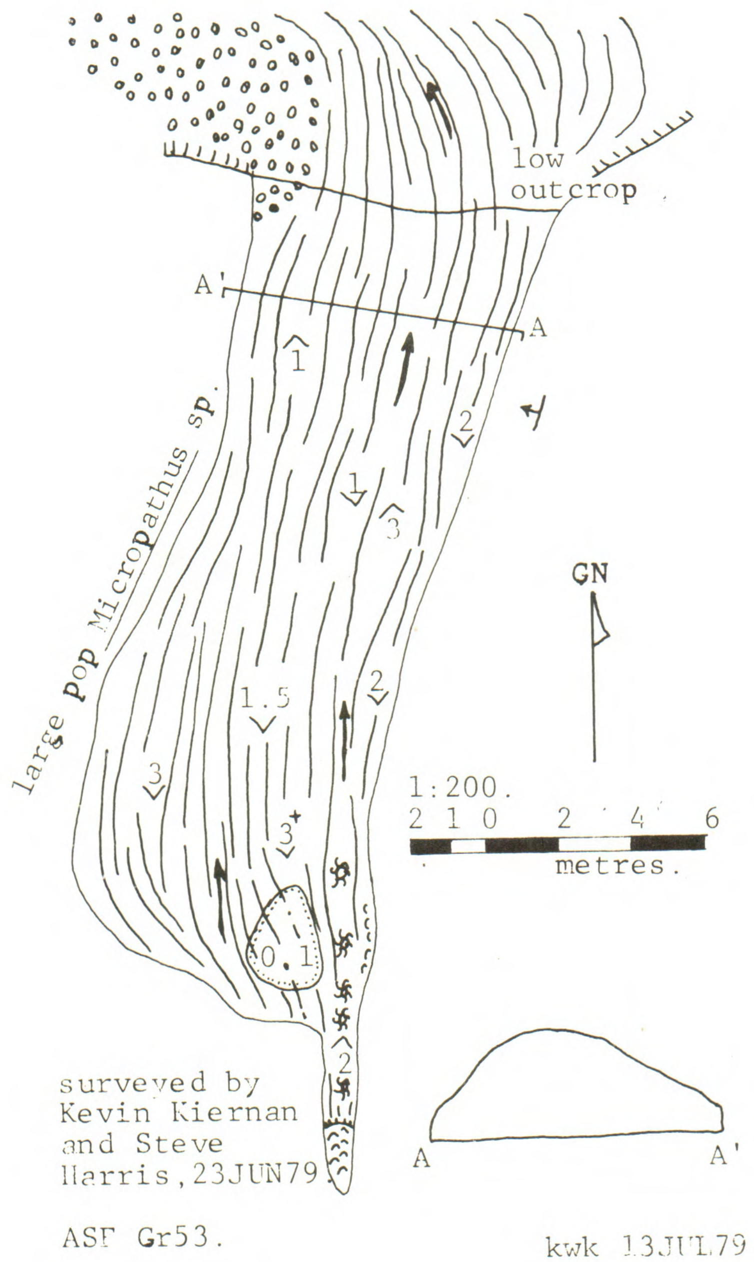
SOUTHERN CAVER

Volume 11, number 4



JULIUS RIVER OUTFLOW CAVE

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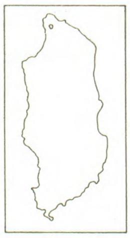

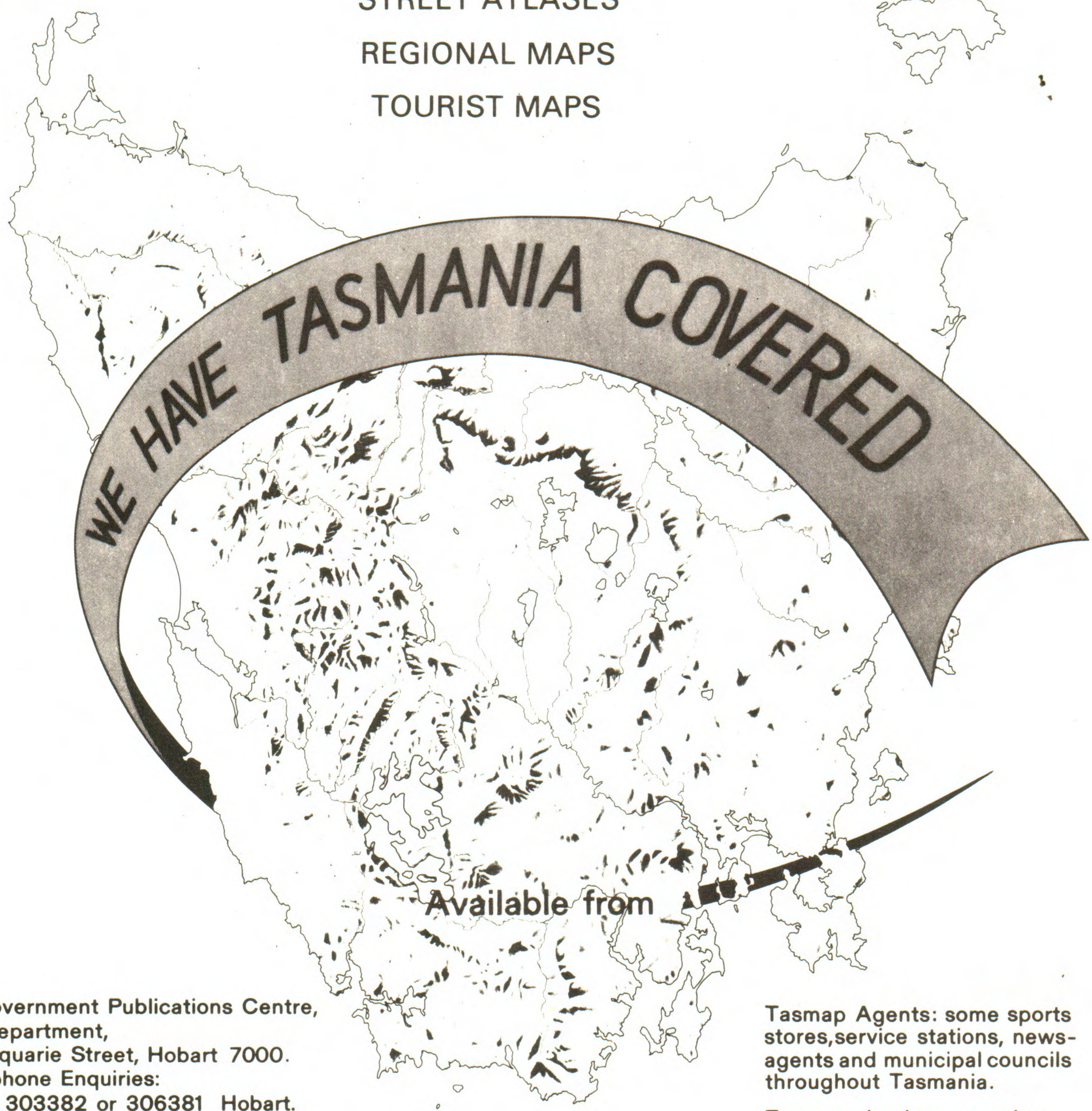

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CONTENTS; Page

MISREPRESENTATION AND THE GORDON - FRANKLIN ISSUE

The Southern Caving Society was one of a number of recipients of a circular letter from the Hydro-Electric Commission inviting comment on aspects of the proposed Gordon-Franklin damming project specific to their particular interests. The letter undertook that all comments received would be taken into account in the final report preparation.

On the 29th May, 1979 the Society replied as follows:

> "The Society wishes to thank you for contacting us through your letter of 11th May, 1979 (ref 06980) about the Lower Gordon, Franklin and King Rivers potential for hydro electric generation.
>
> The members of the Southern Caving Society are prepared to co-operate and assist in the assessment of the speleological aspects of the area. As you would know the full speleological potential of this wilderness area has not yet been defined. As a member society of the Australian Speleological Federation we can offer our expertise and that of other A.S.F. member societies in the field of Speleology.
>
> We note that the Sydney Speleological Society, P.O. Box 198, Broadway 2007, N.S.W. has conducted various exploratory expeditions in the areas concerned and also that Mr. Kevin Kiernan, 9 Benjafield Terrace, Mount Stuart 7000 has an extensive personal knowledge of these areas. Valuable information could be obtained from these sources.
>
> If you have any specific need for information or investigation please contact us and if at all possible we will endeavour to assist."

