VOLUME 22 (2) 1984

Helictite

JOURNAL OF AUSTRALASIAN CAVE RESEARCH

The Eyrie, Spider Cave, Jenolan, N.S.W.
Photograph by Mark Bonwick.

HELICTITE

Journal of Australasian Cave Research

ISSN: 0017-9973

Helictite was founded by Edward A. Lane and Aola M. Richards in 1962.

This Journal was (and is) intended to be wide ranging in scope from the scientific study of caves and their contents, to the history of caves and cave areas and the technical aspects of cave study and exploration. The territory covered is Australasia in the truest sense — Australia, New Zealand, the near Pacific Islands, New Guinea and surrounding areas, Indonesia and Borneo.

In 1974 the Speleological Research Council Limited agreed to support the Journal with financial assistance and in 1976 took over full responsibility for its production.

The Board of Management

Foundation Editors
Edward A. Lane *Aola M. Richards*

Editors
Guy C. Cox *Julia M. James*

Business Management
David Martin

Production Management
Bruce R. Welch

Speleological Research Council Limited

The Speleological Research Council Limited, the publisher and owner of Helictite, is a non-profit limited liability company incorporated in May 1964. The aims of the Speleological Research Council Limited are:-

> To explore and chart and organize and promote the exploration and charting of caves and cave systems.
>
> To promote, support and assist in the scientific evaluation and investigation of caves and to foster speleology as a science and a sport.
>
> To promote and to assist in the promotion of speleology and speleological Societies and to assist such Societies with grants of money and otherwise.

Other publications by SRC Ltd:

CAVES OF THE NULLARBOR. T.M.L. Wigley and J.R. Dunkley 1968.
- a review of Speleological Investigations in the Nullarbor ,Plain.

THE EXPLORATION AND SPELEOGEOGRAPHY OF MAMMOTH CAVE, JENOLAN.
J.R. Dunkley 1972. - a detailed history and description.

CAVES THROUGH THE AGES. G. Hangay, J.M. James & M. Dorrell 1974.
- a colouring book for children.

PAPUA NEW GUINEA SPELEOLOGICAL EXPEDITION NSRE 1973. J.M. James 1974.
- the report of the 1973 Niugini Speleological Research Expedition to the Muller Range.

A BIBLIOGRAPHY OF THE JENOLAN CAVES. PART ONE: SPELEOLOGICAL LITERATURE.
J.R. Dunkley 1976. - a detailed reference list.

THE CAVES OF JENOLAN, 2: THE NORTHERN LIMESTONE. B.R. Welch (ed) 1976.

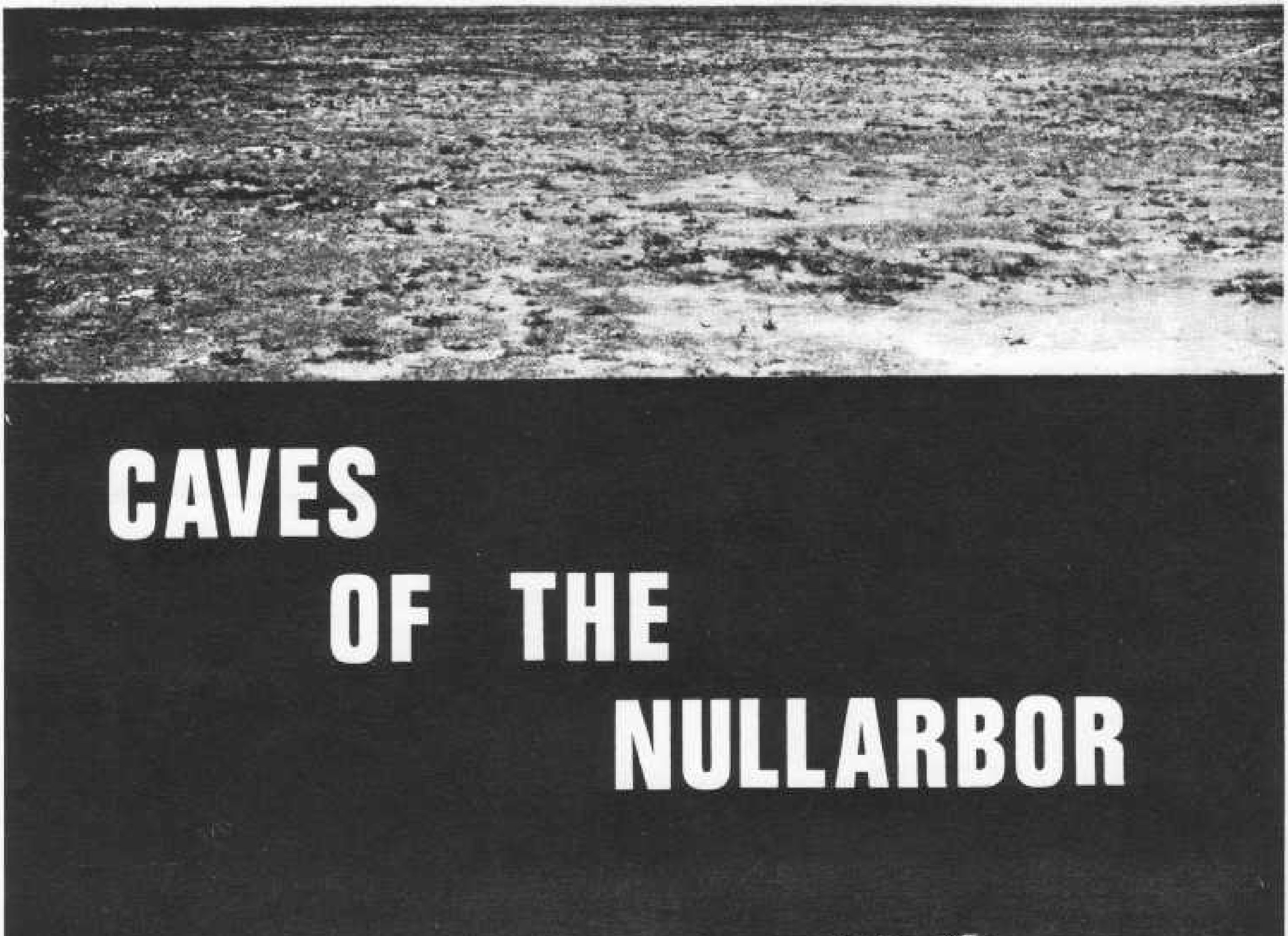
Helictite

JOURNAL OF AUSTRALASIAN CAVE RESEARCH

VOLUME 22(2) 1984

CONTENTS

"HELICTITE", Volume 22, 1984 consists of two issues. Price per volume Aust. $10.00 post paid. "HELICTITE" is printed and published by the Speleological Research Council Ltd. Except for abstracting and review, the contents may not be reproduced without permission of the Editors. All correspondence to: PO Box 183, Broadway, N.S.W. 2007.



Caves of the Nullarbor
J.R. Dunkley & T.M.L. Wigley
A4 66pp, 20 photographs, 12 maps

The first book on this interesting area of Australia. Caves include halite decorations, mumified animal remains, primitive art. A real insight into the famous caves of the Nullarbor.

Published by

THE SPELEOLOGICAL RESEARCH COUNCIL LTD.
P.O. Box 183, Broadway, 2007, Australia.

First published 1967 Reprinted 1978

$6.00

JOE JENNINGS

> And this our life, exempt from public haunt,
> Finds tongues in trees, books in running brooks,
> Sermons in stones, and good in everything.
>
> Shakespeare: As you like it

Andy Spate and Dave Gillieson

Joseph Newell Jennings died of a heart attack on 24 August 1984 whilst skiing in the Snowy Mountains of southeastern Australia. This event brought to an end a long and energetic career devoted to studying the natural world. Joe would argue, were he here, that cavers should not regard his passing as an end but that his career should be a platform on which to build the further development of Australian cave science and exploration. This does not mean that he will not be sadly missed as a friend, mentor and colleague by many people around Australia and, indeed, around the globe.

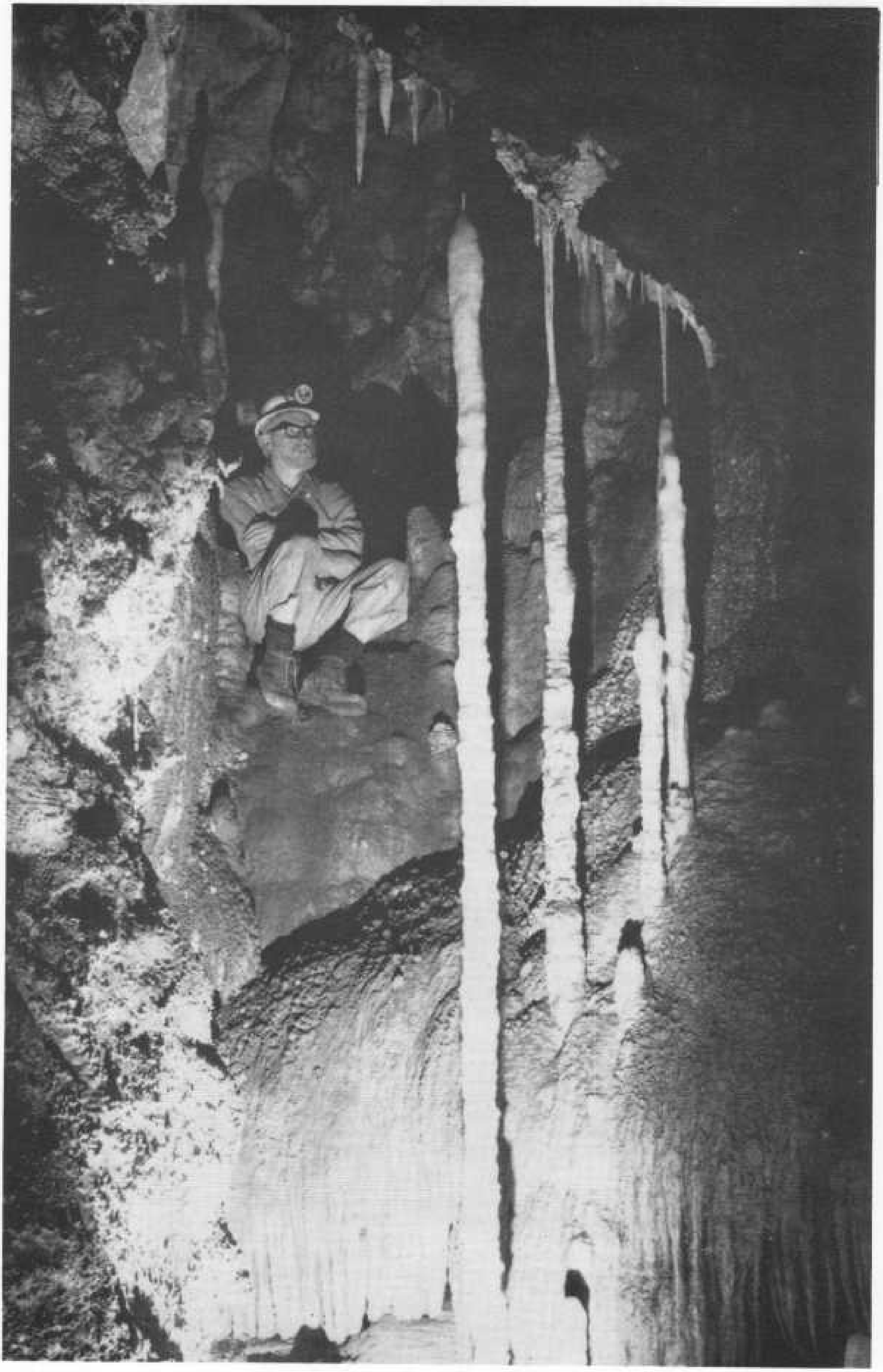
Joe's interest in natural processes began on a school excursion which visited a cave with a large 24 metre waterfall - a sight to enthuse many Australian cavers! After completing his degree at Cambridge largely in human geography, but with some bias toward geomorphology and palynology he evinced research interest in the Craven karst in his native Yorkshire. He was turned from this by supervisor (Majorie Sweeting worked on the area after the War - somewhat to Joe's chagrin) and commenced his research career on the stratigraphy and vegetation history of the Norfolk Broads. Prior to this Joe had partaken in expeditions to Iceland and Jan Mayen to study various aspects of ice-bound terrains especially in regard to long term changes in glacial retreat - he was to carry this interest to Australia along with many others.

