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* * *

Cover Photograph.
Looking straight down into the giant doline near Tuke Village,
East New Britain. The white winding line at the bottom of the
doline is a large stream. The doline has never been descended
but is estimated to be 200-300 m deep. For further information
on this doline, refer the article by R. M. Bourke in this
issue (page 3) and the article by C. J. Borough (Niugini Caver
1(2):25-26).

Photograph by R. M. Bourke.

* * *

TOKTOK BILONG EDITA

This is the first issue of Niugini Caver to be produced by the Pounds in Port Moresby. However, you will still notice a lot of Bourke work in it and this will continue for some time as he writes up the results of his cave studies. We hope the standard of production is as high as in previous issues. You will have to bear with us for the first few issues as we experiment with various means of reproducing maps, diagrams, etc. This issue we are using electronic stencils to produce the two maps and in future issues we plan to try several offset processes.

It is noted that this issue is very late in publication due to a large number of reasons but we hope to be up to date by the end of the year. Of course, this depends on receiving plenty of copy from all those people around Papua New Guinea who make the caving news - the subscribers of this magazine. So keep that copy rolling in. Remember, if your trips aren't published in Niugini Caver, the sweat you put into your caving exploits will be wasted as the information gained will be lost on your departure.

The Papua New Guinea Cave Exploration Group library is now with us in Port Moresby and this contains much of interest to cavers, with a great deal of data on Papua New Guinea caves and publications from around the globe which have been received in exchange for Niugini Caver. This library is growing all the time with material sent in by cavers and all the exchange publications. Anyone is welcome to come to our flat at Flat 3, Lot 4, Section 84, Pruth Street, Port Moresby and browse through the library. Preferably ring first (25 2966b.h., 253204a.h. we are listed as Central Surveys) in case we are out or indisposed. Cavers passing through Moresby are particularly welcome and there is a spare bed available as soon as we take the maps off it.

* * *

ERRATA TO NIUGINI CAVER VOLUME 4 NUMBER 4

Preliminary Report on the 1976 Expedition to the Muller Range.

Kevan Wilde reports that the correct computed depth for the vertical drop between the sink and assumed rising of the Atea is now only -750 m and not -1 000 m as in the article based on an estimation by Neil Montgomery.

Some Rock Art, Ancestral and Prehistoric Sites of the Hindenburg Ranges and Tifalmin Areas of the Telefomin Sub-province; with Brief Notes Relating to Associated Legends and Mythology.

P. 155 Sites are listed from West to East and not as reported.

* * *

THE GREATEST CAVES OF PAPUA NEW GUINEA AS AT DECEMBER, 1976

R. Michael Bourke *

At the request of the Commission of the Greatest Caves of the International Union of Speleology, I have prepared lists of Papua New Guinea's deepest, longest caves etc. The data is presented here with some notes on how these compare on a world wide basis. Unless otherwise stated, all figures are derived from surveyed data. It is up to date as at the end of 1976.

I have not done a comparison with other caves of the Southern Hemisphere as I feel Papua New Guinea's caves are into the big league now and this comparison can be forgotten. It can be noted however that, with one exception, P. N. G. holds the Southern Hemisphere record for every category. For example, of the 10 caves in the Southern Hemisphere documented as over 300 m deep, 5 are in Papua New Guinea including the deepest. The category where Papua New Guinea will never hold the Southern Hemisphere record is highest cave. Most of the high caves in the world (over 3000 m A.S.L.) are in Peru (Courbon, 1972).

The following abbreviations are used in the Tables:

1965 Star Mts. exped.	1965 Australian Star Mountains Expedition
1972-73 UQSS N.Br. exped.	1972-73 University of Queensland Speleological Society New Britain Expedition
1973 NSRE	1973 Niugini Speleological Research Expedition to the Muller Range
NG 75	British Speleological Expedition to Papua New Guinea (1975)
1975 NISE	1975 New Ireland Speleological Expedition
1976 NISE	1976 New Ireland Speleological Expedition
Muller 76	1976 Muller Range Expedition
E.H.P.	Eastern Highlands Province
N.S.P.	North Solomons Province
S.H.P.	Southern Highlands Province
W.S.P.	West Sepik Province

Deepest caves. There are now 24 caves documented as 100 m or more deep (Table 1). Exploration is incomplete in four of these

* 120 James Street, Toowoomba, Queensland, 4350. Australia.

and also in Lameragamas on New Ireland which is just under 100 m.

Papua New Guinea's deepest, Bibima, does not feature too prominently on a world basis. Courbon and Chabert (1975) list 50 caves over 575 m deep, so Bibima might come in about 70th deepest.

Longest caves. There are 11 caves reported over 1 km long in Papua New Guinea (Table 2). Omai south-east of Mendi in the Southern Highlands is also long (Van Amstel, 1973), but it has not been surveyed. Parker (1973) reports that Taema Cave at Lonahan, Buka Island "is said to be at least three miles long" so this may also exceed 1 km.

