and prospectives to try their skill.

11-12th March: Timor - Introduction to caving for prospectives. C. Peters (L)
11-12th March: Bungonia - N.S.W. Cave Rescue Group practice. G. Francis

19th March: Ebor - Surveying the Devils Chimney. C. Peters (L)

24-27th March (Easter): Timor - Geomorphological studies. M. Connolly (L)

8-9th April: Macleay Valley - Geomorphological reconnaissance. C. Peters (L)

22-23rd April: Timor - Geology and geomorphology. W. Jones (L)

6-14th May: Timor - Geology and geomorphology. W. Jones (L)

Informal weekly meetings will be held on Wednesdays at 1.30pm in the small courtyard below the Co-op. Bookshop, commencing on 8th March.

Places to Contact Trip Leaders.

M. Conolly: Geography Honours Room.

G. Francis: Geography Room A9; Robb College (Ext. 2072).

W. Jones: 113 Jeffrey St, Armidale.

C. Peters: 143 Markham St, Armidale.