Before the Norfolk Broads work was completed the War had broken out. Joe joined the Royal Artillery where he strengthened both the volume of his voice and his command of mapmaking and reading; much of Joe's war was spent in uncomfortable conditions in Iceland. After this interlude he lectured at the Geography Department of the University of Leicester whilst carrying on his Norfolk work. It was this work that put Joe "on the map" and it remains a fine example of scientific work properly executed even, as happened in this case, if some of the interpretations were later overturned. In typical fashion Joe wholeheartedly accepted and welcomed this revision.

In 1952 Joe came to Australia as a member of the Geography Department in the fledgling Australian National University. Here in the Old Hospital Buildings began the Australian career of one of its most distinctive and individual earth scientists (Joe's laboratory had been the main operating theatre and even in young Canberra the huge lead-lined sink and other artifacts attested to the surgery of a by-gone age). At first Joe's research was confined, if ever he could be said to be confined, to glacial and periglacial landforms and coasts, with excursions to the arid landscapes.

He began caving in Australia purely for recreation but could not for long remain intellectually aloof from his surrounds. By 1959 karst studies had become part of his research programme. In no sense did he confine his attention to karst; there were forays into zoology, cartography, man's impact on the environment as well as to coasts, glacial and periglacial landscapes, historical geography, climatic change and so on. It is a measure of Joe's achievement that he became a world authority on karst in a country which lacked accessible extensive karst.

It would be convenient in writing about Joe to trace his karst and other research in a gently radiating geographic drift from say, Wee Jasper to further afield. However, Joe did not work like that - his first papers were from King Island and Tasmania, soon reaching out to the Nullarbor, the Kimberleys and New Guinea. In later years the net was cast even more widely to encompass Malaysia, China, New Zealand, Canada and the United States. The only way to comprehend the breadth of Joe's scholarship is to peruse his bibliography, numbering over two hundred works with about half devoted to karst. They include the editorship of a number of books including the seven volume series "An Introduction to Systematic Geomorphology", many of which are used as basic texts world wide. His own contribution to this series "Karst", out of print and in strong demand for many years, will shortly be reappearing as a completely rewritten second edition completed by Joe shortly before his death. Joe was an enthusiastic



The late Joe Jennings, in 1975, admiring the Pointing Finger in Sigma Cave, Wombeyan, NSW. Photograph by Harry Coleman.

supporter of Helictite since its beginnings in 1963 and has contributed papers to almost every volume. He would say that too many were his - a failing of others to write. He edited the Australian Landform Example Series in the Australian Geographer and again he often said that there was a disproportionate number of karst examples; again a failing of others. He published widely in international journals, notably in the Zeitschrift für Geomorphologie, a prestigious journal of which he was an Associate Editor.

Joe had a number of areas of special interest - the Nullarbor, the Limestone Ranges of the West Kimberleys and the small karsts of southeastern Australia particularly Wee Jasper, Bungonia, Wombeyan, Yarrangobilly and Cooleman Plain. His early maps and geomorphic interpretations of the Dip and Punchbowl Caves remain models of their genre. His work on Cooleman is a mirror of his whole career: some twenty odd papers, together with numerous references in broader works, appeared on this are, the most intensely studied karst area in Australia. These projects, at first essentially descriptive and interpretive, evolved into most detailed and quantified studies of processes. The whole forms an excellent example of scientific method and of the adoption of appropriate technologies. Joe often bemoaned his lack of training in the "hard" sciences but was always able to cope with the advances of modern science; on the other hand he did not allow himself to be carried away by gadgetry but remained true to proven approaches and equipment.

It was probably on the Nullarbor that Joe had his single greatest impact on the Australian caving scene. Not only did he participate in early exploration but he kept returning to the Plain and wrote about many aspect of this fascinating karstland. His painstaking examination of thousands of aerial photographs of the Nullarbor in 1964 led to a long list of potential discoveries. Many significant discoveries did result from this exercise but this list has, even now, unvisited sites. This project was typical of Joe - many weeks, if not months, went into ensuring that others would have to kudos of discovering new caves. The Nullarbor, together with Chillagoe and the Kimberleys stimulated Joe's interest in arid and seasonally arid karsts and he became an authority on such regions. Joe also had particular impact in the study of karst in the very young limestones of southern Australia. His pioneering work, in Western Australia, on these syngenetic karsts stimulated world wide interest in dune limestones. In more recent times he devoted much effort to karst forms in sandsones in northern Australia.

The excellence of scientific speleology in this continent is well recognised overseas and Joe's contribution has been recognised by the Royal Geographic Society's Victoria Medal, its senior award for research. The National Speleological Society of the United States also elected Joe as one of a very small and select band of life members.

Joe had a considerable influence on organised speleology in Australia in that he was a founder and past president of the Australian Speleological Federation and was a Trustee of the Federation from 1956 until his death. He also had considerable involvement with a number of other groups notable the Canberra Speleological Society, Sydney Speleology Society and the Western Austrlian Speleological Group. Today, speleology is well established in Australia with a respected journal, an active national body and academic and management posts held by speleologists. The growth of serious cave studies in Australia is in no small way due to the assistance and inspiration provided by Joe Jennings. In addition he has had an immensely stimulating impact on many hundreds of amateurs throughout Australia. These influences are so strong that he has been called the "Father of Australian Speleology" - a title he would have vociferously disliked.

Australian cavers will remember Joe's contribution to our understanding and enjoyment of caves, karst features and landscapes for Joe did not only travel to arrive. He will be remembered for his stories, adventures and for his enthusiasm, energy and ready acceptance of all comers. His company will bemissed around campfires from Tasmania to the Kimberleys, from the Mill Creek Glacier at Yarrangobilly to the wide open spaces of the Nullarbor.

PUBLICATIONS ON KARST BY JOSEPH N. JENNINGS

JENNINGS, J.N., 1956 Calc-sinter and dripstone formations in an unusual context. Australian Journal of Science 18: 107-11.

JENNINGS, J.N., SWEETING, M.M., 1959 Underground breach of a divide. Australian Journal of Science 21: 261-2.

JENNINGS, J.N., 1961 A Preliminary Report on the Karst Morphology of the Nullarbor Plain . Cave Exploration Group (South Australia) Occasional Paper 2. Pp.45.

JENNINGS, J.N., SWEETING, M.M., 1961 An occurrence of caliche pseudo-anticlines in the Fitsroy Basin, Western Australia. American Journal of Science 259: 635-9.

JENNINGS, J.N., 1962 The limestone geomorphology of the Nullarbor Plains (Australia). Actes du deuxieme congrés international de speleologie 1: 371-86.

JENNINGS, J.N., BIK., M.J., 1962 Karst morphology in Australian New Guinea. Nature 194: 1036-8.

JENNINGS, J.N., 1962 The caves of the Limestones Ranges of West Kimberley. Western Australian Speleological Group 1962 Journal: 29-24.

JENNINGS, J.N., 1963 Water sampling at Yarrangonilly. Helictite 1(2): 3-7.

JENNINGS, J.N., 1963 Ridge Mine Pot, Wyanbene. Helictite 1(2): 16-7.

JENNINGS, J.N., 1963 Geomorphology of the Dip Cave, Wee Jasper, New South Wales. Helictite 1(3): 43-58.

JENNINGS, J.N., 1963 Australian Landform Example No.1 Collapse doline. Australian Geographer 9: 122-3.

JENNINGS, J.N., SWEETING, M.M., 1963 The Limestone Ranges of the Fitzroy Basin, Western Australia. Bonner Geographische Abhandlungen 32. Pp.60.

JENNINGS, J.N., SWEETING, M.M., 1963 The Tunnel, a cave in the Napier Range, Fitzroy Basin, W. Australia. Transactions Cave Research Group Great Britain 6: 53-68.

JENNINGS, J.N., 1963 Some geomorphological problems of the Nullarbor Plain. Transactions of the Royal Society of South Australia 87: 41-62.

JENNINGS, J.N., 1964 Geomorphology of Punchbowl and Signature Caves, New South Wales. Helictite 2: 57-80.

JENNINGS, J.N., 1964 Cave surveys and their grading. Cave Research Group Great Britain Newsletter 90-91: 18-22.

JENNINGS, J.N., 1965 Bungonia Caves and rejuvenation. Helictite 3: 79-84.

JENNINGS, J.N., 1965 Man as a geological agent. Australian Journal of Science 28: 159-66.

JENNINGS, J.N., 1965 A note on cloudmaking by caves. Helictite 3: 37-8.

JENNINGS, J.N., 1965 The Big Hole near Braidwood, New South Wales. Journal and Proceedings of the Royal Society of New South Wales 98: 215-9.

JENNINGS, J.N., SWEETING, M.M., 1966 Old Napier Downs Cave, West Kimberley, W.A. Helictite 4: 25-32.

JENNINGS, J.N., 1966 Jiri V. Danes and the Chillagoe Caves district.

JENNINGS, J.N., 1966 Murray Cave, Cooleman Plain, New South Wales. Helictite 5: 3-11.

JENNINGS, J.N., MABBUTT, J.A. (eds.), 1967 Landform Studies from Australia and New Guinea. Australian National University Press, Canberra and Cambridge University Press, Cambridge. (Reprinted 1971). Pp.434.

JENNINGS, J.N., 1967 Some karst areas of Australia. In: J.N. JENNINGS, and J.A. MABBUTT (eds.) Landform Studies from Australia and New Guinea. Pp. 256-292. Australian National University Press, Canberra and C.U.P., Cambridge (Reprinted 1971). Pp. 434.

JENNINGS, J.N., 1967 Australian Landform Example No.8 Semi-blind valley. Australian Geographer 10: 204-5.

JENNINGS, J.N., 1967 Australian Landform Example No.9 Blind valley. Australian Geographner 10: 206-7.

JENNINGS, J.N., JAMES, B.N., 1967 Underground water movements in the Lobster Rivulet-Mole Creek divide, Tasmania. Australia Journal of Science 30: 108-9.

JENNINGS, J.N., 1967 Australian Landform Example No.10 Karst cave. Australian Geographer 10: 298-9.

JENNINGS, J.N., 1967 The surface and underground geomorphology. In: J.R. DUNKLEY and T.M.L. WIGLEY (eds.) Caves of the Nullarbor: 13-31. Speleological Research Council, Sydney.

JENNINGS, J.N., 1967 Further remarks on the Big Hole, near Braidwood, New South Wales. Helictite 6: 3-9.

JENNINGS, J.N., 1968 Syngenetic karst in Australia. Pp. 41-108 in Contributions to the Study of Karst. Department of Geography Publication G/5, Australian National University, Canberra.