Selminum Tem is equal 36th longest in the world and ten countries have longer caves according to the list of Courbon and Chabert (1975).

Longest pitches. Twenty five pitches of 50 m or longer have now been reported (Table 3). Based on the list of Courbon (1972), the 232 m pitch in Tina Bu Tem would have been the 14th longest in the world had it been reported then.

Largest chambers. I have listed only two very large chambers but there may be more reported (Table 4). The Bougainville chamber was not included in Courbon's (1972) list. He gives maximum dimensions for a number of large chambers and his data suggests that there are only three chambers larger than the Bougainville one. These were Torca del Carlista, Spain; La Salle de la Verne in Gouffre de la Pierre Saint-Martin, France; and Grotte Gigante in Italy. The latter is only just larger than the Bougainville chamber.

If one also included vertically walled dolines or shafts, the situation is different as some of these have very large volumes. For example Sima Major in Venezuela is a single huge shaft with a total depth of 314 m and 405 m of plan length (Urbani, 1976). El Sotano and Las Golondrinas in Mexico are similarly shafts of huge dimensions. The huge doline near Tuke Village, New Britain is estimated as 200 m deep with a diameter of 200 m at the base (Editor's comments in Borough, 1973). The Southern Doline of the Ora uvala in New Britain is 150 m by 120 m at the base, 110 m deep and is contained in a uvala 268 m deep (Bourke, 1973a). These two dolines provide access to horizontal cave systems. Tina Bu Tem in the Nong Valley south of Telefomin is a shaft 50 m in diameter and 232 m deep on the highest side (Beck and Goulbourne 1976). The Sting, Finim Tel Plateau, Hindenburg Range is a shaft 110 m by 82 m at the base and 158 m deep (Eavis, 1976b).

Highest caves. Four caves recorded at over 2800 m a.s.l. have been reported (Table 5). There are 13 caves in the world higher than Papua New Guinea's highest, F4, according to Courbon (1972). There are a number of caves in the Horatio and Mamo areas of the Muller Range, S.H.P., that are about 2700 m a.s.l. but exact

altitudes will not be known until more work is done on the NASA satellite photographs (J. M. James, per. comm.).

Largest dolines. Nine large dolines are listed in Table 6. Unlike the caves, these have not been documented as systematically and many other large ones exist. There is a very large doline a few kilometres north-west of Pomio and another near Nutuve Mission on New Britain (Bourke, 1973a). Other large dolines are reported from the Keriaka Plateau of Bougainville and the Saruwaged Range.

Doline surveys on the ground are very difficult and will have to await photogrammetry for accurate measurement. Most dimensions quoted in Table 6 are taken from aerial photographs. The largest of Papua New Guinea's dolines are significant on a world basis, but it is difficult to decide their ranking at this stage. There are larger uvalas than Ora in the Yugoslavian karst (J. N. Jennings, pers. comm.). The dolines near Koripobi Village on Bougainville and Tuke Village on New Britain must rank as amongst the World's greatest.

Largest natural bridges. There are a number of large natural bridges in Papua New Guinea, but measurements are few. It is often difficult to distinguish between a natural bridge and a cave.

There is a large natural bridge over the Mubi River a few kilometres south of the junction of the Mubi and Waga Rivers in the Southern Highlands. The bridge was estimated from the air as 120 m tall and 200-300 m long. The cave mouth into which the river flows is about 15 m tall and 50 m wide (Bourke, 1973b).

The Ora uvala in New Britain is split into two dolines by a natural bridge. The bridge is 200 m long, 80 m wide and 150 m from the bottom of the uvala to the top of the bridge. The cave mouth at the efflux end of the bridge is 20 m high and 22 m wide (Bourke, 1973a).

Tobio in the Southern Highlands should perhaps be considered as a natural bridge as the local villagers use it as such to cross the Iaro River (Ryan, 1974).

The Obura Land Bridge spans the Lamari River in the Eastern Highlands. The river runs under the bridge for 460 m and can be followed if there is no flooding (Parker, 1975).

Verstappen (1960) quoting Montagne (1949) gives an example of a large natural bridge and underground river in Irian Jaya. The bridge is formed over the deserted course of the Worok River, a tributary of the Grand Valley of the Balim River. Elsmore (1945) gives the entrance as 90 m high.