On page 302 of the Commission's report the Society is cited as a body responding to the Commission's invitation to comment. The preceeding page alleges that "Comments given were taken into account in the final preparation of the draft statement". That assertion is patently false. In truth, neither the Society nor Kevin Kiernan were subsequently contacted by the Commission for information, let alone any cognisance taken of information they may have been able to provide with respect to caves and karst in the area. Kevin Kiernan was later shown a copy of the report while visiting the Commission's offices for another purpose, but was told it was too late for comment.

The Society strongly refutes any suggestion that its knowledge of the area was in any way taken into account in framing the draft statement and suggests that the untruths perpetrated there-in places in doubt the integrity of the document.

The cave study appended to the draft report is incomplete, inadequate and incompetent. We must condemn it in the strongest possible terms and dissociate ourselves from it entirely.

EDITORS.

MORE NORTH-WEST TASMANIAN KARST : THE JULIUS RIVER - LAKE CHISHOLM AREA

Kevin Kiernan

Although many would regard the continued inroads of logging operations into the magnificant forest of the Arthur River area with concern, for better or worse it has meant a spreading network of roads and clear-felled coups across extensive areas of Precambrian dolomite and limestone previously little known to the speleologist. In recent years this has led to the discovery of a small cave area developed near where the Julius River, a small north-flowing tributary of the Arthur, disappears briefly underground through a low ridge. Most of the caves were first explored by foresters. An early visit to the site by the Southern Caving Society was recorded by Harris (1975) and the present item represents an elaboration upon that report in the light of more recent investigation and surveying.

Caves and dolomite in north-western Tasmania.

Precambrian and Cambrian dolomite and limestone is widespread in the NE corner of Tasmania to the extent that local promotional material (probably erroneously) suggests the Circular Head municipality possesses "the largest known dolomite deposits in the Commonwealth" (Anon, 1966). Large areas have been cleared of forest without revealing major cave systems but for a few locallities, and much of the dolomite is characterised by low relief, sometimes swampy terrain.

Near the village of Trowutta is a spectacular natural arch. Further north at Montagu, two principle caves and a number of smaller holes were recorded by Kiernan (1973) who also drew attention to bone deposits in some of the caves. In fact the caves of north-western Tasmania have proven to be a treasure trove of such paleontological material, and it is perhaps this for which they are best known, the Montagu site itself revealing a rich fauna including a number of extinct species from one small hole (Murray and Goede 1977) and other material, including Thylacoleo from Main cave (Murray pers. comm.) This material probably dates from subsequent to the peak of the last glacial (18,000 yrs. B.P.). Other bone material revealed in a cave fill during quarrying operations at Scotchtown a few kilometres south of Smithton included a rich megafauna with further giant kangaroos and giant emus, (Fysh and Yaxley 1966). Elsewhere in the area bone material has been recorded from Mowbray Swamp (Gill and Banks 1956) and from Pulbeena swamp, an old spring fed lake basin near Irishtown. At Rodpa, 30 km. N.W. of the area now under discussion, a number of caves occur in similar circumstances to those at Montagu and again there are at least reports of bones, but this time revealed and destroyed during bulldozing operations (Kiernan 1974b). No bone deposits have been recorded from the Julius River caves to date.

Geology.

The general geology of the area has been discussed by Longman and Mathews (1961a). The potentially karstic rocks are the Smithton dolomite and a cambrian dolomitic breccia which overlies it. The Smithton dolomite consists of grey dolomite and blue grey chert with minor occurrences of dolitic limestone, black and white chert and carbonaceous siltstone. It has a stratygraphic thickness of up to 400m.

The dolomitic breccia is comprised of angular and rounded fragments of dolomite and chert, larger towards the disconformable base. The stratigraphic thickness varies from 6m. near Blackwater Rivulet to 100m. near Trowutta. Complex folding has occurred on several scales, with the dominant trends NE and NNW and lesser E-W trends. (Longman and Mathews 1961a).

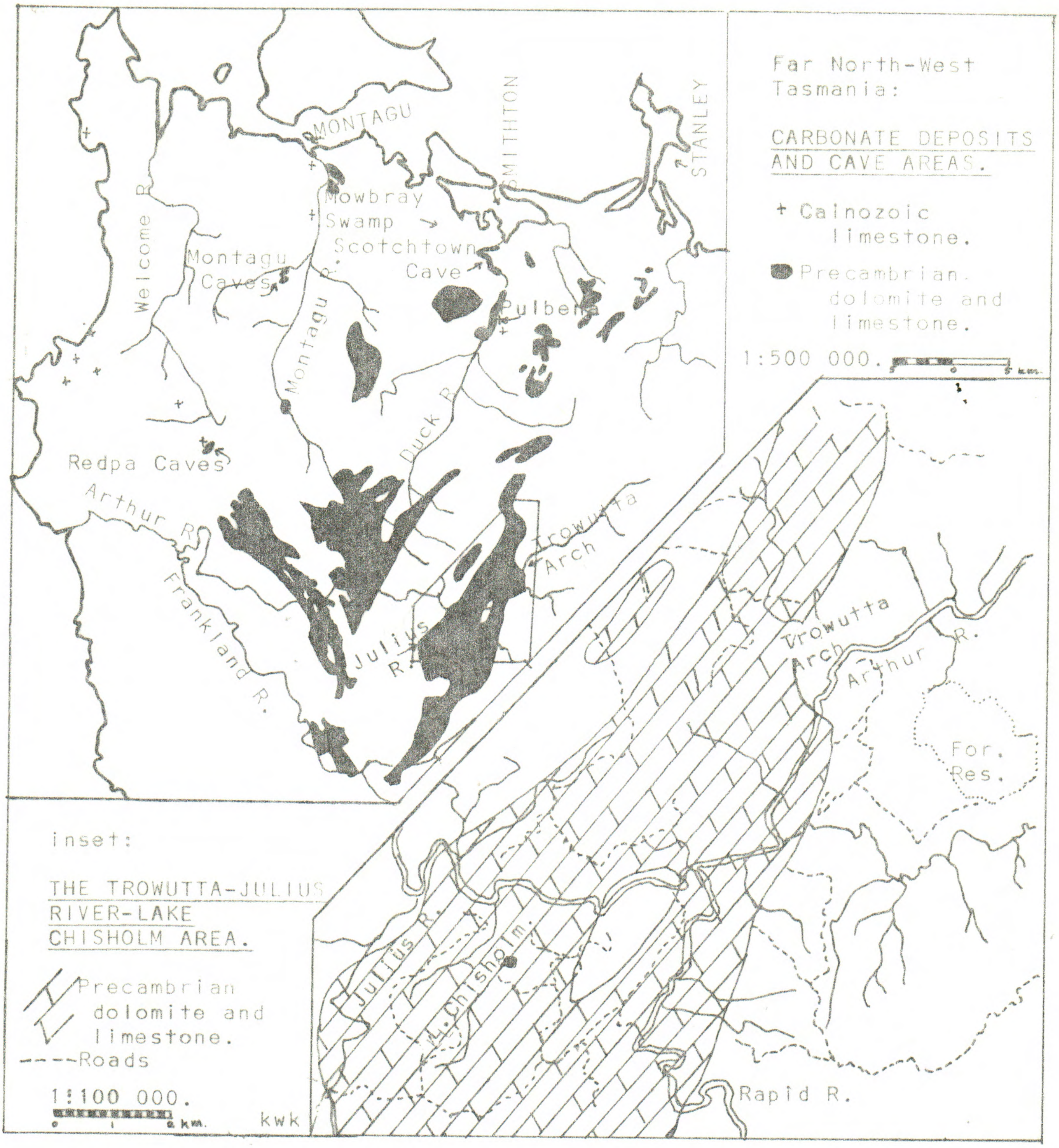
Although petralogical samples have not been examined for the Julius River caves area or from Trowutta Arch, the caves at Redpa are developed in the colitic limestone which has resisted dolomitisation (Longman and Mathews 1961b). Samples from Montagu have also proven to be limestone (Kiernan 1973) and the Scotchtown cave was also developed in limestone (Gulline 1959). Together with the frequent low relief and overlying deposits this may help explain the paucity of cave development in the total carbonate deposits.