JENNINGS, J.N., 1968 The origin of caves and their evolution. In: P. MATTHEWS (ed.) Speleo Handbook: 37-51. Australian Speleological Federation, Sydhey.

JENNINGS, J.N., 1968 Geomorphology of Barber Cave, Cooleman Plain, New South Wales. Helictite 6: 23-9.

JENNINGS, J.N., 1968 Recent Australian contributions on pipes, foibe and climatic history from speleological evidence. Helictite 6: 50-6.

JENNINGS, J.N., 1968 Tafoni. In: R.W. FAIRBRIDGE (ed.) Encyclopaedia of Geomorphology: 1103-4, Reinhold, New York.

JENNINGS, J.N., 1968 Underground geography. New Zealand Geographical Society Record 45: 1-4.

JENNINGS, J.N., 1968 The Nullarbor Plain, Australia, a dryland karst region. New Zealand Gepgraphical Society Record 45: 14-9.

JENNINGS, J.N., 1969 Karst in the seasonally humid tropics in Australia. Pp. 149-58 in Problems of the Karst Denudation Brno 1969. O. Stelcl (ed.), Institute of Geography, Brno.

JENNINGS, J.N., NANKIVELL, I., PRATT, C., CURTIS, R., MENDUM, J., 1969 Drought, and Murray Cave, Cooleman Plain, New South Wales. Helictite 7: 23-38.

JENNINGS, J.N., 1969 River Cave, Kosciusko National Park and its hydrological relationships. Helictite 7: 69-85.

JENNINGS, J.N., 1970 Small cavities in the Nullarbor Plain. Helictite 8: 43-7.

JENNINGS, J.N., 1970 Australian Landform Example No.18 Ingrown meander and cave. Australian Geographer 11: 401-2.

JENNINGS, J.N., 1970 Cooleman and Right Cooleman Caves, Kosciusko National Park, and the shift of risings. Helictite 8: 71-7.

JENNINGS, J.N., 1970 Caves. Life in Australia. Oxford University Press Melbourne. Pp. 32. (Republished in Outdoor Recreation, 1975. Oxford University Press Melbourne).

JENNINGS, J.N., 1970 Australian Landform Example No.19 Karst spring. Australian Geographer 11: 508-9.

JENNINGS, J.N. 1971 Karst. Introduction to Systematic Geomorphology. (J.N. Jennings ed.). Vol.7 Australian National University Press, Canberra and Massachusetts Institute of Technology Press, Cambridge. Pp. 252.

JENNINGS, J.N., 1972 The Blue Waterholes, Cooleman Plain, New South Wales and the problem of karst denudation rate determination. Transactions Cave Research Group Great Britain 14: 109-17.

JENNINGS, J.N., 1972 The character of tropical humid karst. Zeitschrift für Geomorphologie 16: 336-41.

JENNINGS, J.N., 1972 The age of Canberra landforms. Journal of the Geological Society of Australia 19: 371-8.

JENNINGS, J.N., 1972 Observations at the Blue Waterholes, March 1965-April 1969, and limestone solution at Cooleman Plain, N.S.W. Helictite 10: 3-46.

JENNINGS, J.N., JAMES, J.M., COUNSELL, W.J., WHAITE, T.M., 1972 Geomorphology of Bungonia Cave and Gorge. Pp. 113-43 in Bungonia Caves. Sydney Speleological Society Occasional Paper 4.

JENNINGS, J.N., 1972 Revision with an appreciation of C.F. Laseron, The Face of Australia, the Shaping of a Continent. Angus and Robertson, Sydney. Pp. XVI and 205.

LOWRY, D.C., JENNINGS, J.N., 1974 The Nullarbor karst, Australia. Zeitschrift für Geomorphologie 18: 35-81. (Reprinted in M.M. Sweeting (ed.) Karst Geomorphology. Benchmark Papers in Geology Series 59. Academic Press, New York).

JENNINGS, J.N., 1975 Doline morphometry as a morphogenetic tool; New Zealand example. New Zealand Geographer 31: 6-28.

JENNINGS, J.N., 1975 How well of is Australia for karst and caves? A brief geomorphic estimate. Proceedings of the Tenth Biennial Conference Australian Speleological Federation, Brisbane, December 1974, 82-90.

JENNINGS, J.N., 1975 The formation and development of Australian caves. Australian Natural History 18: 204-7.

JENNINGS, J.N., 1976 A test of the importance of cliff-foot caves in tower karst development. Zeitschrift für Geomorphologie Supplement band 26: 92-7.

JENNINGS, J.N., BRUSH, J., NICOLL, R.S., SPATE, A.P., 1976 Karst stream self-capture at London Bridge, Burra Creek, N.S.W. Australian Geographer 13: 238-49.

JENNINGS, J.N., 1976 History of a dry valley on Cooleman Plain, N.S.W., Australia. Proceedings Sixth International Congress of Speleology 3: 199-266.

JENNINGS, J.N., JAMES, J.M., 1976 Rejuvenation and Australia's deepest mainland caves. Proceedings Sixth International Congress of Speleology 2: 179-85.

SPATE, A.P., JENNINGS, J.N., SMITH, D.I., JAMES, J.M., 1976 A triple dye tracing experiment at Yarrangobilly. Helictite 14: 27-48.

JENNINGS, J.N., 1977 Limestone tablet experiments at Cooleman Plain, New South Wales, Australia and their implications. Abhandlungen für Karst und Höhlenkunde. Reihe A Speläologie 15: 26-38.

JENNINGS, J.N., 1977 Caves. The Australian Encyclopaedia Third Ed. 1: 490-2.

JENNINGS, J.N., MABBUTT, J.A., 1977 Physiographic outline and regions. In: D.N. JEANS (ed.) Australia, a Geography. Pp. 38-52, Sydney University Press, Sydney. Pp. 571.

JENNINGS, J.N., 1977 Caves around Canberra. Proceedings Eleventh Biennial Conference Australian Speleological Federation, Canberra January 1976, 79-85.

RIEDER, L., JENNINGS, J.N., FRANCIS, G., 1978 Frustration and New Year Caves and their neighbourhood, Cooleman Plain, N.S.W. Helictite 15: 18-28.

JENNINGS, J.N., 1978 Apostasy or apologetics? Confessions of a natural geographer. Monash Publications in Geography 20. Pp. 39.

JENNINGS, J.N., 1978 Limestone solution on bare karst and covered karst compared. Transactions British Cave Research Association 5: 215-20.

JAMES, J.M., FRANCIS, G., JENNINGS, J.N., 1978 Bungonia Caves and Gorge; a new view of their geology and geomorphology. Helictite 16: 53-63.

FRANK, R., JENNINGS, J.N., 1978 Development of a subterranean meander cutoff: the Abercrombie Caves, New South Wales. Helictite 16: 71-85.

JENNINGS, J.N., 1978 A notable limestone hydrology investigation in Austria. Helictite 16: 86-7.

JENNINGS, J.N., 1979 Morphometry and Dorset dolines. Transactions Institute British Geographers N.S. 4: 118-20.

JENNINGS, J.N., 1979 Aspects of the thermal regime at Cooleman Plain, N.S.W. Australian Geographer 14: 166-72.

BACKSHALL, D.G., BARNETT, J., DAVIES, P.J., DUNCAN, D.C., HARVEY, N., HOPLEY, D., ISDALE, P.J., JENNINGS, J.N., MOSS, R., 1979 Drowned dolines - the blue holes of the Pompey Reefs, Great Barrier Reef. BMR Journal Australian Geology Geophysics 4: 99-109.

JENNINGS, J.N., 1979 Caves and karst terminology. ASF Newsletter Australian Speleological Quarterly 83: 3-21.

JENNINGS, J.N., 1979 Hardness controls of cave drips, Murray Cave, Cooleman Plain, Australia. Helictite 17: 30-8.

JENNINGS, J.N., 1979 An unusual sandstone cave in northern Australia. Helictite 17: 39-45.

JENNINGS, J.N., 1979 Arnhem Land city that never was. Geographical Magazine 60: 822-7.

JENNINGS, J.N., 1979 Man and other animals in Australian caves and shelters: a review. Transactions British Cave Research Association 6: 96-130.

JENNINGS, J.N., 1980 Salt karst. Geography Bulletin 12: 17-20.

JENNINGS, J.N., BAO, H., 1980 Determining doline origins: a case study. Helictite 18: 3-7.

JENNINGS, J.N., 1980 The origin of Deepdene near Augusta, Western Australia. Helictite 18: 25-7.

JENNINGS, J.N., 1980 'Spoil of the old world's farthest end': Does distance tyrannise science? In: J.N. JENNINGS, G.J.R. LINGE (eds.) Of Time and Place: Essays in Honour of O.H.K. Spate. Australian University Press, Canberra. Pp. XVI, 296.

JENNINGS, J.N., BAO, H., SPATE, A.P., 1980 Equilibrium versus events in river behaviour and blind valleys at Yarrangobilly, New South Wales. Helictite 17: 39-54.

JENNINGS, J.N., BAO, H., SPATE, A.P. 1981 Equilibrium versus events in blind valley enlargement. Proceedings Eighth International Congress of Speleology 1: 1-3.

JENNINGS, J.N., 1981 Morphoclimatic control - a tale of piss and wind or a case of the baby out with the bathwater? Proceedings Eighth International Congress of Speleology 1: 367-8.

JENNINGS, J.N., 1981 Landform, rock and soil. In The Heritage of Australia. An Illustrated Register of the National Estate. Macmillan, Melbourne. Pp. 17-84.

JENNINGS, J.N. 1981 Further results from limestone tablet experiments at Cooleman Plain. Australian Geographical Studies 19: 224-7.

JENNINGS, J.N. 1981 Karst in China. Caving International Magazine 13: 6-17.

JENNINGS, J.N. 1981 The problem of cavern formation. In: H.S. SHARMA (ed.) Perspectives in Geomorphology 1: 223-53. Concept, Delhi. (Preprinted 1980 in ASF Newsletter Australian Speleological Quarterly 89: 1-8, 11-9).

JENNINGS, J.N. 1982 Limestone mountains transformed by ice. Geographical Magazine 54: 268-76.

JENNINGS, J.N. 1982 Pseudokarst: a comment on substance and terminology. Journal Sydney Speleological Society 26: 79-86.

JENNINGS, J.N. 1982 Quaternary complications in fluviokarst at Cooleman Plain, N.S.W. Australian Geographer 15: 137-47.

JENNINGS, J.N. 1982 The karst potential in the Holocene. In: B.G. THOM, R. WASSON (eds.) Holocene research in Australia 1978-82. Pp.15-18. Department Geography Royal Military College Duntroon Occasional Paper 33.

CALDWELL, J.R., JENNINGS, J.N., DAVEY, A.G., SPATE, A.P., 1982 Colour in some Nullabor Plain speleothems. Helictite 20: 3-10.

JENNINGS, J.N., JAMES, J.M., MONTGOMERY, N., 1982 The development of the landscape. Pp. 45-64 in Wombeyan Caves. Sydney Speleological Society Occasional Paper 8.

JAMES, J.M., JENNINGS, J.N., MARTYN, M., HALBERT, E., 1982 Investigating the water. Pp. 65-82 in Wombeyan Caves. Sydney Speleological Society Occasional Paper 8.

JENNINGS, J.N., JAMES, J.M., MONTGOMERY, N., 1982 The origin and evolution of the caves. Pp. 83-104 in Wombeyan Caves. Sydney Speleological Society Occasional Paper 8.