Table 1. DEEPEST CAVES

Cave	Location	Depth (m)	Explorers	References
1. Bibima	Porol Escarpment Chimbu Province	494	V. Watson, K. Wilde & others (1972)	Wilde and Watson (1973)
2. Terbil Tem	Fault Valley Western Province	354	NG 75	Wilde <i>et al.</i> (1976)
3. Camp III Hole	Fault Valley Western Province	330	NG 75	Wilde <i>et al.</i> (1976)
4. Kanada Heiowa Heia	Muller Range S.H.P.	314	1973 NSRE	Montgomery (1974)
5. Uli Guria	Muller Range S.H.P.	314	1973 NSRE	Montgomery (1974)
6. Tina Bu Tem	Nong Valley Western Province	277	NG 75	Beck and Goulbourne (1976)
7. Langlang Tem	Fault Valley Western Province	200	NG 75	Wilde <i>et al.</i> (1976)
8. Darua Muru	Porol Escarpment Chimbu Province	187 ⁽¹⁾	Various (1973/75)	Wilde (1973a) Bourke (1976b)
9. Owillfore Tem	Feramin area W.S.P.	183 ⁽²⁾	NG 75	D. Brook pers. comm.
10. Uli Ui	Muller Range S.H.P.	182	1973 NSRE	Montgomery (1974)
11. Agim Tem	South of Tifalmin W.S.P.	167	NG 75	Yonge & Wilde (1976)
12. Mebile	Upper Chimbe Valley Chimbe Province	160 ⁽³⁾	A. L. Brown W. Sanders (1973)	Brown (1973)
13. The Sting	Hindenburg Range Western Province	158	NG 75	D. Brook pers. comm.
14. Girtol	Hindenburg Range Western Province	156	NG 75	D. Brook pers. comm.
15. Cave near Koripobi Village	Bougainville Is.	152 ⁽⁴⁾	F. Parker (1963)	Parker (1970)
16. Fungi Tem	Mt. Wamtakin W.S.P.	142	NG 75	Eavis (1976a)
17. La Buum Tem	Hindenburg Range Western Province	138	NG 75	D. Brook pers. comm.
18. Selminum Tem	Hindenburg Range Western Province	137	NG 75	D. Brook pers. comm.
19. Uli Mulmulum	Muller Range S.H.P.	130	1973 NSRE	Montgomery (1974)
20. Ariyorba Tem	Mt. Wamtakin W.S.P.	122	NG 75	Eavis (1976a)
21. Lowatkusmeri Lemet Silot	Lelet Plateau New Ireland	102	1975 NISE	Brown <i>et al.</i> (1976)
22. Obungeram	Baining Mts. New Britain	102	R. M. Bourke J. Farnworth & others (1971-75)	J. Farnworth pers. comm.
23. Atea Kanada	Muller Range S.H.P.	(5)	1973 NSRE Muller 76	J. M. James pers. comm.
24. Kabase	Namatanai area New Ireland	100 ⁽⁴⁾	H. Gallasch (1974)	Gallasch (1974)
25. Lemeragamas	Lelet Plateau New Ireland	97 ⁽⁶⁾	1976 NISE	Sprod (1976b)

- (1) Descended to 187m. Exploration stopped at top of pitch estimated as 7m.
- (2) Descended to 183m; estimated depth 260m.
- (3) Descended to an estimated 160m; cave continues.
- (4) Not surveyed.
- (5) Over 100m deep; exact depth not known because roof is too high for estimation.
- (6) Descended to 97m; exploration stopped at top of pitch estimated as 15m.

Table 2. LONGEST CAVES

Cave	Location	Length (m)	Explorers	Reference
1. Selminum Tem	Hindenburg Range Western Province	20 500	NG 75	D. Brook pers. comm.
2. Irukunguai (Irapui)	Porol Escarpment Chimbu Province	4 000	Various (1964/72)	Parker (1967) Wilde (1973b) K. A. Wilde, pers. comm.
3. Atea Kanada	Muller Range S.H.P.	3 852 (1)	1973 NSRE Muller 76	Jamer et al (1977) Parker (1975)
4. Ikenar/Kipuari	Lamari River area E.H.P.	2 230 (2)	F. Parker (1964)	Montgomery (1974) Francis (1975)
5. Kanada Heiowa Heia	Muller Range S.H.P.	1 500	1973 NSRE	Robertson (1971) Meier (1975)
5. Kopunei	Central Manus Island	1 500	G. Francis & others (1974)	Francis (1975)
5. Nenduma	Bougainville Is. N.S.P.	1 500	P. Robertson H. Meier & others (1971-1975)	Robertson (1971) Meier (1975)
8. Pumpulyun	Central Manus Island	1 250	G. Francis & others	Francis (1975)
9. Bibima	Porol Escarpment Chimbu Province	1 222	V. Watson, K. Wilde & others	Wilde & Watson (1973) Parker (1973)
10. Cave system at Malasang	Buka Island N.S.P.	1 200 (2)	F. Parker (1963)	
11. Ok Tem (Ok Kaakil Tem Uneibo)	Hindenburg Range Western Province	1 040	NG 75	D. Brook pers. comm.

(1) Cave length is over 4km as there is some passage unsurveyed (J. M. James, pers. comm.)

(2) Not surveyed.

Largest underground rivers. Beck (1975) estimates the river flowing in Tobio (Iaro River Cave) in the Southern Highlands as 85-113 m³/sec. This exceptionally high rate has not been measured but even if the flow is a fraction of this, it is an enormous flow.

Average dry season stream flow in the Atea Kanada, Muller Range, S.H.P. is estimated as 12 m³/sec. (James et al., 1977).