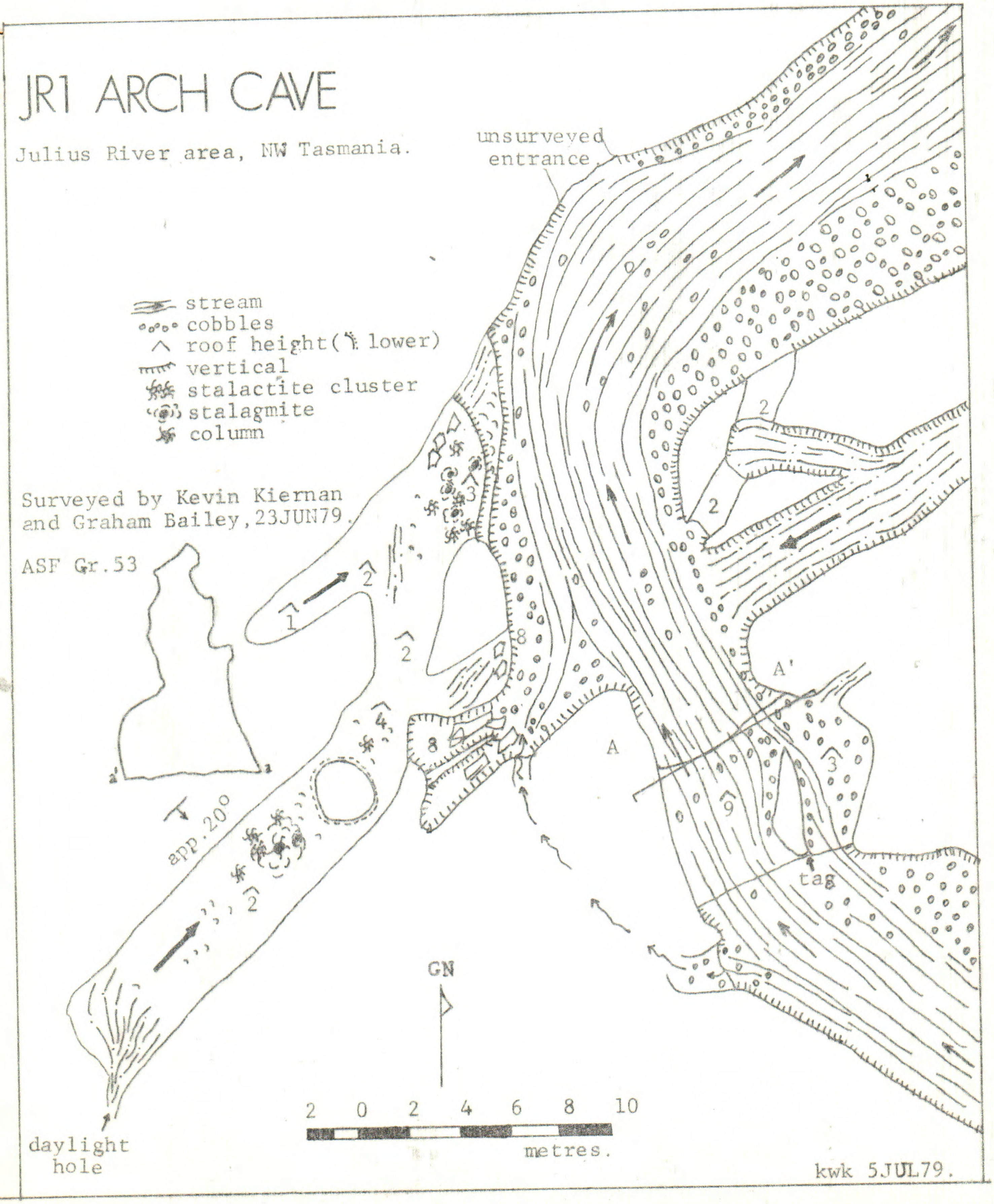
The Julius River - Lake Chisholm area lies south of the Arthur River at the broadest part of an outcrop of dolomite extending from Nabagena, through Trowutta and south wards almost to Balfour, a distance of some 30 km. The maximum width of the outcrop is 8 km. (Williams and Turner 1973). North of the Arthurs much land has been cleared for foresty and pastoral purposes. Sinkholes are widespread but few caves are known. The best known karst feature is a spectacular natural arch linking a series of steep sided sinkholes south-east of the township of Trowutta (Kiernan 1974). The chequered history of a "Crown Lands Reserve covering this feature has been documented by Kiernan (1974c), but recently it has gained improved protection through gazettal as a State Reserve under the National Parks and Wildlife Act. South of the Arthur three Forest Reserves have been established by the Forestry Commission but have little legal standing and are inadequate to protect representative samples of these remarkable forests. One reserve, at Milkshake Hills, reflects the tendency towards window dressing and nominal reservation through protection of residuals left over after development has progressed unabated, in being almost entirely lacking in forest vegetation in the first place. The two other forestry reserves have been established over the Julius River caves (85ha) and Lake Chisholm (190 ha.) (Anon 1979).

Evolution of the area.

The most striking topographic feature of the area is a wide emergent plain, from which rise more resistant hills capped with Tertrary basalt. This plain constitues part of Davies lower coastal surface, rising from less than 60m. near the coast to 240m. further inland (Davies 1959). This uplift is more recent than the early Miocene sediments it truncates, and postdates the late Pleistocene sediments which are superimposed. Van de Geer, Colhoun and Bowden (1979) describe marine sediments overlying dolomites and Tertiary limestones from this part of the state where they occur up to 20m. above present sea level and interpret them as a single interglacial marine sequence, occurring at a higher elevation than features of equivalent age elsewhere in south-eastern Australia due to differential tectonic instability and perhaps hydro-isostatic responses of the region during the late Quaternary.

The Arthur River probably originated as a consequent stream, flowing into Bass Strait by either the present Duck or Montagu Rivers, most likely the former. In the early Tertiary it trended E.N.E. through Trowutta towards Stanley but by the end of the Pliocene infilling of the valley with basalt, alluvial, palludal and other sediments ocurred to a depth of over 150m.


Far North-West Tasmania:
CARBONATE DEPOSITS AND CAVE AREAS.
+ Cainozoic limestone.
Precambrian dolomite and limestone.
1:500 000.
5 km.
MONTAGU
SMITHTON
STANLEY
Welcome R.
Mowbray Swamp
Scotchtown Cave
Montagu Caves
Montagu R.
Pulbeena
Duck R.
Redpa Caves
Arthur R.
Frankland R.
Julius R.
Trowutta Arch
inset:
THE TROWUTTA-JULIUS RIVER-LAKE CHISHOLM AREA.
Precambrian dolomite and limestone.
----Roads
1:100 000.
0 1 2 km.
kwk
Trowutta Arch
Arthur R.
For. Res.
Julius R.
L. Chisholm.
Rapid R.



JR1 ARCH CAVE
Julius River area, NW Tasmania.
stream
cobbles
roof height(lower)
vertical
stalactite cluster
stalagmite
column
Surveyed by Kevin Kiernan and Graham Bailey, 23JUN79.
ASF Gr.53
unsurveyed entrance
app.20°
A
A'
tag
GN
2 0 2 4 6 8 10
metres.
daylight hole
kwk 5JUL79.

Subsequently it formed a new course on the western side of its old valley where it became established in the less resistant dolomite forming the wide and open valley which is now the Duck River plain. (Nye and Blake 1938). This plain extends to the Arthur whereas the Duck River drainage does not, the Montagu draining the Southern part and the nearest waters of the Duck only 10m. above the Arthur. It is likely that a westerly flowing coastal stream captured the upper Arthur, diverting it to the west coast, while the former lower Arthur became the present Duck. For this there may be some biogeographical support, Nye, Finucane and Blake (1934) noting the presence of blackfish (Gadopsis marmoratus) in the Arthur, representing the only west coast stream containing this species (at least at that time), usually restricted to streams entering Bass Strait. The area was affected by the glaciations of the Pleistocene through sea level fluctuations. Evidence from pulbeena swamp suggests colder and drier conditions prevailed during glacial episodes, with a more open and grassy vegetation. (Colhoun 1979).

Caves and Karst.

Thus while starting as a consequent stream for a variety of reasons the course of the Arthur is now more complex. Subsequent streams controlled by regional strike or preferential entrenchment in dolomite contribute from the south. The Julius River is one flowing from the south to impinge the dolomite outcrop whereupon it follows the strike of the dolomite beds and becomes entrenched in a steep sided valley. The caves are developed where it passes through a low ridge at an elevation of 100m. above sea level. Lake Chisholm lies some 3 km. to the SE and is nearly 400m. long and of unknown depth, occuppying a sinkhole or perhaps a series of inter-connected sinkholes. The carbonate areas are characteristically flat, low lying and swampy with internal draingage, occurring at an elevation above sea level of 30-60m.

The Julius River caves area thus a fairly recent phenomenon and younger than much of the dolomite surface. They lie close to the western margin of the dolomite. The principle eastern tributary of the Julius is known as the Little River and originates on the southern most part of the outcrop, flowing 2 km. across it from the vicinity of the fault which probably forms the eastern margin onto the underlying material. It passes across a small area of basalt before again encountering the dolomite. Some 2 km. further on is the confluence with the principle western tributary where the latter impinges the western margin of the Smithton dolomite after flowing 1.5 km. across the dolomitic breccia. The caves lie a further 1.5 km. downstream of the confluence. Upstream of the caves the river is essentially strike oriented but it passes through a series of minor folds with axes aligned NE-SW. The stream is underground for some 200-300m., rising again where it flows generally up dip onto the dolomitic breccia which underlies the final 2 km. of its course to the Arthur.