JENNINGS, J.N., 1982 Karst of northeastern Queensland reconsidered. Tower Karst. Chillagoe Caving Club Occasional Paper 4: 14-52.

JENNINGS, J.N., 1982 Principles and problems of reconstructing karst history. Helictite 20: 37-52.

JENNINGS, J.N., 1983 The disregarded karst of the arid and semi-arid domain. Karstologia 1: 61-73.

JENNINGS, J.N., 1983 Swirlholes and related bedrock river channel forms. Australian Landform Example No.45. Australian Geographer 15: 411-4.

JENNINGS, J.N., 1983 A map of karst areas in Australia. Australian Geographical Studies 21: 183-96.

JENNINGS, J.N., 1983 Further studies at the Blue Waterholes, Cooleman Plain, N.S.W., 1969-77. Part I, Climate and Hydrology. Helictite 21: 3-20.

JENNINGS, J.N., 1983 Further studies at the Blue Waterholes, Cooleman Plain, N.S.W., 1969-77. Part II, Water Chemistry and Discussion. Helictite 21: 35-54.

JENNINGS, J.N., 1983 Karst landforms. American Scientist 71: 578-86.

JENNINGS, J.N., 1983 Thirty years of geomorphology downunder. In: R.W. YOUNG, G.C. NANSON (eds.) Aspect of Australian Sandstone Landscapes, Pp. 1-3. Australia and New Zealand Geomorphology Group Spec. Publ. 1.

JENNINGS, J.N., 1983 Sandstone pseudokarst or karst? In: R.W. YOUNG, G.C. NANSON (eds.) Aspect of Australian Sandstone Landscapes, Pp. 21-30. Australian and NewZealand Geomorphology Group Spec. Publ. 1.

GILLIESON, D.S., JENNINGS, J.N., SPATE, A.P., 1983 There is a silver lining to every missing cloud. Newsletter Australian Speleological Federation Quarterly 101: 5-7.

JENNINGS, J.N., 1984 The karst potential for Quarternary history. In: G.E. WILFORD (ed.) Quarternary Studies in Australia: Future Directions, Pp. 59-66. B.M.R. Record 1984/14.

STATE, A.P., GILLIESON, D.S., JENNINGS, J.N., 1984 Anomalous red quartz sands in certain Nullarbor Plain caves and dolines. Proceedings Second ANZ Geomorphology Group Conference, Broken Hill, 93-98.

STATE, A.P., GILLIESON, D.S., JENNINGS, J.N., DAVEY, A.G., 1984 The red sands of Nullarbor. Proceedings 14th Biennial Conference, Australian Speleological Federation, Adelaide, 61-65.

JENNINGS, J.N., 1985 Karst. Second edition. Blackwell, London.

SPIDER CAVE, JENOLAN - A FAULT CONTROLLED SYSTEM

Guy Cox and Bruce Welch

(Paper presented at Cave Convict, 12th Biennial Conference of the Australian Speleological Federation)

Abstract

Spider Cave is an influent cave, representing one stage in the progressive capture of the surface flow of the Jenolan River by a cave system. It consists principally of a rarely-active inlet passage, largely of phreatic form, which descends to join the large passage carrying the Jenolan Underground River. Both the position and the form of the inlet passage have been strongly influenced by the presence of a fault, which has also influenced the course of the surface river, and given rise to a large cliff - Frenchmans Bluff. The fault-line has also affected the development of the main underground riverway.

INTRODUCTION

Spider Cave (J 174) is the largest "new" cave discovered at Jenolan in recent years. It was first entered by Bruce Welch and John Dunkley, who came across the open, but very inconspicuous, entrance in May 1975. Progressive digs extended the cave until in June 1979 the underground course of the Jenolan river was reached. The history of the exploration of the cave, and a description of all the passages then known, is given by Cox et al. (1979).

Several workers have studied the geology of the Jenolan area, but few of these studies have been at a suitable scale for correlation with cave development. Sussmilch and Stone (1915) were the first to deal with the area, and it was later the subject of a BSc Hons thesis by Stanley (1925). More recently the limestone was mapped by Chalker (1971). The current state of knowledge has been summarized by Pickett (1982). Surprisingly, none of these authors noted that the spectacular cliff face which towers over the entrance to Spider Cave (Plate 1) and contains the entrances to the well-known Frenchmans (J 18) and False Frenchmans (J 21) caves has been formed along a fault-line. This fault (Fig 1) has played a major part in determining the form of Spider Cave, and of Frenchmans Cave, which is a high-level relic passage of Spider Cave.

This paper presents an account of the forms of the major passages in Spider Cave, and attempts to assess the influence of the local geology on the development of the cave.

LOCAL GEOLOGY

The limestone is of Upper Silurian age (Chalker, 1971); it overlies Ordovician or Devonian cherts and shales, and is overlain by Upper Silurian argillites and slates (Stanley, 1925; Shannon, 1976). Chalker (1971) states that no bedding is visible in the limestone. However true this may be on the surface, it is not the case underground. Even just inside caves and rock shelters clear bedding planes can be seen, and dips measured. Throughout the Northern Limestone region (the valley of the Jenolan River prior to its confluence with Camp Creek) the limestone shows westward dips; according to Chalker (1971) the strata are in fact overturned, so that the limestone "youngs" to the east (Figure 1). At Spider Cave the limestone has a westward dip of 80°, striking at around 160° true. Moving northward, the dips become less steep. Around Mammoth Cave, 800m to the north, the dip is still around 80° in a westerley direction, but 400-500m further north, in Serpentine and Hennings caves, it is 45-50°, while at Wiburds Lake Cave it is 20°.

The major changes in dip coincide with two prominent faults (Figure 1), one between Dwyer and Serpentine Bluffs (D) and one which intersects Wiburds Bluff (F), where it has given rise to a spectacular fault-line controlled rift. Further to the south, two faults have had a major influence on Spider Cave and on the underground drainage in general. The more obvious of these, Frenchmans fault (A) has displaced the eastern boundary of the limestone by about 60m, and has created a spectacular cliff, Frenchmans Bluff (Plate 1) by erosion along the fault-line.

Almost at right angles to this is the Playing Fields fault (B), which has displaced the limestone contact by about 200m on the western boundary and

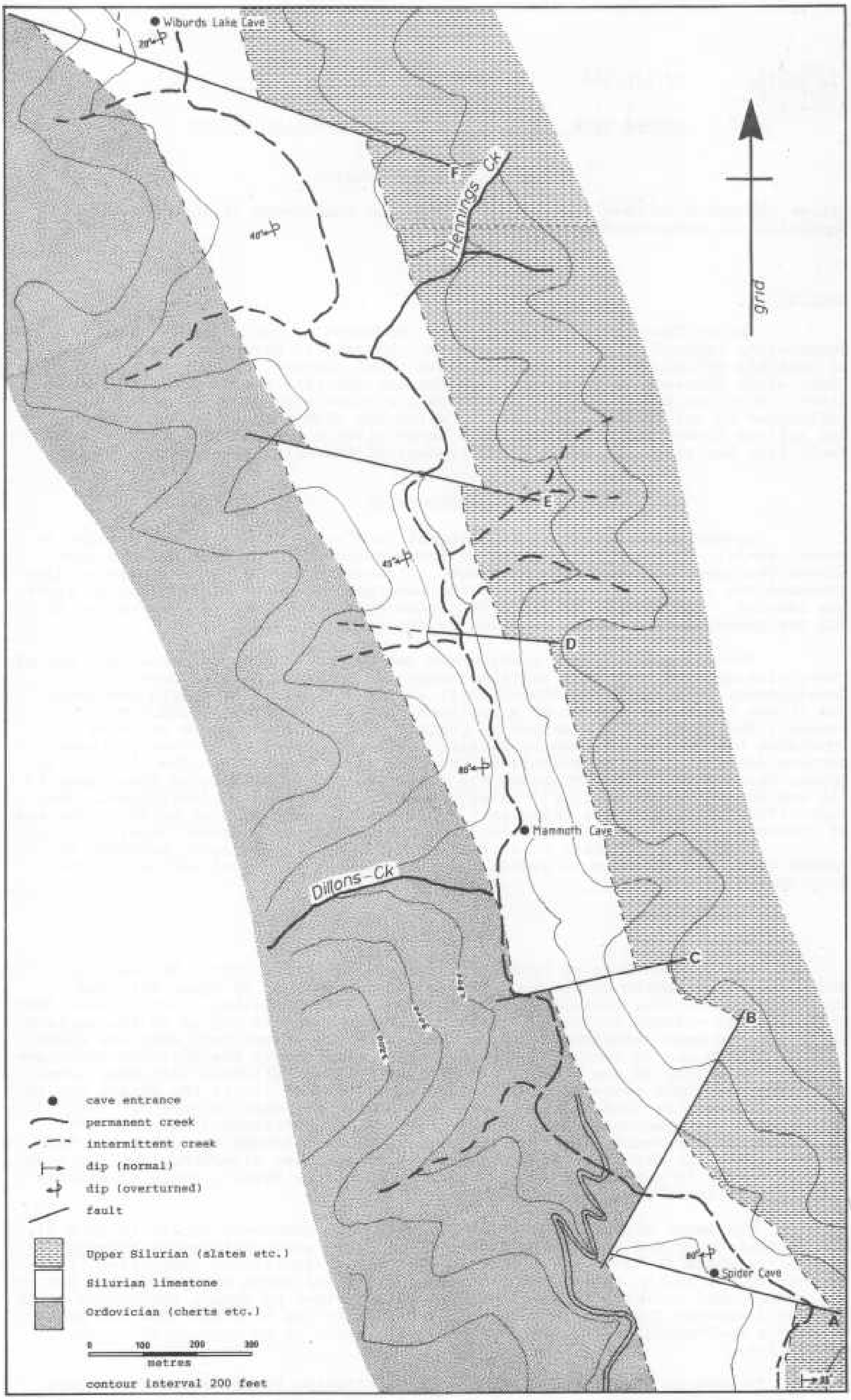


Figure 1. Geological map of the Northern Limestone area, Jenolan Caves.

100m on the eastern. Frenchmans fault cannot be recognized on the surface where it intersects the larger Playing Fields fault. North of the Playing Fields fault the river flows on the shales almost all the way from the intersection of Dillons Creek at Mammoth Flat. Another fault (C), 200m downstream of the Dillons Creek confluence, takes the river briefly on to the limestone; the stream course is deflected slightly at this point and there is a sink which is active in wet weather. This sink is probably of (geologically) recent origin; since the limestone dips to the west it would not have been exposed here until the valley floor reached almost its present level. The surface exposure of the fault more or less overlies Slug Lake, the most southerly point at which the underground course of the Jenolan River is seen in Mammoth Cave. Slug Lake has been dived; the river descends steeply to a depth of 20m or more. It seems likely that this is the effect of the fault.

A larger stream-sink is seen where the river crosses on to limestone at the Playing Fields fault. From here there are many signs of sinkage in the creek bed but the next discrete sink (recognizable as a point where the stream's advance is checked in flood) is seen just where the streamway leaves the limestone at Frenchmans fault to flow briefly on the Silurian argillite.

THE CAVE

The cave consists of two major parts: the influent system, a tributary passage carrying water from the surface Jenolan River to its underground course, and the underground riverway itself. Both have low-level active or intermittently-active passages and higher, parallel, fossil series. Both are very largely phreatic in form, indicating that most speleogenesis took place before the valley was lowered to its present level. The influent system closely follows the line of Frenchmans fault, running more or less due west to its confluence with the southward-flowing underground river (the Hairy Diprotodon).