Measurements of the river in Ora Cave, New Britain, of 4.0 and 5.7 m³/sec were made in December, 1972 - January, 1973 (Bourke, 1973a). The river effluxes from a cave entrance in a cliff face 1.5 km away in a spectacular 55 m waterfall.

Borough (1973) gives stream dimensions for an efflux cave near Tuke Village, New Britain that indicate a stream flow of 75 m³/sec. From Borough's photographs, the present author has estimated the flow as more like 4-6 m³/sec.

I have seen only a few figures for large underground rivers overseas, but nothing to compare with the large flows found in Papua New Guinea. It may be that Tobio contains one of the greatest underground rivers known in the world.

The longest reported underground river that can be negotiated by boat in Papua New Guinea is in Pumpulyun Cave, Manus Island. Here the passage can be followed upstream by canoe for 1250 m (Francis, 1975).

The Ok Sibul in the Star Mountains of Irian Jaya flows underground for 16 km. Dye placed in the river emerged in the East Digul four hours later (Brongersma and Venema, 1962 p77-78).

Other Papua New Guinea cave records. The hottest reported water in a Papua New Guinea cave is a pool in a pseudokarst cave near Tauruvur Volcano (Matupit), New Britain. The temperature at the surface has been measured at between 47 °C and 40 °C on different occasions. The water at the bottom of the pool is too hot to swim in and is at least 60 °C (Sprod, 1976a).

The longest pseudokarst cave is Rarururunga, Keravat, New Britain. It is 250 m long (J. Farnworth, per. comm.) and is in welded tuff.

Of the described caves, Irukunguai (Irapui) in the Chimbe is probably the best decorated (Wilde, 1973b). The cave with the most exotic decoration would be a 15 m long hot cave in one of the craters of Tauruvur Volcano, near Rabaul, New Britain. The cave is beautifully decorated with a variety of white, yellow, orange, brown and green crystals of volcanic origin (Bourke, 1972).

The cave with the most rock art in it? Probably Ak Kagamugl near the Chimbe Gorge. Wilde (1974) describes the art. The cave with the most interesting history in my opinion is Matarai on New

Table 3. LONGEST PITCHES

Cave	Location	Length of Pitch (m)	Explorers	Reference
1. Tina Bu Tem	Nong Valley Western Province	232 ⁽¹⁾	NG 75	Beck and Goulbourne (1976)
2. Tina Bu Tem	Nong Valley Western Province	153	NG 75	Beck and Goulbourne (1976)
3. Uli Guria (The Shot Tower)	Muller Range S.H.P.	123	1973 NSRE	Montgomery (1974)
4. The Sting	Hindenburg Range Western Province	122 ⁽²⁾	NG 75	Eavis (1976b)
5. Girtol	Hindenburg Range Western Province	113	NG 75	Eavis (1976b)
6. Lambelubung	Lelet Plateau New Ireland	81	1975 NISE	Brown et al. (1976)
6. Uli Ui (Pendulum Shaft)	Muller Range S.H.P.	81	1973 NSRE	Montgomery (1974)
8. -	Muller Range S.H.P.	80	Muller 76	J. M. James pers. comm.
9. Anawol Tem	Fault Valley Western Province	76	NG 75	Wilde et al. (1976)
10. La Buum Tem	Hindenburg Range Western Province	73 ⁽³⁾	Local villagers NG 75	Brook (1976)
10. The "240 feet" Pot	Hindenburg Range Western Province	73	NG 75	Eavis (1976b)
10. Uli Mulmulum	Muller Range S.H.P.	73	1973 NSRE	Montgomery (1974)
13. MR116	Muller Range S.H.P.	71	1973 NSRE	Montgomery (1974)
14. Darua Muru	Porol Escarpment Chimbu Province	70	Various (1973/76)	Wilde (1973a) Bourke (1976b)
15. Obi Tum Tem	Tifalmin Valley W.S.P.	68	NG 75	D. Brook pers. comm.
15. Fungi Tem	Mt. Wamtakin W.S.P.	68	NG 75	Eavis (1976a)
17. Mebile	Upper Chimbe Valley Chimbu Province	65	A. L. Brown W. Sanders (1973)	Brown (1973)
18. Owillfore Tem	Feramin area W.S.P.	61	NG 75	Eavis (1976a)
19. Uli Oogua	Muller Range S.H.P.	60	1973 NSRE	Montgomery (1974)
20. Nosok Tem	Urapmin area W.S.P.	58	NG 75	D. Brook pers. comm.
21. Uli Guria (Absolute Rip-off Pitch)	Muller Range S.H.P.	55	1973 NSRE	Montgomery (1974)
22. Hells Gates (Murafinka Shaft)	Henganofi area E.H.P.	51	Local villagers and various local cavers	Bourke (1976a)
23. Gagogangama	Porol Escarpment Chimbu Province	50	J. James V. Watson and K. Wilde (1972)	Watson (1973)
23. Langlang Tem	Fault Valley Western Province	50	NG 75	Wilde et al. (1976)
23. Tum Dabom Tem	Fault Valley Western Province	50	NG 75	Wilde et al. (1976)

(1) Measured, not descended.