Lake Chisholm is a sheltered and sombre lake of extrordinary beauty and tranquility. A well made track now winds from a forestry road down around a series of small sinkholes to its shore, where trees bend over placid waters rippled occasionally by a platypus or breeze. It is 400 x 200m. in extent, and of karst origin. It drains via an ephemeral stream bed into a series of shallow sinkholes at one end. No bare limestone is exposed in the immediate vicinity which is generally low lying and pock-marked with sinkholes.

The Julius River caves.

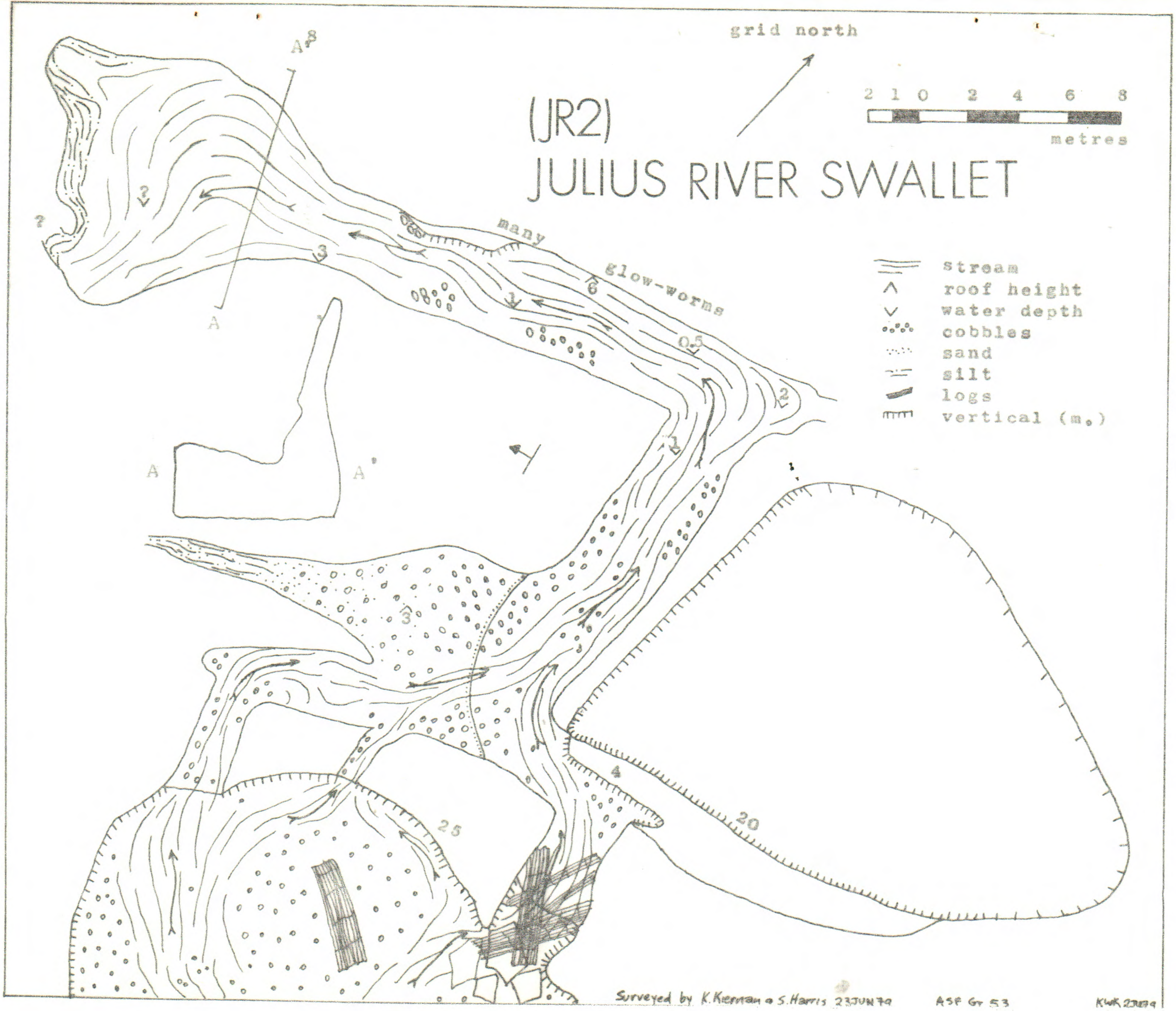
Although minor solution cavities occur in the banks of the Julius the first principle cave is the Arch (JR 1) which lies some 100m. upstream of the Julius River swallet (JR 2). Between the two are several smaller entrances and a minor talus maze system where much of the river is diverted through a subterranean meander cutoff. Between the inflow and the outflor cave are a number of minor pots and it is possible not all have been explored. An overflow valley of low gradient extends beyond the semi-blind valley where the river sinks its floor about 8m. above stream level at that point. This section of valley contains at least two small caves, the southern most itself an inflow cave, drawing its water from an anabranch of a small west flowing tributary which intersects the overflow valley about half way between the Julius River swallet (JR 2) and its outflow (JR 5) and which maintains a surface course to the latter. Logs jammed in the main fissure entrance to the Julius River Swallet some 10m. above normal stream level attest ponding of waters under flood conditions to a level at which they overflow into the valley and ultimately reverses the direction of the anabranch's flow back to join its stream of origin and thence fellow a surface course to the resurgence.

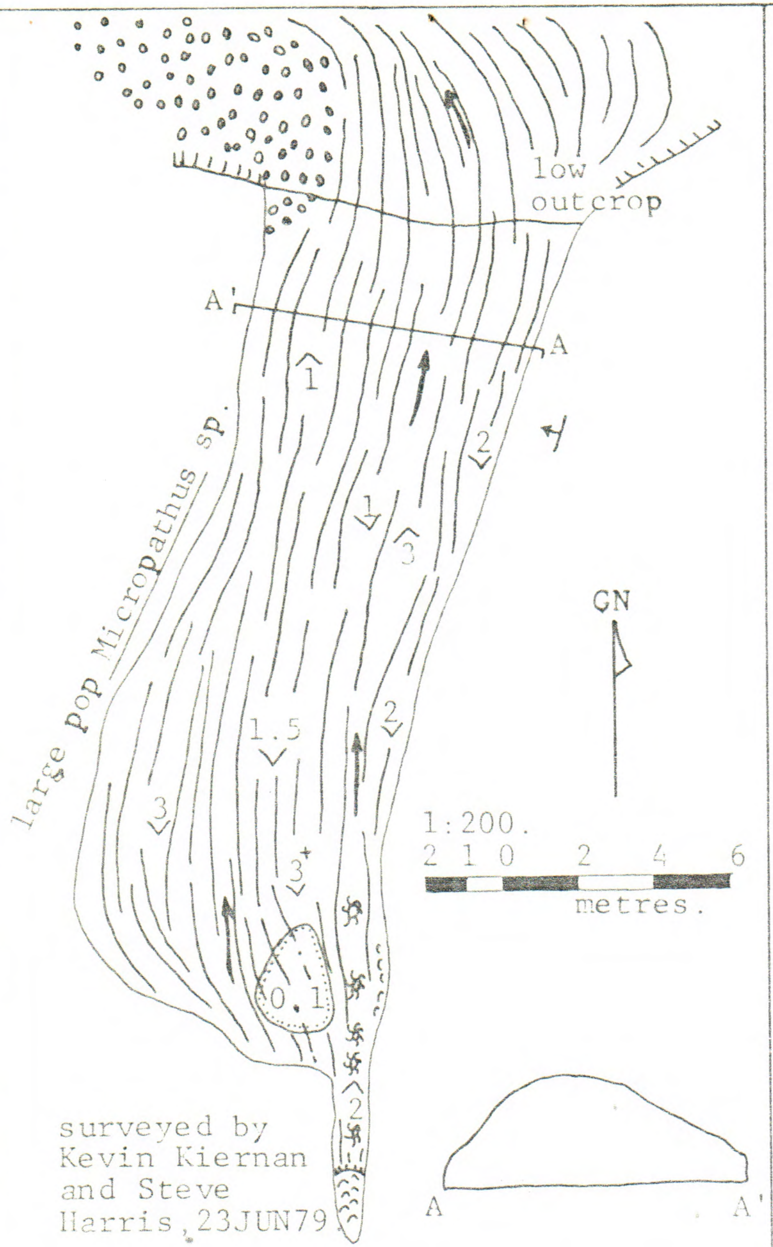
This overflow valley could be interpretted either as developed by the tributary, which previously flowed to the Julius River Swallet (JR 2) but has changed its course towards the resurgence. More likely perhaps, it is the former bed of the Julius, but the question arises as to why any waters of the tributary should flow up the valley of the Julius rather than down. The valley between the swallet and the tributary has a very low gradient, and it is possible this was a very slow stretch of the river which overflowed at the far end. Ponding in this manner might also explain solutional opening of the river bed to develop the subterranean course of the river. Subsequently the tributary flowed to the Julius River Swallet steepening the gradient, but now only the minor anabranch does so, the bulk of the water flowing northward and the south flowing branch reversed under flood conditions.