The Influent System

Frenchmans and Spider Caves represent successive sinking points in the surface riverway, along the line of the fault, as the valley has deepened and moved eastward. Frenchmans Cave, which is large and descends steeply, must have been a fairly major sink for the river, though the age, size and level of the passages associated with the main underground river suggest that even at this time a major part of the river sank much further upstream. At this stage, because of the convergence of the Playing Fields and Frenchmans faults, and the dip of the limestone, the riverbed would have been on limestone for only a short distance above the sink. There would have been no sink at the Slug Lake fault; the riverway would have been on the Ordovician strata from just below Mammoth Cave entrance (which itself would have been an active sink at that time). All tributaries entering from the west below this point, including Dillons Creek which today is one of the few permanent surface streams in the area, would have reached the main river bed and sunk eventually in Frenchmans cave.

Spider Cave entrance, about 3m above the current level of the creekbed, represents a more recent, but still now inactive, sink. Water does still enter the cave when the creek flows outside - its sinking point has not been proven, but it enters Main Chamber from the east, emerging from a small passage which runs along along the line of the fault. This can be followed to a point vertically beneath the gate, and thus not far in horizontal distance from the cave entrance. The most likely source is a small sink visible where the surface stream bed crosses the fault line. This water flows across Main Chamber and fills Dingo Dig; access to the rest of the system is therefore blocked when the inlet is active.

The current entrance to Spider Cave lies 4m north of the fault, and the entrance crawlway soon swings west, with the fault forming its left wall. Almost immediately 2 consecutive 2m drops lead into a small chamber, the south wall of which is the fault and the east wall (down which one has just climbed) a bedding plane, dipping at 80° to the west. From here the passage drops steeply down a series of climbs into Main Chamber, so named, rather pessimistically, when it was first reached. The walls of Main Chamber are almost totally covered with flowstone; the fault must cross the chamber, but cannot be recognized. On the SE side of the chamber a steep, flowstone-floored ramp rises up to a point (The Jail) level with the entrance. This passage approaches False Frenchmans Cave (J 21), which may represent another fossil sink on the fault, intermediate in level between Frenchmans Cave and the Spider Cave entrance. The whole of this part of the cave is phreatic in form. The current wet-weather trickle of water has done no more than carve a small channel in the sediments of the floor.

From Main Chamber both water and cavers pass down a steeply descending and rapidly constricting passage to Dingo Dig. This was choked when the cave was first discovered, and has been dug out. Dingo Dig is the first of three classic "phreatic loop" structures in the cave. Their presence is puzzling: such passages are typically formed where the slope from sink to resurgence is gentler than the dip (Ford, 1971). Passages run down dip, and sumps are formed where the stream from time to time breaks through a bed into the bedding plane above. In Spider Cave the direction of the influent stream is certainly down dip, but since the dip is 80° the passage never (except for the climb just inside the entrance) runs down the dip. Nevertheless, a somewhat similar mechanism may operate where shale partings have constrained the stream downward until a weaker point permitted penetration. At first sight it seems surprising that the fault, which never lies more than a few metres from any of the three phreatic loops, did not provide an easier penetration. However, nearby, in Frenchmans Cave, a dyke is seen to have intruded along the fault (below) and this may have blocked this route.

The approach to Dingo Dig is a descending, small passage, which is probably an enlarged joint. At its lowest point (a sump in wet weather) the passage turns right, following the strike of the limestone and creating a very awkward constriction. After 2 metres the passage turns left, breaking through a shale band, and rises as a classic "ramp" passage for 9m at an angle of 20°. Since the passage is only around 30cm high (section d), the ascent is fairly energetic.

The ramp ends in a lofty phreatic chamber, Frustration Chamber. The way on is through the second phreatic loop, the Z-squeeze. This is short and shallow, and though once extremely tight now presents no obstacle to anyone who can negotiate the other two. There is no obvious geological cause of the constriction, but immediately beyond the passageway is again large and spacious. A stream channel is evident in the floor, the first true vadose feature in the cave, though the passage itself is phreatic in form. Soon the passage forks. The streamway drops down to the right (section g), where it continues as a lofty, spacious passage with thick sediments on its floor and clear signs of an ancient water level on the walls (Plate 2). The passage closely follows the line of the fault, and is, in part, formed in fault breccia. The left hand passage runs at a higher level and is very well decorated. To traverse it without muddying the flowstone involves acrobatic manouevres and the progressive removal of layers of clothing. Visitors are urged not to attempt it, particularly since the finest helictites (which give the passages together their name of Helictite Chamber) are right at the start of the passage and are easily seen without going far.

The Helictite Chamber passages represent the route of the water which once sank in Frenchmans Cave. Frenchmans Cave lies on the fault, directly above the lower passage, and descends to the level of the end of the upper passage. The upper chamber of Frenchmans Cave, entered by either of two short pitches from the surface, is of classic nothephreatic shape (see survey in Welch, 1976), but its walls are largely covered with flowstone. A series of short climbs leads down into the lower section of the cave, a straight passage aligned along the fault. At this point a dyke has intruded close to, or along, the fault, and it is clearly visible in the roof along the length of the passage. At its western end the passage terminates in a descending, choked rift following the fault itself. This is extremely close to the northern branch of the upper Helictite Chamber passage; some determined navvying might force a connection, but there would be little point in the exercise.

Continuing downstream in the lower branch of Helictite Chamber, after 30m the passage starts to descend, and closes down rapidly (sections m-p) to a flat-out crawl. Here is the third of the digs involved in opening up the cave, and the most spectacular of the phreatic loops, Pirates Delight. At the low point, which is extremely constricted and floods in wet weather, the passage has a very small offset to the north, along the strike of the bedding. Such an offset is a feature of each of the three squeezes, but only in the first, Dingo Dig, is any controlling shale band actually visible.

From Pirates Delight a very spectacular, and constricted, ramp ascends for a vertical distance of 4m at 31° (Plate 3), ending in a circular aven chamber, the Bus Stop. Here a small tributary stream enters. It is only a barely perceptible trickle in dry weather, but keeps the ramp down to Pirates Delight moist, though its original flow was clearly onward. The way on is an extensive boulder choke, which is probably the collapsed remnant of an extensive phreatic maze, as some fine flakes and pendants are visible. (A particularly large flake, the Map of England, has unfortunately now become detached from the wall.) A tortuous and very tight passage, the Serpentinious Passage, skirts the collapsed area to the north; Cox et al. (1979) interpreted this as a vadose canyon but it is more probable that it is a joint-controlled phreatic passage.

The latter part of the boulder choke is a steeply-descending (~45°), partially boulder-filled rift, in which a further small inlet enters. These passages merge into a well-defined stream passage in bedrock, though it does not carry more than a trickle of water under any conditions in which cavers can reach this area. In a dozen metres or so this debouches into a very spacious passage, Glop Hole Gallery. This is very much larger (5-7m wide by 8-10m high) than any passages encountered hitherto; this point represents the confluence of the influent system with the passages formed by the Jenolan Underground River itself.

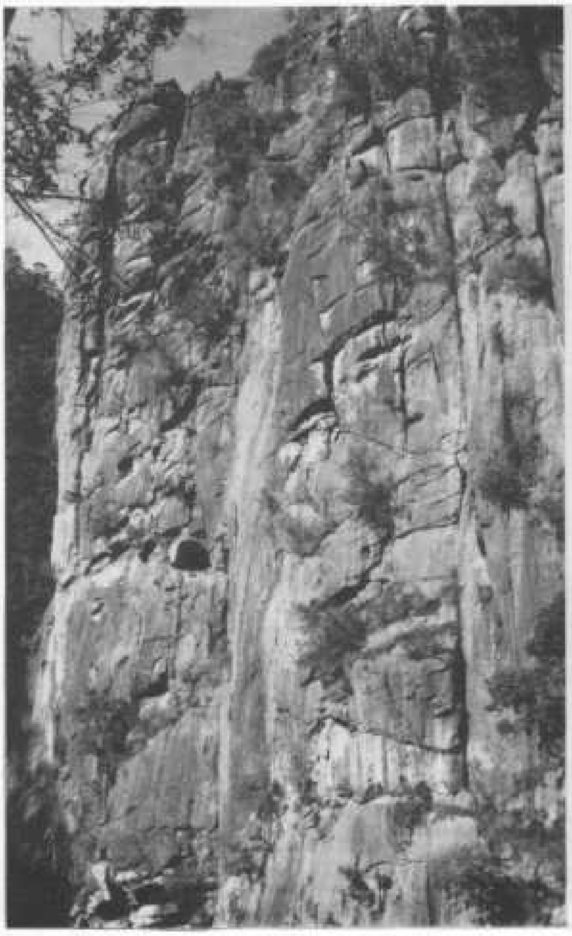


Plate 1. The cliff above the cave which marks Frenchmans Fault. Note two cavers (on rope and at cliff-top). Photo Peter Winglee.

Plate 2. Lower Helictite Chamber. Note old sediment fill levels on walls. Photo Bruce Welch.

Plate 3. Ian Mann ascending the ramp up from Pirates Delight. Photo A.S. White.

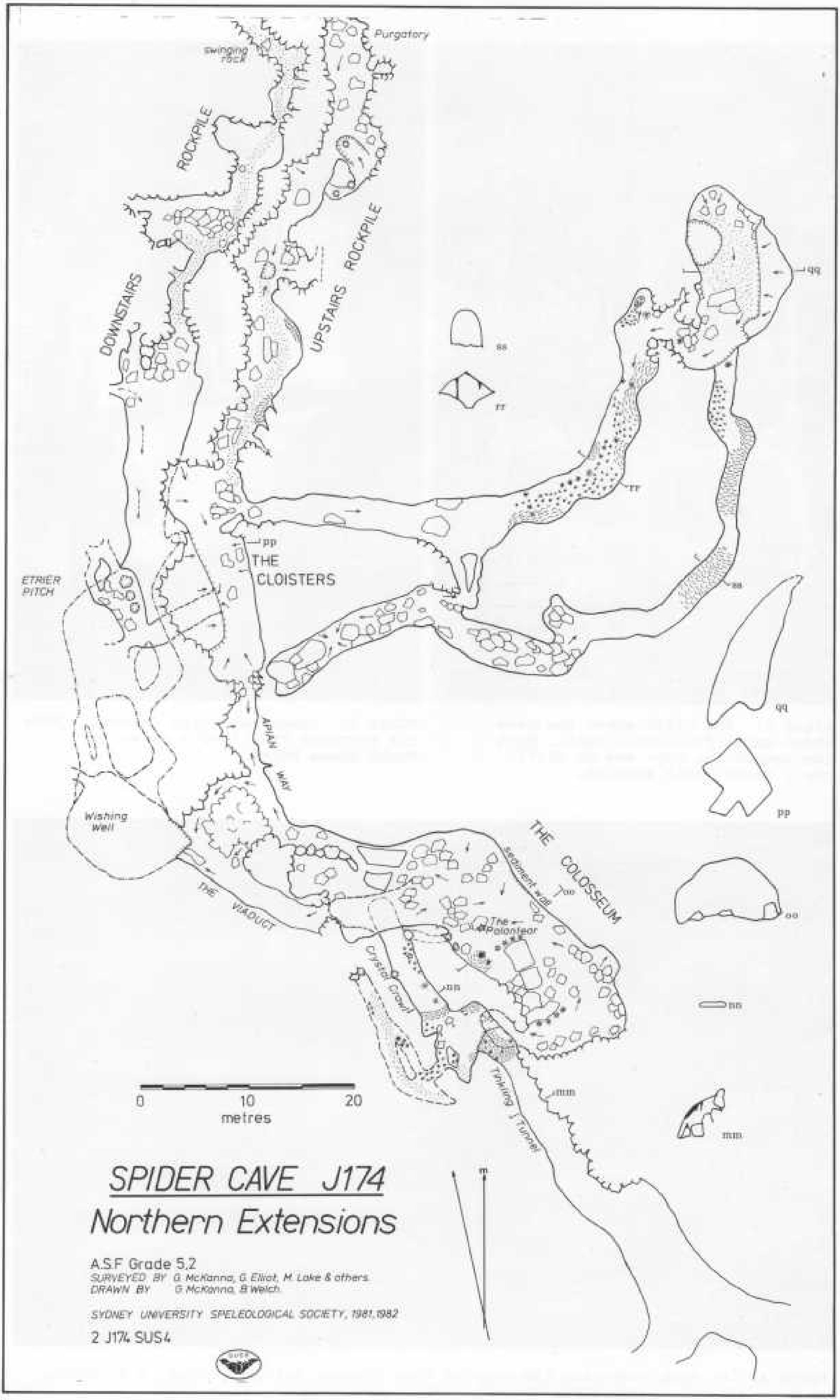


Figure 3 (above). Plan of the northern extensions of Spider Cave.