(2) Eavis gives the pitch as "400 feet (120 m)" in the text but as 440 feet on the map.

(3) An alternative hang is 98 m.

Table 4. LARGEST CHAMBERS

Cave	Location	Length (m)	Max. Width	Max. Height (m)	Explorers	Reference
1. Cave near Koripobi village Bougainville Is., N.S.P.		274	137 ⁽¹⁾	152	F. Parker (1963)	Parker (1970)
2. Matapara	New Ireland	308	60	43	Local villagers	Bourke (1974b)

(1) Cave Mouth is 107m wide and 91m high.

Table 5. HIGHEST CAVES

Cave	Location	Entrance Altitude (m)	Explorers	Reference
1. F4	Mt. Fugubil Western Province	2990	NG 75	D. Brook pers. comm.
2. Small unnamed cave	Dokfuma Plateau Star Mountains	2850	1965 Star Mts. Expedition NG 75	Hayllar (n.d.) D. Brook pers. comm.
3. Ariyorba Tem	Mt. Wamtakin W.S.P.	2800-2850	NG 75	D. Brook pers. comm.
4. Fungi Tem	Mt. Wamtakin W.S.P.	2800-2850	NG 75	D. Brook pers. comm.

Table 6. LARGEST DOLINES

Doline	Location	Depth (m)	Length (m)	Width (m)	Explorers	Reference
1. Ora ⁽¹⁾	Nakanai Mts New Britain	268	900	560	1972-73 UQSS N.Br. exped.	Bourke (1973a)
2. Doline near Koripobi Village, Bougainville Is.		193	613	420	F. Parker (1963)	Parker (1970)
3. Doline 1	Dokfuma Plateau Star Mountains	90	800	800	1965 Star Mts expedition. NG 75	Shepherd (1969) Eavis (1976c)
3. Doline 3	Dokfuma Plateau Star Mountains	90	800	800		
5. Doline near Tuke Village	Nakanai Mountains New Britain	200-300 ⁽²⁾	400	400	C. Borough K. Read (1968)	Borough (1973)
6. MR201	Muller Range S.H.P.	250	400	400	1973 NSRE	Montgomer (1974)
7. -	Lelet Plateau New Ireland	120	300	300	-	C.H.C. Shannon pers. comm.
8. MR208	Muller Range S.H.P.	-	800	250	1973 NSRE	Montgomer (1974)
9. MR202	Muller Range S.H.P.	-	400	200	1973 NSRE	Montgomer (1974)

(1) Ora is a uvala (a complex closed depression with more than one hollow). It consists of two dolines with a bridge across the centre.

(2) Dimensions estimated by R. M. Bourke from aerial observations. Borough (1973) estimates depth as 450 m.

Ireland. It was used to house prisoners of war in the Pacific War (Bourke, 1974a). Very little has been recorded about cave history as perceived by Papua New Guineans and no doubt there are caves with more interesting history that have not been written up.

Discussion. Some of Papua New Guinea's caves are definitely world class, although there is still a long way to go to be up with the really big ones for deepest and longest. The amount of exploration and documentation that has occurred since 1971 can be appreciated from the data presented. It also highlights the pioneering work of Fred Parker and the contributions of the expeditions, especially the 1975 British expedition.

Most of Papua New Guinea's greatest caves are found in the Highlands with a lesser number on the large islands of New Britain, New Ireland, Bougainville and Manus. Jennings and Bik's (1962) suggestion that high tropical mountains may provide optimum conditions for karst evolution appears to be more valid every year.

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Footnote. In a number of articles consulted, information on depths and lengths was not given in the text and had to be scaled from small scale maps. This information should always be given in the text together with altitude, at least for caves over 2000 m a.s.l. I would appreciate receiving any corrections or additions to these lists. Finally I have listed a number of caves that require further exploration or surveying. These are as follows:

Deep caves: Owillfore Tem near Feramin, West Sepik Province;
Darua Muru, Mebile and Angunga in the Chimbu;
Kabase and Lemeragamas on New Ireland.

Long caves: Ikenar/Kipuari, Eastern Highlands;
the caves at Malasang and Lonahau, Buka Island;
Omai near Mendi.

Large river caves:

The cave and doline near Tuke Village and Ora
cave, New Britain;
Atea Kanada and Tobio, Southern Highlands.

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".... The travelling up to this point had been bad and even difficult, but from here on it grew worse and worse. Broken limestone with knife like edges, crevices 20 to 30 feet deep, spanned by only a few moss covered roots, or a fallen tree; sudden sharp descents and equally sharp climbs, into and out of a series of large "pot holes" or depressions varying from 50 to 100 yards in diameter, and from 30 to 100 feet deep, and other obstacles too numerous to describe. The depressions just mentioned are the visible indication of the direction of flow of the subterranean streams, running in a chain as they do, and gradually working to a lower level."

Karius C.H., and Champion I.F. (1928). (Report on the Crossing of New Guinea. Papua Annual Report 1927/28, Appendix D pp90-108 on some of the country between Bolivip and the Victor Emanuel Range.)