Cave Descriptions (numbers in parentheses have not been physically affixed).

JR 1 ARCH CAVE: In the vicinity of Arch Cave the Julius River turns in a karst gorge from a down dip course to follow strike. The Arch itself is 9 m. high, 6m. long and spans some 8m. at its widest point. Immediately downstream a dry, strike aligned passage some 20m. long enters the gorge from the left, its floor some 8m. above stream level - comparable to that of the overflow valley near JR 2. This passage bifurates at its mouth where old speleothems are fairly abundant in an entrance some 3m. high. Two smaller natural arches occur through a low strike ridge on the opposite side of the stream. The cave cricket *Micropathus fuscus* is present.

(JR 2) JULIUS RIVER SWALLET: The Julius River sinks into three entrances at the foot of a 25m. limestone cliff. The cave comprises two low entrances and a 15m. high fissure leading into a small entrance chamber up to 4m. in height, with a short sand floored side passage entering from the west and a spectacular collapse doline entering from the east. The doline is degraded on the northern and eastern margin but an overhanging 20m. cliff borders it to the south and west. From the foot of the debris slope a 5m. drop enters the main chamber. Logs jammed in the main entrance fissure up to 10m. above stream level suggest banking up of water at the entrance in times of flood.


(JR2)
JULIUS RIVER SWALLET
grid north
2 1 0 2 4 6 8
metres
stream
roof height
water depth
cobbles
sand
silt
logs
vertical (m.)
many
glow-worms
A
A'
Surveyed by K. Kiernan & S. Harris 23JUN79
ASF Gr 5 3



surveyed by
Kevin Kiernan
and Steve
Harris, 23JUN79.

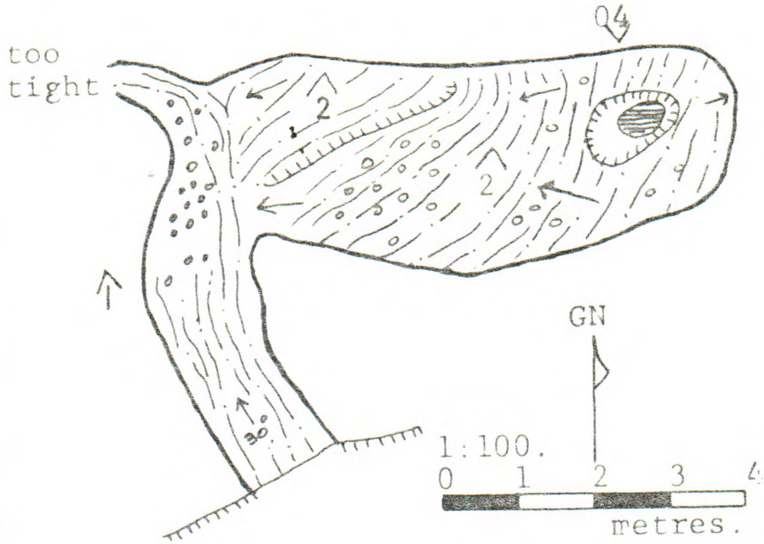
ASF Gr53.

kwk 13JUL79

JULIUS RIVER OUTFLOW CAVE

(JR3)

Small un-named cave in dry valley
adjacent to Julius River Swallet,
NW Tasmania.



Surveyed by
Kevin Kiernan
23JUN79.

ASF Gr. 43.

silt and sand
pit in floor
pool
cobbles
floor slope
roof height (m.)

From the entrance chamber the stream flows North along strike for 18m. in a spacious cobble floored passage 4m. wide and of similar height. Rocks in the stream bed which has a gradient of about 50 are up to 50 cm. long, but the mean is less than 10 cm. The passage then swings westerly down dip, with a deep pool in the corner where it is probably joined by the stream originating from (JR 4). A further 20m. of passage up to 6m. high leads to a chamber some 12m. in diameter filled by a deep pool. Here the stream appears to sump although there is a possible lead on the far side of a low mudbank. This attractive little stream cave is all the more noteworthy for an excellent display of glow-worms. Arachnocampa (Arach no campa) tasmaniensis. while small flies also occur and small spiders are in abundances.

(JR 3) This small hole occurs on the western margin of the overflow valley some 20m. north of (JR 4). A mud slope leads to a chamber 7m. x 3m., floored with an alluvial fill and containing abundant Micropathus fuscus and Hickmania troglodytes.

(JR 4) This small swallet extends some 20m., primarily following dip but with some passages developed along strike, to a point where it becomes too low to follow. There is some cave coral and a few small stalactites. An alluvial fill up to 50 cm. thick occurs in the two principal chambers, which are up to 4m. high. The cave carries an anabranch of a surface tributary which joins the Julius River near its resurgence from JR 5. There are some glow-worms towards the inner recesses.

(JR 5) JULIUS RIVER OUTFLOW CAVE: The Julius River rises from a strike oriented passage which is filled across its full width by deep water. The dolomite dips westerly at about 30°. The cave is penetrable by swimming some 25m. to a sump. Water depth is in excess of 3m. in much of the cave, with an air space of up to 3m. The cave contains significant speleothem development at the inner extremity in the form of a flowstone covered wall and row of stalactites. There is a large population of Micropathus fuscus.

Further prospects.

The most obvious area for attention lies in the possible lead beyond a mud bank in the Julius River Swallet. The extent of cave development in the Julius River area is not known and other caves may well exist. Although no caves are known in the Lake Chisholm area it will still amply reward any visitor. Moreover there way well be further cave sites in the north-west of the state awaiting discovery.

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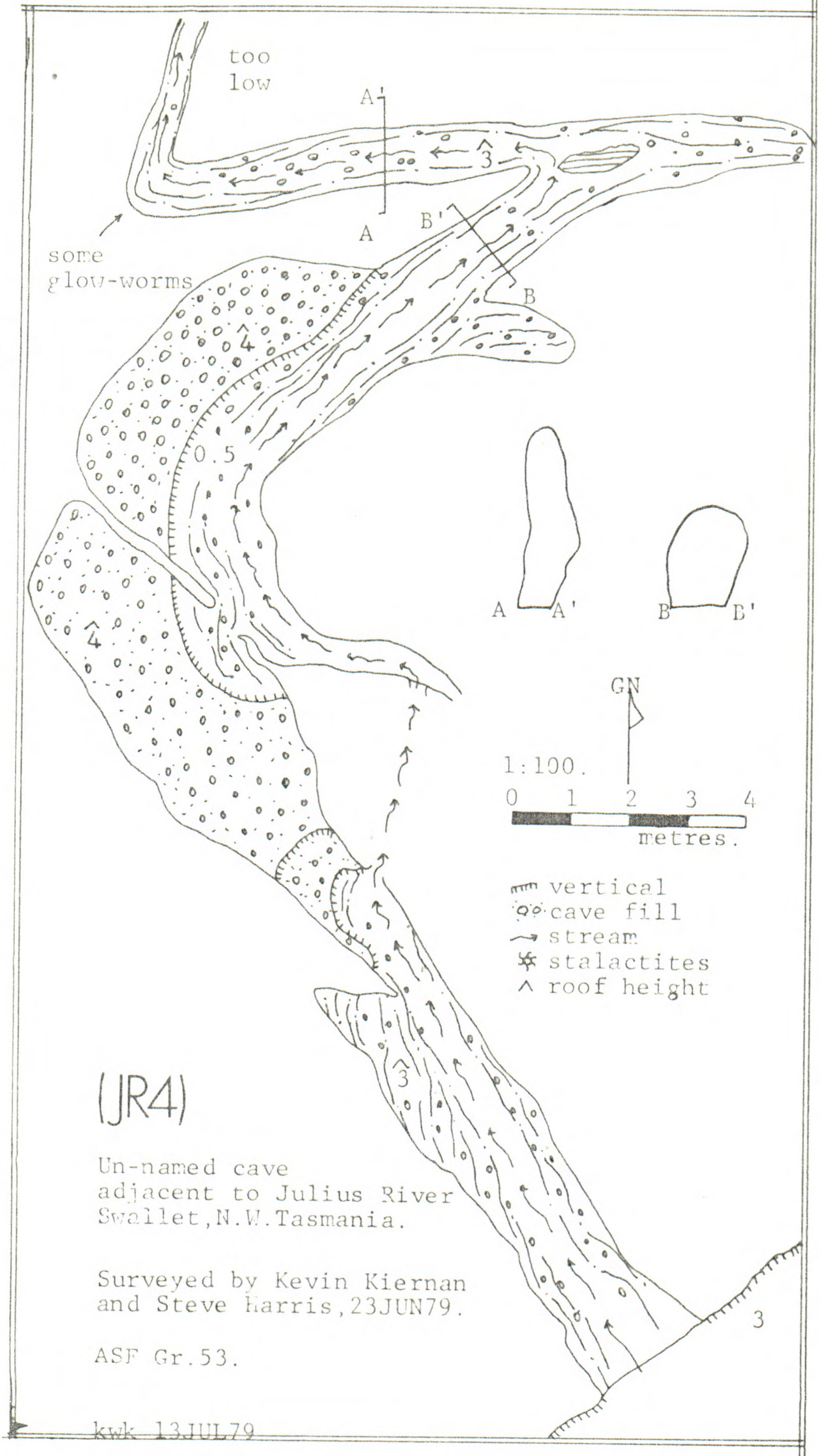
CAVE S & R COMMUNICATIONS BREAKTHROUGH EXPECTED