Figure 2 (facing). Plan of Spider Cave, as known up to 1981.

Figure 2 Plan of Spider Cave,
as known up to 1981.

39 cm x 50.5 cm

Not available at time of scanning

3/9/2016 GNB

The Jenolan River System - Fossil Passages

Glop Hole Gallery is phreatic in form (section s) with extensive sediment deposits on the floor. Drips from the roof have formed pits which resonate musically (glopholes), and a route has been marked to minimise damage to the sediments and these features. The stream from the influent system has cut itself a deep vadose channel, partly through the sediments but also into the bedrock. This eventually leaves Glop Hole Gallery, running due south.

Another inlet, Khan passage, enters from the southeast. This is superbly decorated (Plate 4) - it takes its name from the Mini Khan, a large domed stalagmite, but it also contains a wall of fine helictites (Plate 5) and some excellent stalactites as well as shallow gours in the stream bed. Beyond these the passage rapidly narrows and is soon impenetrable. There is at least a trickle of water here under almost any weather conditions. Downstream this has formed a vadose trench like that of the main influent stream; it leaves Glop Hole Gallery to the south just opposite the point at which the main influent stream enters from the north. The two streamway passages unite just south of Glop Hole Gallery.

Glop Hole Gallery, while clearly a part of the main Jenolan River system, shows no sign of an outlet to the southeast. It seems likely that it is a branch of a deep phreatic system (nothephreas) much enlarged by mixed-water corrosion (Bogli, 1971) as a result of the entry of the Khan Passage and Spider Cave waters.

The combined waters of these two streams descend very steeply (-40°) to the Underground River, in a passage which is phreatic in form at roof level, but is a typical vadose canyon below (sections ee and ff). An aven halfway along cannot be penetrated very far upwards, but provides an alternative route down to the river, dropping into a parallel passage which debouches just upstream of the main confluence. It represents a small inlet which once joined the main influent stream, but subsequently found an independent route to the river.

At its westward end, Glop Hole Gallery joins a series of passages which form a parallel system to the main riverway, ten to twenty metres above it. The passages are phreatic in form, and evidently represent an old course of the underground river. Glop Hole Gallery is around 35m below the surface stream bed, so that its roof is still 25-30m below this level; it is thus not apparently necessary to postulate that these passages were formed before the valley reached its present level. However, the series reaches much higher elevations both upstream and down, with roof levels approaching the level of the valley floor. Passage forms suggest a deep phreas (nothephreas) - floor levels are essentially random, and there are wide variations in passage size - though there has been a lot of subsequent modification by invading tributary streams. The passage shapes, and the quantity of sediment, are remniscent of Frenchmans Cave; the passages are also largest where the Frenchmans Cave water once entered (the present entry of the Spider Cave stream). It seems reasonable, therefore, to date this series to the time when Frenchmans Cave was an active sink, and the surface riverbed was at least 45m above its present level.

Downstream, the main route of the fossil series is a steeply ascending sandbank which rises 10m in a passage named (rather unoriginally) the Whale's Throat. A choked shaft descends from the high point; this probably drains into the aven to the right of the main influent stream passage (described above; section ee). After skirting this pit, the passage levels out and becomes low but wide until it is almost blocked by a stalactite curtain (section gg). Beyond this, one is on the lip of a 19.6m drop to the main underground riverway. This lofty chamber, the Mausoleum, probably represents a major point of connection between the fossil and present river systems - an early breakthrough to the lower level. The old passage can still be followed by an exposed ledge on the left wall (Terror Traverse). Beyond the traverse the old passage swings eastward, along the line of major jointing in the limestone. A small, occasional stream has invaded this part of the passage, incising a trench in the sediments; it flows in the reverse direction, towards the Mausoleum. The passage ends in an enigmatic chamber, the Eyrie (section kk). This is a sloping rift, described by the original explorers as a bedding plane, but which must in fact be a joint, dipping at 50°, strike 205°. Another joint, or minor fault, along which approximately 30mm of vertical movement has taken place, bisects the slope. The lower end of the slope is a boulder choke, apparently continuous with that into which the river disappears. The rift is ornamented with superb shawls, and at the top leads into a flat, superbly-decorated chamber, Caverna Alba. The highest point of the floor here is -9.4m w.r.t. the cave tag, and so just 6m below the surface stream level.

The upstream route of the fossil series, northward from Glop Hole Gallery, rapidly enters a zone of collapse. This lies due west of the Rockpile, and may therefore share a common geological cause. The route through this boulder choke, Tinkling Tunnel, was discovered in 1981, and is not therefore included on Fig. 2; it and the series beyond are shown in Fig. 3. The boulder choke has many stalactites and small shawls, indicating that it is of some age,

Plate 4. Formations in Khan Passage. Photo A.S. White.

Plate 5. The Helictite Wall, Khan Passage. Photo Franc Maleckar.

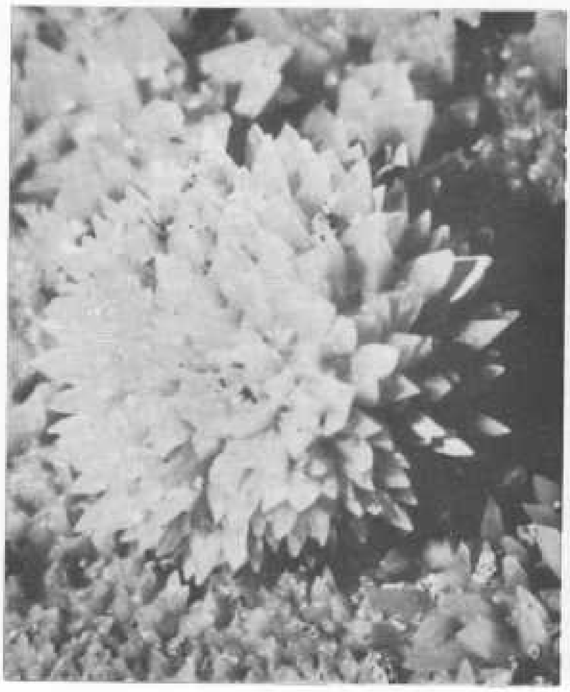


Plate 5. Formation in Crystal Crawl. Photo Mark Bonwick.

Plate 6. The Palantear. Photo Geoff Innes.

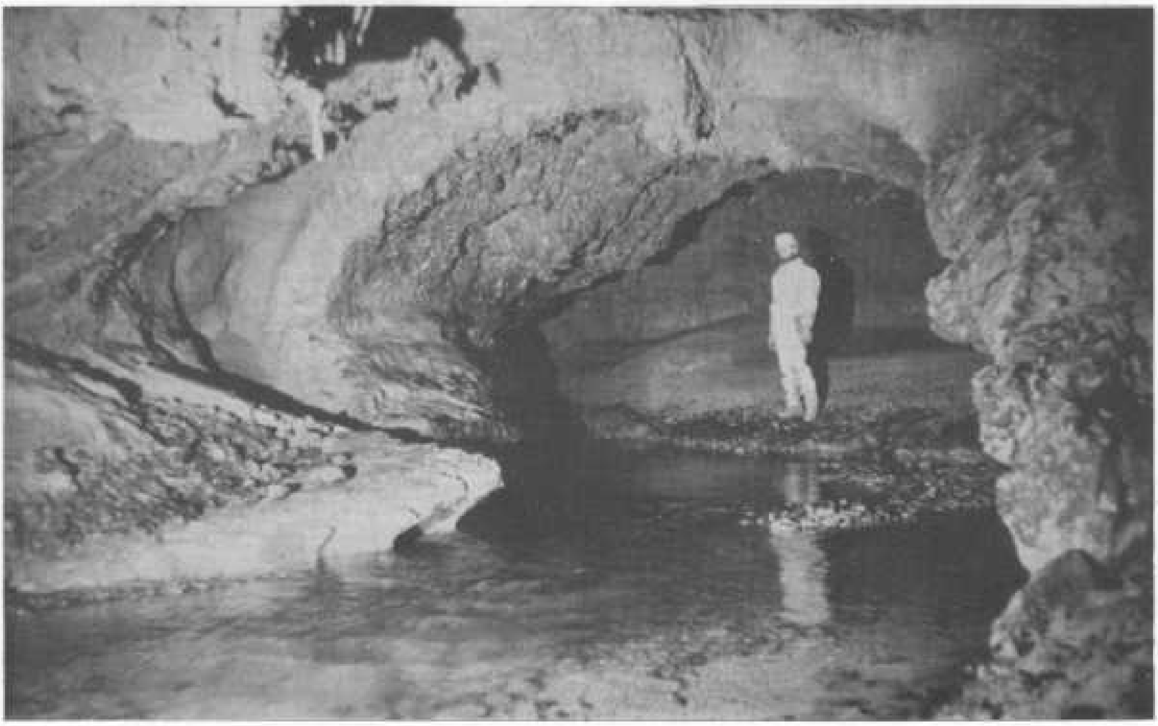


Plate 7. The Underground River, looking upstream from the confluence. One of the few places where vadose features are apparent. Photo Franc Maleckar.

Plate 8. The Riverway, looking downstream from Pike Lake. Shale partings are prominent in the limestone. Photo Bruce Welch.

and presumably fairly stable. Tinkling Tunnel leads to a 3m drop into a well-decorated chamber. An aven above leads to the Colosseum, but is not free-climbable, so cavers must follow a crawlway, Crystal Crawl, which contains exceptionally fine crystal formations (Plate 6). From this, an awkward squeeze leads into the Colosseum, a large, boulder-floored chamber, the true extent of which is difficult to know since several of its walls are boulders or sediment. The most remarkable feature of this chamber is an extraordinary calcite formation, the Palantear (Plate 7). This "crystal ball", sitting in a calcite crater, is, to the best of our knowledge, unique. McKanna (1984), has advanced an hypothesis as to how it was formed.