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REPORT OF A BRIEF RECONNAISSANCE OF THE PORGERA
AND MOUNT KAIJENDE AREAS OF THE ENGA PROVINCE

Kevan A. Wilde**

Between Saturday the 30th April and Saturday the 7th May, 1977 a geologist, Ron Britter* by name and myself made a short trip to the Porgera area by road from Goroko. The aims were twofold; (A) to establish whether it would be a feasible proposition to field an expedition into the area by road from Mount Hagen; and (B) to establish the speleological potential of Mount Kaijende and the surrounding limestones.

The results were very favourable in so much as it is possible to field an expedition by road from Mount Hagen, via Wapanamanda, Wabag, Laiagam and thence Porgera. The entire drive, in good weather taking a little over eight hours. The section of road between Mount Hagen and Laiagam being of relatively high standard and is suitable for conventional drive vehicles; but a four-wheel drive, and some Papua New Guinea driving experience, is recommended for the somewhat tortuous section between Laiagam and Porgera.

From Laiagam the road ascends steeply along the south-western side of the Laigap Valley to Timundan Village, and then taking a south-westerly direction it traverses the northern limits of a relatively flat limestone plateau. The highest point reached by the road being in the order of 2 650 m. The road continues towards the south-west and descending, equally as steeply, past the nearby broken and jagged ridges of Kaijende, winds its way past Tibinini Village and into Porgera. The total distance being approximately 80 km, and taking four hours to drive.

We spent a couple of interesting days looking at the Porgera Goldmine, and then on Wednesday the 4th we made a trip to the summit area of Mount Kaijende (locally known as Asenda), with a view to, very basically, establishing its speleological potential. Looking upwards through the clearing morning mists of the Porgera Valley we were both very excited and impressed by the incredibly rugged and almost forbidding pinnaled peaks that rise almost vertically to a height of 3 500 m⁺.

We located two capable looking guides from Faiam Village (a short distance south-west of Tibinini Village) who went by the names of Rungapin and Wainke, and commenced our walk from their place at 0700. We followed the south-western side of the Fraipaka drainage up past the Faiam Cliffs, which are almost horizontally bedded and 5-600 m high. We then followed traditional hunting tracks for most of the way, and cutting our own track and navigating by

+ Our estimation from an altimeter reading - the map shows it as 3 261 m at the summit.

** & * Post Office Box 747, Madang, Papua New Guinea.

aerial photographs when necessary. By 1400 we had arrived at a small overhanging rock shelter under a cliff along one of the main south-western ridges of Kaijende itself, and set up a relatively comfortable bivouac for the night. Up to this point we had not been particularly impressed with the quality of the somewhat muddy limestones.

Early the following morning we made ready for a push at the summit and we were on our way by 0700 in full anticipation of reaching it, and being able to return to Faiam the same day. We followed the cliff for a short distance and located a 'ridge', and as the weather was still clear Ron said he would like to follow it in order to take some photographs. But, doubtful Kevan reckoned it was a massive tower karst feature rather than a ridge leading to the summit. It was, and we ended up climbing almost vertically for well over 100 m. When on the top (3 300 m) we discovered that it was more-or-less vertical on all sides, but we were treated to a most magnificent view. Rungapin pointed out various places of interest, and told us of many caves and shafts to the south on a mountain he called Lapwap. He also indicated that there were a number of caves, or shafts on the back-slopes of the Faiam Cliffs, but he thought that there were none elsewhere (no doubt due to the fact that his clan own the Lapwap and Faiam areas).

We decided that time was running short and that we should attempt to find an earlier way off the tower as I was a little apprehensive of going back along the original route. A short 'recce' produced a more favourable way onward which we negotiated with comparative ease. We abandoned a summit attempt in favour of cutting a new track back to camp. In retrospect we would have easily made it to the summit, but we were concerned about Wainke who had cut his foot with a bush knife the previous day. We found our way back to the 'bivvie' and took a slightly different route down to Faiam by following the eastern side of the Fraipaka drainage, arriving at about 1600.

Potential: We saw no caves during the reconnaissance, no doubt due to the poor run-off and substandard limestone. The route across the Fraipaka drainage revealed much in the way of shales, calcareous mudstone, sandstone, calcaranite, and muddy limestones, but it is possible that this drainage has its origins from high level resurgences. The quality of the limestone improved greatly towards Mount Kaijende itself and mature karst forms such as massive towers and pinnacles were in abundance.

In my opinion it is likely that there will be no worthwhile cave development in, or immediately around the area visited. However, extensive cave development can be envisaged on the main plateau and on the north-eastern slopes of Mount Kaijende. Kaijende is said to have the greatest relief of limestone in Papua New Guinea and there are many dolines, polje-like karst features and sinking

streams (aerial photograph interpretation), among a considerable area of pinnacles and aretes. Mount Faiam's apparent potential is in the order of 500 m, and Mount Lapwap, as previously mentioned, is known locally to have many caves and shafts. A considerable area of plateau limestone, up to 3 000 m plus high, is reported to the south-west of Porgera but is unmapped. Aerial photographs show well formed and numerous dolines and faults with sinking streams and many lakes and tarns. The potential of this area is completely unknown, but looks very impressive on the photographs. In general extensive cave development is likely, but I am doubtful as to whether substantial vertical development is possible because of interbedded shales.