Amateur radio equipment will be used to attempt two way communication from the depths of Welcome Stranger Cave at Maydena in an exercise scheduled for May 25th, 1980. The frequency being used is 1.825 MHZ and preliminary tests indicate that the system should be successful.

The implications of positive results of this test on cave search and rescue situations is enormous. Direct contact with the rescue site in the cave and the surface teams would enable quick action to be taken on requests for equipment and medical knowledge.

A detailed report on this exercise by caver and amateur radio enthusiast, Ron Mann, will appear in the next issue of Southern Caver.



(JR4)

Un-named cave
adjacent to Julius River
Swallet, N.W. Tasmania.

Surveyed by Kevin Kiernan
and Steve Harris, 23JUN79.

ASF Gr.53.

kwk 13JUL79

MAN AND KARST IN TASMANIA (PART 1)

Kevin Kiernan

Foreword

Lest this item appear somewhat schizophrenic, a word on its origins may be in order. Much of it dates from a discussion paper prepared in early 1974 for a conservation group with virtually no knowledge of karst. It assumed something closer to its present form in late 1976 with minor additions the following year. Some further additions were made in early 1978 with expansion of the section dealing with Tasmanian legislation. Already overlarge, it has not benefitted from some relevant material which has appeared on the Australian scene since that time, and suffers from that limitation. Nonetheless, in the hope that some of it may still be of interest to a more general speleo audience, it is published here without the drastic revision which it really needs were I able to find the time. - K.K. 20 Aug. '79.

INTRODUCTION

The comparative solubility of carbonate rocks may give rise to underground drainage and the characteristic suite of landforms which together constitute karst, resulting from corrosion of the rock by slightly acid rainwater, which may be further charged with carbonic acid during infiltration through the soil. A wide range of environments frequently results. The resource value of such areas may be scant or else rich and diverse. The possibilities for a multiple purpose approach to their management are often inadvertently foreclosed by inadequate knowledge and consideration of the susceptibility of such landscape to damage.

Cavers in some areas have long been aware of threats to caves. Government has sometimes responded by the establishment of cave reserves, but never have any Tasmanian reserves been defined on ecological criteria (Kiernan, 1974 a), and serious problems have arisen, such as deterioration of cave streams originating outside reserves. While many new, better defined reserves are needed, caves are not the only resource of karst, and speleologists and tourists are not the only interests with a call on karst resources. Nor can karst be adequately managed in isolated, arbitrary, myopic units.

Rather, there seems a need for more broadly based management of total karst landscapes and their resources. Caves could gain a substantial measure of protection as a consequence, whether they be inside or outside reserves. Such a proposal was raised in this State (Kiernan and Harris, 1973 a) in a submission to the National Estate Enquiry on behalf of the Southern Caving Society, noting that the Mole Creek area posed a number of conservation problems of high priority, and would be a useful pilot area for a general karst management plan. The need for such was also raised by the writer in 1974 in a discussion paper prepared for a Tasmanian conservation group (Kiernan, 1974 b). Response was understandably tempered by other pressures and a short lived sub committee was formed which failed to attract any interest or membership beyond that of its convenor, although a list of potential cave reserves was a little more enthusiastically received (Kiernan, 1975).

However, Legrand (1973) strongly emphasises the need to view and manage karst as a complex system created by the interplay between carbonate rock, and climatic, topographic, hydrologic and biologic factors, while Harris and Williams (1975) have stressed the importance of safeguarding evoluntionary processes, and more recently Hamilton-Smith (1977) has discussed the necessity to consider the surface environment in cave conservation. Since the bulk of the present eompilation was prepared, Davey (1977) has raised the issue of Karst resource planning in fairly broad terms in a paper published in the 11th A.S.F. Conference proceedings, which ought to be read by anyone with an interest in this field.

In various parts of the world karst features are valuable for water supply, minerals, electricity generation, fish breeding and agriculture. Some springs allegedly possess curative properties. Caves have, and are, being used for storage, air raid shelters, tourism, cheese production, mushroom growing or air conditioning of surface buildings. In Hungary and Turkey the allegedly therapeutic value of cave air has led to development of underground treatment for respiratory ailments.[1] Karst is also a valuable recreational and educational resource (Maximovich 1977, Jennings 1971).

Some 4.5% of the surface of Australia and adjacent Pacific islands is karst terrain (Balazs 1977). By world standards that means Australia is deficient in karst (40% of France is karst), although Tasmania perhaps approaches the world average (Com. Enquiry Nat. Estate, 1974). In this State, karst has been developed on Ordovician limestone and Precambrian dolomite outcrops, some of which are in hitherto unroaded terrain. Others have been developed for agriculture, forestry and other purposes, often with disastrous results. Improvement in karst management is complicated by inadequate knowledge, motivation and government control, and the extent to which land alienation has progressed. Problems are likely to increase.

They result from a failure to appreciate that virtually all karst features are continuously interacting with water (Hamilton-Smith, 1977). The extra-ordinary richness of cave speleothem development which characterises Tasmanian caves in particular and is the only contact with karst for many Tasmanians owes its existence to a soil cover which in many cases has been removed totally by inappropriate surface development. Difficulties of water supply have been compounded for the future by pollution of groundwater. The community has had to pay for ill considered development.

Apart from engineering geology publications overseas, and in the area of underground water supplies much of the literature on karst and man suffers from four main short-comings : it is predictably pre-occupied with caves per se ; or, if more broad ranging, tends to be anecdotal, or negative, or superficial.[2] This is particularly true of Australia where interest is almost entirely academic and the paucity of karst has limited involvement in the problems entailed in developing it. We have the paradox that some karst resources are being lost simply because we have so little to lose we can ill afford to (Jennings, 1975).

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1. Although Gurnee (1977) notes the possibility of some danger due to radioactive decay of gasses found in some caves and of ecological damage in drastically modifying cave climates.

2. A number of papers published since this article was prepared have changed this situation somewhat.

The purpose of this paper is to examine the interactions between man and karst with respect to agriculture and forestry, the two dominant uses of developed surface karst in Tasmania, and in the likely future spread of settlement and industry, and in so doing hopefully provide some framework for more effectively protecting caves by means other than localised arbitrary reserves.

LAND USES AND ITS EFFECTS

(i) Agriculture

In Tasmania, limestone derived soils consist largely of yellow clay present in pockets and representing the insoluable residue of solution. Where continuous soil is present it often consists simply of organic matter overlying the clay, which in turn overlies the limestone with a fairly sharp interface. Where it is thicker, a bleached upper layer has formed to produce a yellow podzolic. There are a number of hydrological and geomorphic implications in the conversion of forested karst environment to cleared land for agriculture or exotic pasture. Normal soil erosion processes may be accentuated. The critical factors are land use and management associated with steepness and length of slope, a particularly erodable soil type, and prolonged rainfall at certain times of the year, particularly when the ground is bare. The problems are accentuated by the intensive use of small holdings which characterises Tasmanian farming as well as the short term economic pressure on farmers.