From the north-west end of the Colosseum, several routes through boulders lead to a drop, the Wishing Well, down to the underground river. The continuation of the fossil series, however, is a passage running due north, the Appian Way, with an eastern wall of bedrock and boulders on the western side. This continues as the Cloisters and then as the Upstairs Rockpile, essentially in a straight line, to the northernmost part of the cave (Purgatory), where it becomes a route entirely through boulders and finally chokes. In the Cloisters area, a low passage leads westward to several holes through boulders to the riverway. This is the normal route used by parties travelling dry to the river above Sump 1; some form of aid is usually used on the climb, hence the name Etrier Pitch. A passage runs due east from the Cloisters; this turns northwards at its end (Inspired Point), and is probably still part of the fossil main river system. A parallel passage, at high level, leads back almost to the Cloisters.

The River Passage

At the point where the Spider Cave tributary joins it, the main riverway is a gently meandering passage, with many vadose features (Plate 8). This point is 47.3m below the cave tag. Downstream, one immediately enters the Mausoleum, a tall aven-chamber, crossed 20m up by the balcony of Terror Traverse. The Mausoleum, in its present form, must largely have been formed by collapse; the western side of the chamber is a steep boulder slope. Near-vertical bedding planes (visible in the roof and upper walls) have probably facilitated the enlargement by collapse, in the vadose phase, of an original descending phreatic passage. Downstream from the Mausoleum the passage follows the strike of the limestone, with bedding clearly visible, to a major cross-joint (see Innes, 1979). Here part of the river turns westward and sinks in bedrock, while the major flow follows the joint to the east and disappears into an extensive, loose rockpile. The river can be followed for at least 20m through the choke, but further progress will require extensive boulder-shifting.

Upstream from the confluence, the river passage swings westward (Plate 8), then turns to follow the strike of the limestone. Shale partings between the beds are very prominent here (Plate 9) and have evidently had a major controlling influence on the form of the passage. Soon the water deepens in a circular pool, Pike Lake. The passage form here is entirely phreatic. At the upstream end of the lake is a dyke (Fig. 2); this could possibly mark the position of the Frenchmans fault (A), since a dyke is associated with the fault in Frenchmans Cave (above). It is directly in line with the mapped exposures of the fault. Continuing upstream, the roof becomes progressively lower. The passage is phreatic in form, and follows the strike closely. Soon the water deepens, to >2m, and the roof dips to water level - Sump 1.

The actual sump runs almost east-west, and is very short - around 1m. It simply represents the point of breakthrough through a fairly substantial shale band. Upstream, one surfaces in a large chamber containing a deep lake. In the southeast corner, a boulder-filled aven leads upward for an estimated 20m. This is the Wishing Well pitch from the fossil series (Figure 3), and is an easy, but exposed, free climb. Upstream from this chamber, three parallel passages lead on, each bounded by shale partings. These join in a sloping, boulder-floored chamber, but the passage onward remains strongly strike controlled. This ends abruptly after another 17m in a tall rift, beyond which is a choke of angular (new-looking) boulders. The rift runs east-west, and is clearly a fault - the bedding is rather massive south of it, while to the north it is very fine, with uniform beds around 10cm thick. The river emerges from the west, running in a narrow rift which follows the fault, and a dyke intruded along it. 3m along this rift the water wells up from a deep blue hole, Sump 2. This has been dived, and continues for at least 13m vertically downward (Cox et al., 1979). This fault was thought by Cox et al. (1979) to be the continuation of the Frenchmans fault (A), but it could alternatively be the Playing Fields fault (B). If the latter, one would expect the continuation to be rather deep, since the limestone dips steeply below the cherts north of the fault - an approximate calculation suggests that the top of the limestone could be 100m or more below the cave passage at this point. Of course any easterly trend of the passage would reduce this depth requirement very substantially.

Various routes into the rockpile are possible. One leads to a deep pool which communicates with Sump 2 and provides an easier diving site. Another, the Downstairs Rockpile, runs closely parallel to the Upstairs Rockpile (entered from the Cloisters) but does not connect. It continues for at least 50m, and probably represents the most promising chance for a dry route beyond Sump 2.

CONCLUSIONS

Spider Cave is hydrologically rather simple - an inlet system, Spider-Frenchmans, leading into the main course of the Jenolan Underground River (the Hairy Diprotodon). The latter is very similar to the continuation of the same passage in the Imperial Cave divers' extensions, and is separated from it only by an impenetrable boulder choke. The current surveyed length of the cave is 1570m, including two small extensions from Glop Hole Gallery (Lake, 1980) which are not included in Figure 2 or Figure 3. Most of the passages are phreatic in form, though there has been a little vadose development in parts of the inlet system, and rather more in the furthest downstream part of the main riverway. Much of the general direction of the inlet system has been determined by a fault, while the major control in the main riverway has been the strike of the bedding.

Previous studies have not regarded faulting as a major influence at Jenolan. However, it is clear that as well as controlling the direction of the Spider Cave inlet system, faulting is also responsible for the inaccessibility of the main underground river between Slug Lake in Mammoth Cave and Sump 2 in Spider. Many of the faults shown in Figure 1. have not been previously mapped, and it seems that as our knowledge of the Jenolan area increases, geological controls of speleogenesis are becoming more apparent.

ACKNOWLEDGEMENTS

We are very grateful to many members of Sydney University Speleological Society who have contributed to the exploration and surveying of Spider Cave, and to those whose photographs we have used (acknowledged in the plate captions). We thank the NSW Department of Tourism for permission to work at Jenolan, and G. Francis and R.A.L. Osborne for commenting on the manuscript.

REFERENCES

BOGLI, A., 1971 Corrosion by mixing of karst waters. Trans. Cave. Res. Gp. G.B., 13: 109-114.

CHALKER, L., 1970 Limestone in the Jenolan Caves area. Rec. Geol. Surv. N.S.W., 13: 53-60.

COX, G., WELCH, B.R., LAKE, M., MACKAY, R. and INNES, G., 1979 Spider Cave, J 174. Bull. Syd. Univ. Speleo. Soc., 19: 47-57

FORD, D.C. 1971 Geologic structure and a new explanation of limestone cavern genesis. Trans. Cave. Res. Gp. G.B., 13: 81-94

INNES, G., 1979 The Hairy Diprotodon. Bull. Syd. Univ. Speleo. Soc., 19: 55-56

LAKE, M., 1980 Trip report - Jenolan 29th December to 1st January 1979/80 - Entry into the Tomb Chamber, Spider Cave. Bull. Syd. Univ. Speleo. Soc., 20: 23-25

McKANNA, G., 1984 Geomorphology of the Palantear. Bull. Syd. Univ. Speleo. Soc., 24: 65-67

PICKETT, J., 1982 The Silurian system in New South Wales. Bull. Geol. Surv. N.S.W., 29

SHANNON, C.H.C., 1976 Notes on geology, geomorphology and hydrology. In: B.R. WELCH (ed), The Caves of Jenolan 2: The Northern Limestone: 5-9. Sydney University Speleological Society.

STANLEY, G. A. V., 1925 A preliminary Account of the Geology and Petrology of the Jenolan Caves Reserve. B.Sc. Hons Thesis, University of Sydney.

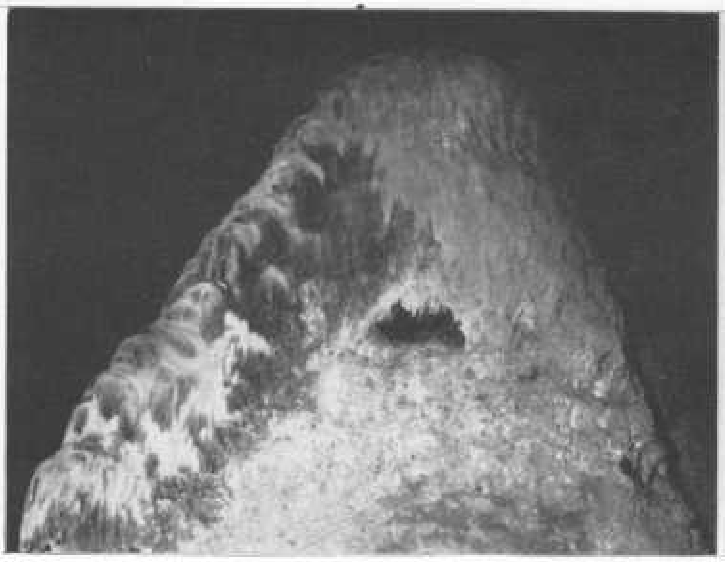
SUSSMILCH, C.A. and STONE, W.G., 1915 Geology of the Jenolan Caves district. J. Proc. Roy. Soc. N.S.W., 49: 332-384

WELCH, B.R. (ed), 1976 The Caves of Jenolan 2: The Northern Limestone. Pp 131. Sydney University Speleological Society.

Address for correspondence: Electron Microscope Unit, University of Sydney, NSW 2006, Australia.

Plate 2. Parallel ranks of Lobsters on the ridge, with a drop to the entrance chamber on the left. The steps from Arch Cave landed at the rear of the picture, right of centre.

Plate 1. A Lobster, showing the serrated profile. The blue-green algae are darker where they are damp.



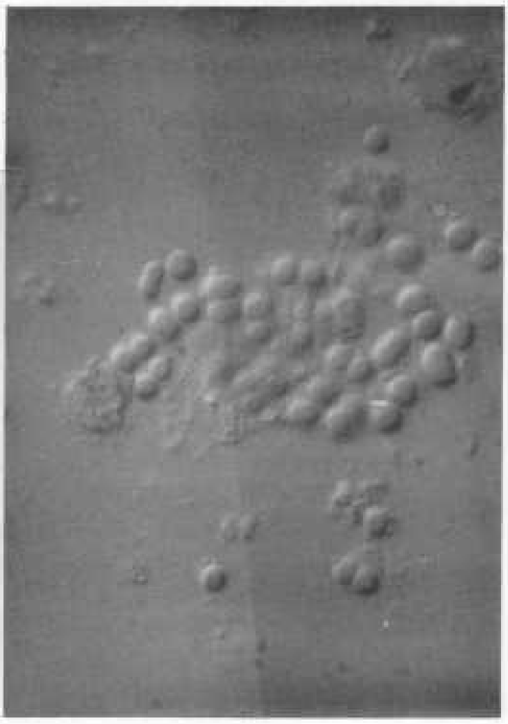


Plate 3. Another Lobster, with a more rounded profile.

Plate 4. Differential interference contrast micrograph of algae from the surface of a Lobster, x 1120

LETTER

PHOTOTROPHIC STALAGMITES AT JENOLAN CAVES, N.S.W.

Nettle Cave, a high-level part of the main show-cave system at Jenolan,was open as a show-cave from 1838 until 1932 - almost a century - but has received little visitation since, and is not now at all well known to speleologists. Recently the New South Wales Department of Leisure, Sport and Tourism has decided to redevelop the cave, probably as a self-guided tour. As a preliminary to this, a study of the system was undertaken by a team from the Australian Speleological Federation (Hamilton-Smith, 1984).This note results from a botanical investigation of the cave which formed part of the study.

A well-known feature of the cave was a group of stalagmites known as the Lobsters. These are mentioned in all the 19th century accounts of Jenolan Caves (Cook, 1889; Foster, 1890; 'Argus', 1898); 'Argus' describes them as follows: "Other stalagmites take the form of immense lobsters. So close is the resemblance that an artist might envy their extreme naturalism." These stalagmites are flattened, humped structures, with a very characteristic saw-tooth profile (Plates 1 and 3). They are coloured bluish green by cyanobacteria, and are oriented parallel to each other on a high ridge at the eastern end of the cave (Plate 2 and Figure 1). This part of the cave is essentially an arch. On the northern side of the ridge is a pitch to the floor of the Devils Coach House (Figure 2), while above light streams in from a large hole in the roof, 60m above the Coach House floor. On the southern side of the ridge is a steep slope (Plate 2) down to the base of the slope from the present Nettle Cave entrance. This entrance is a tall rift, so that the ridge is lit from this direction also. Some light also enters from the entrance of Arch Cave; this has been partially obstructed by a concrete wall built recently, but would always have been of less importance than that from the Nettle Cave entrance. A flight of steps (in the earliest days a ladder) formerly led from Arch Cave into Nettle Cave, landing on the ridge among the Lobsters.