Geology: The entire area is satisfactorily covered by aerial photography. The Wabag Sheet of the Papua New Guinea 1:250 000 Geological Series (SB 54-8) shows the geology (incomplete) and an accompanying geological report is available.

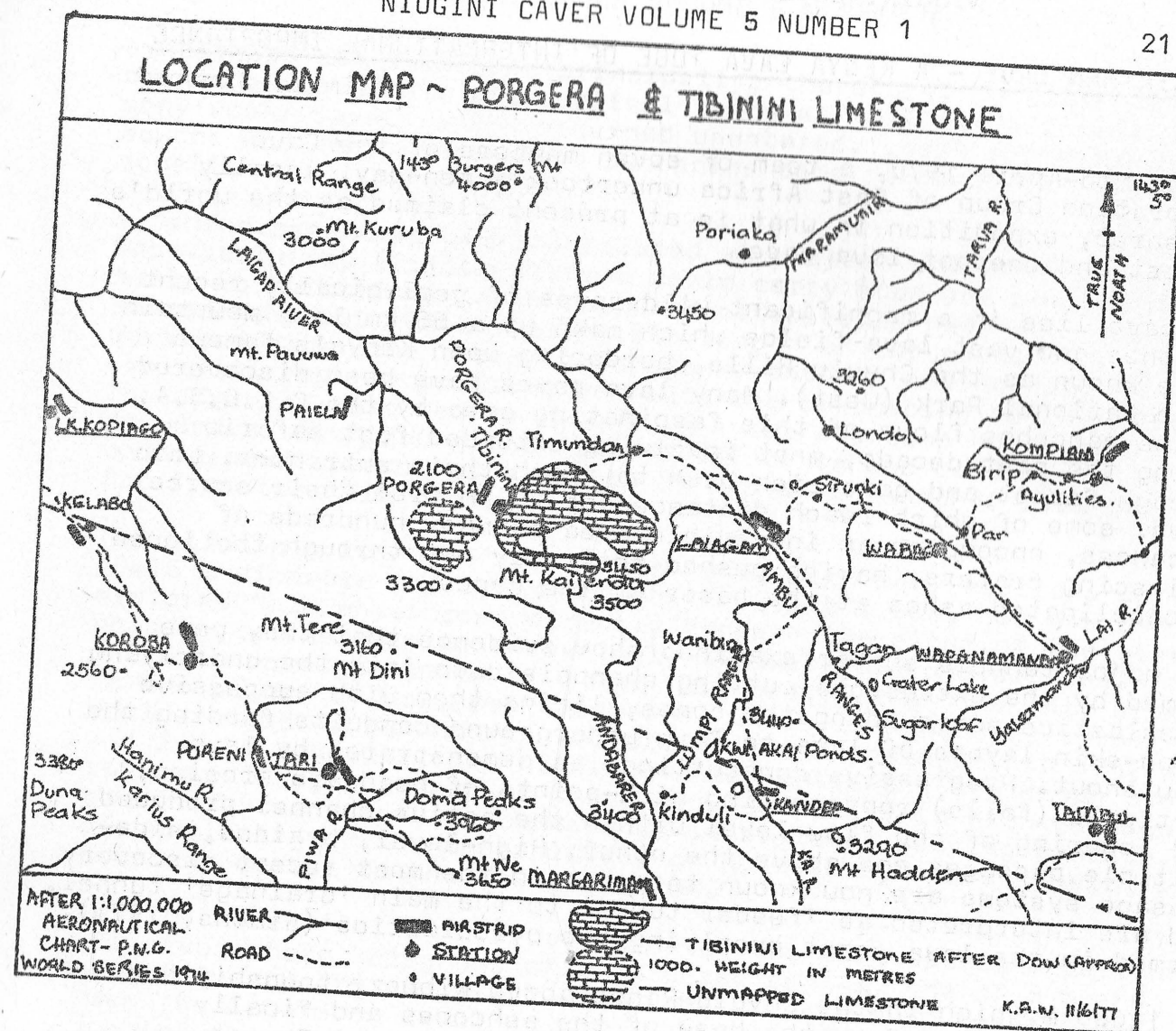
The Porgera limestones have been mapped as the Tibinini Limestone Member (after the village of the same name) and form the spectacular Faiam Cliffs, 'which bound the head of the Porgera Valley and the southern flank of the Laigap Valley near Tibinini Village'. The Tibinini limestone member (upper oligocene to middle eocene), 'consists of fine grained grey to white limestone which is massive to thick bedded with interbeds of marl and some chalky beds crowded with macro-fossils including coral', and overlies the Laigap sedimentary beds consisting of grey slate, shales and siltstones (Dow and others, 1972). Abundant faulting and some folding is apparent with the limestone around Mount Kaijende dipping to the south.