In sketch outline, these erosive processes include : the splash action of raindrops which may cause sheet erosion, removing an almost uniform layer insidiously, reducing infiltration, and increasing the liklihood of flash run off. Particularly where uphill-downhill oriented cultivation is practised due to the practical problems of using tractors on steep terrain, concentration of runoff energy may lead to rill erosion, the effects of which may be masked by subsequent oultivation, In deeper bodies of soil, slumping may follow saturation of steep slopes, by prolonged rains. Steep farm tracks may initiate gully erosion. Over grazing may strip ground cover. All this may be reflected in slope-foot deposits. Where a surface water course exists the increased sediment load may promote aggradation further downstream, increasing the incidence of over-bank flow such that erosion can be initiated on often more valuable flood plain lower in the catchment. Damaged soils may be colonised by hardy weeds, the seeds of which may wash downstream and infect pastures. The efficiency of karstic conduits may be inhibited by sedimentation. Sedimentation problems may of course be equally consequent upon mismanagement of the upper catchment of allogenic streams. The real problem on the karst surface itself, lies not in sedimentation so much as in the susceptibility of the soil to destruction by total removal from the limestone.

Accelerated soil erosion in limestone areas is often evidenced by the exposure of rundkarren, a form of rounded solutional fluting of the rock developed beneath a soil cover. These runnels tend to be fairly rapidly sharpened once exposed, and their presence is indicative of recent accelerated erosion. It is very widespread in Tasmania where farming and limestone coincide.

Just as agriculture may detract from the value of karst resources, so may karst pose problems for farmers in other ways. At Mole Creek one farmer lost 12 animals down holes in 10 months (Anon 1978). Subsidence may be a **serious** problem, and has amounted to a gradual drop of nearly 10m in one Mole Ck. pasture over the past five years. Such depressions may then fill with water during winter and leave large areas of pasture **inaccessible**. Free drainage appears to operate a positive feedback on the solution process. As with any weathering process, if the weathering products are not removed the process will cease, but when soil is removed the limestone may be open to renewed vigorous attack. Only where poor drainage operates a negative feedback and acts to keep calcium in the system will soils be stable in the long term and joints not subject to opening. (Trudgill 1976).

Runoff from stock pens and barnyards has been established as a major pollutant of groundwater in some karst areas. Inorganic nutrients derived from agricultural sprays, dissolved materials, and toxic substances, may readily gain rapid access to groundwater through large voids in the limestone. The faeces output of one pig per day may be equivalent to that of three human beings, hence areas of large scale animal husbandry basically constitute unsewered communities. Where the Mole Ck. itself emerges briefly on the surface it is often heavily foulded due to stock watering direct from the stream. At Redpa all the water occuring in a system of caves in a small hill has been polluted by direct access of cattle to a pool just inside one entrance. In South Australia, 40,000 sheep carcases were dumped down one cave following a bushfire. (Gartrell 1969). At Mole Ck. one very popular cave is littered throughout with household debris from nearby farms due to dumping down a creek bank just upstram. Other natural shafts and entrances have been used for domestic dumping, and for trees and rocks during pasture clearing.

Thus the recreational amenity of caves may be lost. At Mole Ck. one cave has been ruled "out of bounds" by a caving club due to increased instability following clearing and tree-felling **above** it (Anon 1967). There may be implications for cave biota; the glow-worms which once attracted visitors to the old Flowery Gully tourist caves near Beaconsfield have vanished, probably due to the stream which flows into the cave and upon which they appear dependent for maintenance of adequately humid conditions having become intermittent in apparent response to forest clearing and conversion to pasture. (Kiernan 1977).

(ii) Forestry

Undoubtedly the greatest threat arising from forestry activity as presently practised on some limestone areas and planned for others lies in soil erosion. As previously noted, such soil tends to be thin and delicate, in places almost toally absent, elsewhere present in pockets. It takes many thousands of years to develop. In contrast, it may be totally removed by erosion in a matter of months.

In the Florentine Valley sheet erosion on very low angle slopes has exposed rundkarren, and in one area led to deposition of nearly a metre of sediment blocking a cave within one year of clearfelling.

As with agriculture, the problem is one of promoting increased surface runoff on slopes which were not as strongly influenced by that process during their development. Again there is a danger of total removal from the limestone due to sheet erosion and erosion associated with roads and tracks. As Richards and Ollier (1976) have noted, "forestry on limestone slopes can be a suicide path of irreversible processes."

Harwood and Jackson (1975) examined losses of soil nutrients to the atmosphere in the Florentine Valley, following the slash burning of clear-felled mixed forest typical of present forest management in Tasmania. By studying marked plots they determined a phosphorous loss amounting to 10kg/ha., potassium 51kg/ha., calcium 100 kg/ha., and magnesium 37kg/ha. As a percentage of nutrients contained in the fuel actually consumed, this amounted to 18%, 17%, 12% and 29% respectively, and as a percentage of nutrients in the total fuel 10%, 9%, 7% and 17% respectively. Moreover, they determined that the ash fraction contained about half the above ground nutrients remaining, and this of course could be readily washed down slope. Their study considered an atypically cold regeneration burn, and a considerably greater loss through volatilisation may be anticipated from the greater heat and stronger updraughts of a fiercer fire. In addition to volatilisation large losses occur in the log harvest and in the downslope washing and deep leaching of nutrients mineralised in the ash.

In addition to the loss of the recreational amenity in one cave to which allusion has already been made, others have been rendered dangerous by dumping of debris into shafts. There is one incidence of broken speleothems which may be due to the passage of heavily laden jinkers overhead. At Gunns Plains, the situation with a tourist cave theoretically protected by a state reserve, but fed by a catchment extending beyond its boundaries into an area recently clear-felled, has compelled its operator to complain of serious siltation and even speleothems being broken by floating debris during times of high flow. (Wing, pers com.)

The implications for cave biota are open to speculation. A large bat colony departed a cave in Victoria following forest clearing which left the ceiling from which they hung constantly damp. (Hamilton-Smith 1977). Cave-dwelling bats do not occur in Tasmania of course, but the incident illustrates how prone to damage cave eco-systems are, even by above ground activity. Williams (1975) outlines problems in the Waitomo glowworm cave due to forestry and roading in the catchment. Hawke (1977) outlines research aimed at ameliorating the problem.

(iii) Settlement, Communications and Industrial Development.

Clearly, the presence of karst terrain poses a number of problems to human settlement. Apart from possible water supply problems, construction activities may also be complicated. A brief glance at some of the engineering geology literature on karst areas raises some interesting problems.

The siting of roads may be complicated by the need to fill or by-pass dolines. Collapse of roads has occured, but the main problems are associated with high foundation loadings such as are involved in bridge construction. Common sense in siting will avoid many problems, but in the Liena area a minor resurgence was simply plugged and built over by the Hydro Electric Commission (Young, pers com.) A major landslide which swept over the area in 1972 causing considerable damage to a nearby farm may have been related to this blockage. Following repairs which didn't consider resiting the road, a major doline 5m deep formed in its surface over-night after heavy rain in 1974. The hole was simply plugged and the road quickly handed over to the jurisdiction of the Public Works Department. The latest "repair" has promoted saturation of nearby paddocks by numerous small springs, while heavily silted water resurges through the bed of the Mersey River nearby. At Yarrangobilly in N.S.W. a siltation threat to caves following re-routing of the Snowy Mts. Highway was countered by the construction of silt traps which were not particularly successfu.

Impermeable road surfaces, through restricting infiltration and promoting rapid runoff into adjacent areas may expedite soil erosion and lead to more rapid sinkhole development. In Pennsylvania such a situation developed when the sealing of part of the bottom of a karst depression for a factory and car-park increased runoff carrying overburden into bed-rock cavities and promoted accelerated doline development. In that case a $1 million proposal to pipe runoff some distrance to a surface stream seemed the only satisfactory answer (Knight 1971).

The stage of evolution reached by a karst area will determine the best water sources. In the early stages diversion underground has not progressed far but later a greater proportion runs underground and karst springs may be a useful source, as is reflected in the siting of Mole Ck. township. The extent of turbidity after heavy rain can be a useful guide to the degree of filtration since passing underground, and emphasises the ease with which karst water may be contaminated, and the need for elucidation and protection of the relevant catchment if water quality is to be maintained (Thornbury 1957).

Where the limestone is dense and of low permeability satisfactory wells may be contingent upon chance intersection of solution conduits. In the United States buried karst is also important for water supply, and the presence of a suitable filter such as sandstone above it is of great utility. Water may also be intercepted upstream of swallets and piped elsewhere. (eg. Westmoreland Cave, Mole Ck.)