The only comparable stalagmites described in the literature seem to be the Craybacks in Victoria Arch, Wombeyan Caves, N.S.W. (James et al., 1982), though similar structures are found at Abercrombie Caves, N.S.W. (R.A.L. Osborne, pers. comm.) and at Chillagoe, Qld. (E. Hamilton-Smith, pers. comm.). James et al. (1982) regard the Craybacks as phototrophic stalagmites, resembling in their form and structure marine stromatolites. They describe their formation as follows:

> "Blue-green algae live on the surface of the Crayback and grow toward the light. The Crayback is splashed by drips from the cave roof and from this water the algae remove carbon dioxide for photosynthesis, thus depositing calcium carbonate on the surfaces facing the open ends of Victoria Arch."

The only other phototrophic speleothems described in the literature have been small stalactites, usually only a few centimetres long. Cubbon (1976) describes several examples of 'Eucladioliths' - small phototrophic stalactites formed by the moss <u>Eucladium</u>, and one example of a small stalactite formed by a cyanobacterium (blue-green alga). The Nettle Cave Lobsters therefore seem to be both rare and of great scientific interest.

A scraping was taken from the surface of one of the Lobsters. This contained large numbers of a unicellular cyanobacterium, with rather few other organisms. The cyanobacterium (Plate 4) has circular to ovoid cells, often in pairs or fours, enclosed in a common lamellate sheath. They seen to be a <u>Gloeocapsa</u> sp., and resemble <u>Gloeocapsa</u> strain NS4, an isolate obtained in culture which originated from a cave wall in northern Spain (Cox, Benson and Dwarte, 1981). An organism apparently identical to <u>Gloeocapsa</u> NS4 was collected from the entrance of Atea Kananda, Papua-New Guinea (Cox et al., 1981), so it seems to be a common component of the flora of cave walls in the twilight zone. If so, and this is the alga responsible for the formation of the Lobsters, we have the interesting situation of a fairly common cave-wall alga forming rather uncommon structures - presumably when stringent environmental conditions are met.

The Lobsters clearly deserve much more detailed study, and further work is planned. The purpose of this short note is to draw the attention of other cave biologists and mineralogists to their existence and their scientific interest. I thank the NSW Department of Leisure, Sport and Tourism, and Mr. E. Holland, Chief Guide at Jenolan Caves, for making this study possible.

'ARGUS', 1890 <u>The Jenolan Caves and the Blue Mountains.</u> Cumberland Argus, Parramatta.

COOK, S., 1889 The Jenolan Caves: an Excursion in Australian Wonderland. Eyre and Spottiswoode, London.

COX, G., BENSON, D. and DWARTE, D.M., 1981 Ultrastructure of a cave-wall cyanophyte - *Gloeocapsa* NS4. Arch. Microbiol., 130: 165-174.

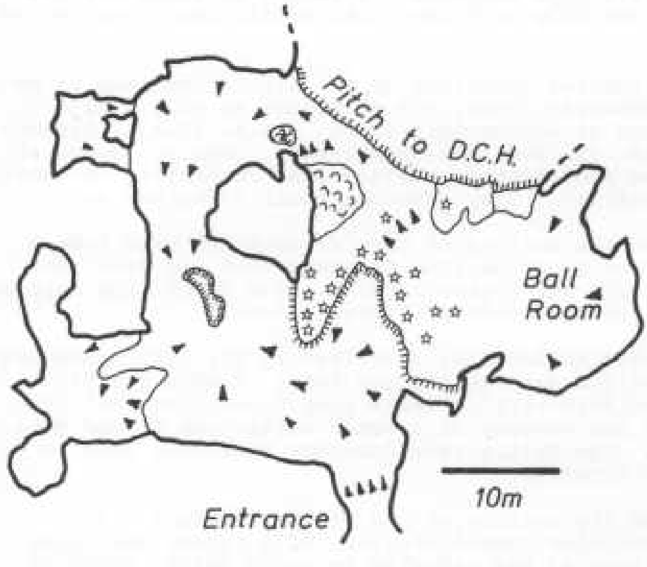
CUBBON, B.D., 1976. Cave flora. In: T.D. FORD and C.H.D. CULLINGFORD (eds), The Science of Speleology: 423-452. Academic Press, London.

FOSTER, J.J., 1890 The Jenolan Caves. Government Printer, Sydney.

HAMILTON-SMITH, E.(ed), 1984 Jenolan Caves Resort - some Management Issues. Unpublished report prepared for the N.S.W. Department of Leisure, Sport and Tourism by a study team from the Commission of Cave Tourism and Management of the Australian Speleological Federation.

JAMES, J.M., JENNINGS, J.N., DYSON, H.J., 1982 Mineral decoration and weathering of the caves. In: H.J. DYSON, R. ELLIS and J.M. JAMES (eds), Wombeyan Caves: 000-111. Sydney Speleological Society, Sydney.

Guy Cox,
Electron Microscope Unit,
University of Sydney,
N.S.W. 2006,
Australia



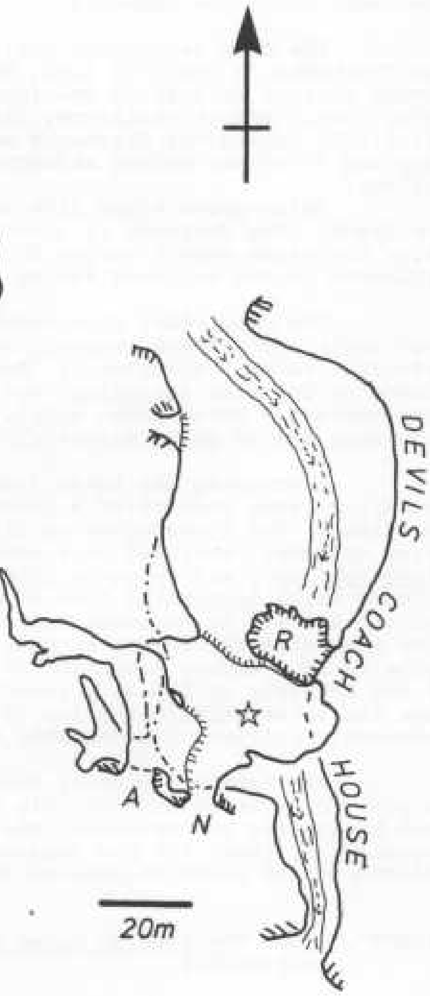


Figure 1 (above). Nettle Cave. The stars indicate the area where the Lobsters are situated (but not the actual position of individual stalagmites). From a survey by K. Oliver and others.

Figure 2 (right). Sketch map of Nettle Cave, Arch Cave and the Devils Coach House. The ridge carrying the Lobsters (star) receives light from the Nettle Cave entrance (N) and the Arch Cave entrance (A) to the south, and from the roof-hole (R) in the Devils Coach House to the north. From a survey by O. Trickett.

INFORMATION FOR CONTRIBUTORS

SCOPE

Contributions from all fields of study related to speleology will be considered for publication. Suitable fields include Earth Sciences, Speleochemistry, Hydrology, Meteorology, Conservation, Biospeleology, History, Major Exploration (Expedition) Reports, Equipment and Techniques, Surveying and Cartography, Photography and Documentation. Comprehensive descriptive accounts of the exploration and morphology of individual caves will be welcomed, but simple trip reports and brief cave descriptions are not adequate. Papers overall should not exceed 20 printed pages in length. Contributors intending to write at greater length or requiring any advice on details of preparation are invited to correspond with the Editors. All manuscripts will be read by referees. Short 'Letters to the Editor', expressing a personal view or giving a preliminary report of interesting findings, are welcomed, and will be given preference for speedy publication.

MANUSCRIPTS

Submitted manuscripts should be in a final form ready for publication. As proofs are not normally sent to authors particular care should be taken to check for typing errors. Manuscripts should be typed, double spaced, on one side of the paper. The title should be uppercase and underlined, and the authors' names should follow. A brief and explicit summary of the notable aspects of the paper, headed Abstract, should precede the main text.

Throughout the main text major headings should be in upper case, centred and not underlined, while subheadings should use lower case, underlined and aligned with the left hand margin. Acknowledgements should be placed at the end of the text before the references, and the authors' addresses for correspondence should follow the references.

Authors with access to an IBM Golfball typewriter may wish to submit their papers in 'camera-ready' form. They should request our leaflet "Helictite Typographic Style". Papers should still be submitted in the above form in the first instance.

REFERENCES

References should be listed alphabetically at the end of the manuscript and cited in the text by the author's name and the year of publication (e.g. "(Grey, 1973)"). Where there is more than one reference to the same author in one year the letters a,b, c, etc. should be added. If there are more than two authors, they should all be named at the first citation and in the reference list, but the first name followed by 'et al.' should be used in subsequent citations. References should be checked particularly carefully for accuracy. Journal titles should be abbreviated following the "World List of Scientific Periodicals", which is available in most large libraries. The following examples illustrate the style:

GRAY, M.R., 1973 Cavernicolous spiders from the Nullarbor Plain and south-west Australia. J. Aust. ent. Soc. 12: 207-221.

VANDEL, A., 1965 Biospeleology. The Biology of the Cavernicolous Animals. Pergamon, London. Pp. xxiv, 524.

WIGLEY, T.M.L. and WOOD, I.D., 1967 Meteorology of the Nullarbor Plain caves. In: J.R. DUNKLEY and T.M.L. WIGLEY (eds), Caves of the Nullarbor. A Review of Speleological Investigations in the Nullarbor Plain, Southern Australia: 32-34. Speleological Research Council, Sydney.

ILLUSTRATIONS

Figures and photographs should be kept to a minimum and generally should not duplicate information in tables or other material. Photographs should be clear black and white prints with sharp focus. Where several photographs are to form one plate they should be mounted together on white card. Any lettering required on photographs should be applied with 'Letraset'. Figures should be drawn in Indian ink on white card, heavy paper or tracing material and lettered using stencils or 'Letraset'.

All illustrations should be drawn to fit a print area of 153 x 260 mm. They may be larger provided that these proportions are maintained, but allowance for reduction must be made when choosing letter sizes and line thickness. Several diagrams or photographs can only be included in one page if they all require the same reduction. Diagrams for inclusion in the text must be drawn to a width of either 153 mm (to appear at the same size) or 210 mm (for reduction); they must be clear and simple as they will be reproduced by a lower-quality process.

Figures and plates should each be numbered consecutively and specifically referred to in the text. The numbers should be marked lightly in pencil on the margin or back of each illustration. Captions should be typed on a separate sheet.

UNITS

The S.I. system (Australian Standard AS 1000) should be used unless citing historical data, in which case the original units should be quoted and appropriately rounded metric equivalents added; e.g. "100 feet (30 m)".

OFFPRINTS

Offprints of papers will be supplied after publication, at the author's expense. The number required should be stated when submitting the manuscript.

Helictite

JOURNAL OF AUSTRALASIAN CAVE RESEARCH

VOLUME 22(2) 1984 1983

CONTENTS

Speleological Research Council Limited