Although cases of successful damming schemes on limestone (despite the threat of gross leakage) are recorded (eg. Pavlin 1970), numerous engineering misadventures are also recorded involving both leakage problems and dam instability. In Tasmania, Roberts and Andric (1974) have considered such factors with respect to the proposed Lower Gordon Hydro-electric scheme. On the Tennesee River, the Hales Bar dam was built by private interests during the years 1905-13 at a site selected primarily on the basis of a narrowing of the valley. Failure to recognise likely problems of limestone at the site increased the cost of a 2 year/$3 million project to 8 year/$11½ million. In SE New Mexico the Hondo reservoir had to be totally abandonned due to rapid leakage. The costly May River dam in Central Turkey is unlikely to ever serve its function. In Indiana, city officials twice ignored advice and built water supply dams on limestone, precipitating a series of water crises. The list is a very long one, and continues to grow. Grouting is an expensive partial solution.

While underground water may be of considerable significance in karst areas, there are numerous ways in which karst waters may become polluted. Knight (1971) records that "it was common practice in some areas, before the enforcement of modern sanitary laws, to find a sinkhole for waste disposal". In Tasmania, something very similar is still perpetrated at government level. In the Mayberry area, a series of dolines on the apparent drainage divide between Sassafras Creek and Overflow Creek serve as the Municipal disposal area. However, Overflow Creek itself has been diverted underground : it's surface course northwards through Sensation Gorge is dry except during times of heavy winter flow, and underground drainage in that direction is cut off by impermeable rocks. The chain of dolines in which dumping occurs extends from the mouth of Sensation Gorge towards resurgences accounting for a major proportion of the flow of Sassafras Creek. Although it has not to date been tested, the reported occurrence of sawdust at the resurgence during heavy rain, lends support to this hypothesis (see Jennings, 1967) that underground drainage passes under the tip.

Almost undoubtedly, a major karstic water supply will in due course be found to be very severely polluted. A somewhat similar situation has been reported concerning pollution of a cave at Buchan in Victoria (White and Davey, 1977). Sewage represents a serious potential source of pollution, threatening despoilation of groundwater with pathogenic micro-organisms, faecal coli etc. Septic tanks and stormwater disposal down a sinkhole near the main street of Katherine, N.T., has possibly polluted a potential water supply from the limestone at the locality. In northern Tasmania, workmen at a limestone quarry at Flowery Gully have for some years utilised a natural shaft as a toilet. The relationship of this to local hydrology is not known in detail due to a remarkable reluctance of Tasmanian cavers to explore this shaft.

Serious pollution of karst groundwater by industrial effluent has become a major problem in some areas. Radio-active wastes may pose particular problems. At Mt. Gambier in South Australia a cheese factory has polluted its own water supply, and 300,000 litres of milk was pour- into a cave in Western Victoria (White, 1976). In Tasmania there is some evidence of pollution of a cave stream by disposal of refuse down a sinkhole at a limestone quarry (Kiernan, 1973), while sediment in underground streams may also result from quarrying.

There are numerous cases of subsidence due to interference with karst hydrologic systems. Near Hershey in Pennsylvania a chocolate factory was established in 1903 adjacent to a plentiful water supply from karst springs. Due to pumping of water from a limestone quarry, amounting to over 4 million litres per day and lowering the water table by 60m. at one point, a cone of depression developed 9 x 2 km. in extent. Not only did this jeopardise the springs, but the removal of water from clay in solution cavities caused shrinkage leading to the development of numerous sinkholes in the cone of depression, threatening the very structure of the factory. Following litigation by the chocolate company recharging operations were commenced.

A similar process (Martini et al 1977) caused by pumping of goldmines in Far West Rand in Transvaal, South Africa led to disaster in 1962 when sudden subsidence engulfed a crusher plant at West Dreifonten (Jennings 1971), killing 29 people.

In the Transdanubian Range, pumping has lowered the water table an average of 15m. and presently totals 20% in excess of natural infiltration (Bocker 1977). Adverse consequences may follow excessively large diversions from swallets, and as a consequence one such proposal in Southern Tasmania was halted following pressure by conservationists.

Proctor (1948) describes cave-ins at a rayon plant in Elizabethton, Tennessee due to collapse of cavities formed not in underlying limestone but in overburden, after soil was flushed into limestone voids by the plant's excess water. Clark (1961) describes collapse not only in overburden, but with the overburden cavity not directly over the entrance to the limestone void.

Thick overburden may make location and utilisation of suitable bedrock for foundations difficult and costly. Leggett (1939) cites a case in which failure to recognise how irregular a limestone bedrock surface may be, increased the cost of one contractors site preparation from $82,992 to $209,018, with massive increases in rock excavation required, an increase from a planned 1100m. of drill holes to 3500m. and 6368 bags of cement used instead of 4200 bags.

In Pennsylvania a few hundred square metres of car park at a two storey motel fell victim to an overnight doline, and it was subsequently found that one wing of the hotel spanned a large void (Knight 1971).

Allen (1969) suggests that if subsidence commences the theoretical options are threefold : induce rapid subsidence, fill the hole or control the process. Preferable to that of course, is identification of potential problems and adjustment or avoidance in the planning stage.

Inadequately considered tourism may also pose problems. In the United States, sealing of a car park led to speleothem dehydration in a subjacent tourist cave (Skinner 1972). The cave environment may suffer from artificial lighting encouraging the growth of algae and lint from visitors clothing settling on speleothems. At Hastings in Tasmania, a tourist cave stream has been littered with logs from old stairways and broken glass from spent light globes. In Victoria, Moon Cave at Buchan has been polluted by camp ground sewage, and other aspects of planning are of concern (White and Davey 1977). At Jenolan N.S.W., dehydration problems were considered in installation of air tight doors. The famed glow-worm display of Waitomo, N.Z. is threatened by a number of factors including misguided tampering with cave water levels.

The foregoing has raised but a few of the many problems and complications man has encountered in seeking to more densely settle and utilise karst terrain using techniques satisfactory on other non-karstic terrains. The lessons should be clear and the solutions for failing to heed them are often expensive. Planning needs to be more than writing down today what one did yesterday, or one sectional interest trying to make a belated imput to the decision making process after costly planning and purchase has given way to construction. Davey (1977) contrasts the failure of government to action many recommendations of the National Estate enquiry report and the readiness of the Victorian government to accept recommendations of its Land Conservation Council and suggests they relate to the degree to which each is incorporated into the machinery of government.

Most likely it is not that simple - the more deeply embedded in government an agency lies probably also influences the extent to which it makes recommendations of a type not discomforting to that government : specialists may define the options but value judgements are involved in the act of choice.

Part Two of this article will appear in the July issue of Southern Caver.

AREA REPORTS

by Stefan Eberhard

This report covers the period from 1st March to 30th April.

Mole Creek

On 8th April Leigh Gleeson showed some visiting Highland Caving Group members through the upstream section of Herbert's Pot, as far as the waterfall.

Junee/Florentine

Early March saw Leigh Gleeson take Stefan Eberhard and Aleks Terauds through the wet squeezes and well decorated passages of the very interesting Cashion Creek Cave.

Hastings

On 25th April, Stefan Eberhard and party abseiled into Wolf Hole, exploring as far as Lake Pluto. On the same trip Aquamire was descended for a short distance before the very muddy and unpleasant conditions induced a retreat.

Ida Bay

Mystery Creek cave has been the centre of activity recently with a total of five trips, including a descent of Midnight Hole. On 23rd March Aleks Terauds, Bob Cockerill, Richard Cockerill, Mike Cole, Joshua Cole, Stefan Eberhard, Peter and Kathy McQuillan were led on a familiarisation trip to the cave by Tony Culberg. The following weekend a party consisting of Tony Culberg, Bob Cockerill, Stefan Eberhard, Kevin Kiernan, Ian Brown and five Highland Cavers intended to abseil down Midnight Hole on double ropes and then walk out from the bottom of Mystery Creek cave. Unfortunately this trip had to be aborted due to the risk of rising water levels preventing the party from exiting.

During Easter Stefan Eberhard took a large party of visitors on an introductory trip through the cave. The glowworm display was magnificent despite the fact that it was described as, "much diminished", when Kevin Kiernan made a brief visit to this cave, and Bradley Chestermans Cave, only a few days previously.

On 26th April, Bob Cockerill and Stefan Eberhard, led by Leigh Gleeson, succeeded in descending the spectacular shafts of Midnight Hole on single ropes. Stefan and Bob then walked out through Mystery Creek Cave while Leigh jumared back up, clearing the pitches as he went, in less than an hour.

Nelson River

Kevin Kiernan and Albert Goede visited the inflow and outflow caves looking at bones.

Eagle Creek

Kevin Kiernan was among a party which visited this very scenic area on the Lower Gordon River. Kevin reported on the "spectacular fluting on limestone residuals but only a couple of minor holes were entered".

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M. COLE	SOUTH FRANKLIN ... 7113.
K. DARLING	BATTERY POINT ... 7000.
D. ELLIOTT	24 Talune Street, LINDISFARNE ... 7015.
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