Conclusions: The Kaijende - Porgera area is a speleological unknown, the only other time the area has been visited by a caver (to the writer's knowledge) was by Prof. Paul Williams but no substantial caves were discovered by him (Williams, 1969).

A short expedition of about two weeks duration concentrating on the north-eastern slopes of Mount Kaijende and the Mount Faiam and Lapwap areas could be most rewarding in terms of large caves, and all the areas are within two to three days walk of Porgera. The plateau areas would have to be considered too extensive for an expedition of such short duration, but should be considered a prime P.N.G. 'home based' expedition target for the future.

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THE NEW CONTRIBUTOR

Jim Simonds is the Honorary Chairman of the Nairobi based Cave Exploration Group of East Africa. He commenced his Kenyan caving in 1964 and was one of the founding members of the Group in that year. He has caved widely in Kenya and elsewhere in Africa and published a number of articles on African caves.

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LEVIATHAN CAVE - A KENYA LAVA TUBE OF INTERNATIONAL IMPORTANCE

Jim W. Simons*

During mid-April 1976, a team of seven members of the Cave Exploration Group of East Africa undertook a ten-day, locally sponsored, expedition in what is at present claimed as the world's longest and deepest lava cave.

The cave lies in a magnificent wilderness of geologically recent ashcones and vast lava fields which make up a 65 km long mountain range known as the Chyulu Hills, bordering upon Kenya's famous Tsavo National Park (West). Many lava caves have been discovered in the pahoehoe flows of this fascinating area by the C.E.G.S.A. during the past decade, most involving extended foot safaris through forest and game rich bush to reach their entrances. Lava flows, some of which reach distances of 20 km from their source volcanoes, encompass an incredible area of many hundreds of coalescing craters, having pushed their way out through the loose unconsolidated ashes at the bases of the cones.

All major tunnels so far examined show evidence that they were formed by the extrusions cutting channels down into the underlying pyroclastics surrounding the cones, lining them with successive onion-skin layers of lava to form underground conduits flooding the flow snout. Progressive downcutting, as demonstrated by lava verticals (falls) representing nick-points of headward erosion, and lowering of the flow level within the active channel produced multiple passages one above the other. High-level, braided, side-passage systems are now known to occur in the most recent discovery and are interpreted as 'feeder tubes' to the main 'drainage' tunnel, formed in the lava sheet overlying the pyroclastics (Simons, 1971).

At 1 600 m, high in the Chyulu Range above Kibwezi township and running eastwards from the base of the ashcones and finally beneath the thick, confusing game-inhabited Kibwezi Forest, Leviathan Cave was first 'discovered' through a study of aerial photographs and received its first C.E.G.E.A. investigation in September, 1975. Five extended two and three day trips were taken to explore the main tunnel line and some of its upper levels. Difficulties of exploration were aggravated by a 240 km drive from Nairobi, a 4 km walk to the main entrance and by having to carry all water supplies in addition to food and equipment. To locate additional entrances over the cave it also became necessary to blaze trails through the forest on compass traverses, the last two collapse holes lying 4 km further within the Kibwezi Forest, downflow of the main entrance. Supply lines to the farthest reaches of the cave were, therefore, rather extended and it became apparent that to produce a high-grade survey of the entire cave would be a protracted affair involving many costly visits. The ten day

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expedition was organised principally, therefore, to establish the cave's exact length and vertical range as well as to investigate many upper levels which remained unentered. Local sponsorship was sought and many Kenya-based companies came forward with generous donations.

A tented base camp was established at nearest road-head from which four recruited African porters would carry food and water supplies daily to maintain an advanced base established near one of the entrances about mid-way along the length of the cave. From the advanced base camp teams would survey both up and downstream, exploring any new sections on route and bivouacking as required. The advanced base was to have been a surface camp but torrential downpours the first night flooded all tents and bedding and a new underground bivouac site had to be set up in another lava tube not far from the main cave.

The principle tunnel of Leviathan Cave, with many sections up to 10-15 m diameter and large enough to permit a bus, has now been explored from an ashcone directly beneath the slope of the source volcano, downstream to a seemingly impenetrable boulder seal for a single passage length of 8 km! This great length is only broken in two places by collapse entrances, where linking digs through boulders had to be undertaken, dividing the passage into 3.5, 2.5 and 2.0 km segments. Ten other collapse entrances are known over the cave line, but each of these provides entry to high passage sections, the otherwise continuous lower level passing beneath. Discontinuity of the upper levels or natural breaks in their floors provides access to the lower section.

Vertical lava 'falls' are prevalent in the most upstream part of the cave; there being one of 2 m, three of 4 m, one of 5 m and one of 6 m (Scorpion Falls). A climb of 10-15 m in a shaft passing from the lowermost level up through two higher level passages enabled the upstream survey party to exit at a small collapse 250 m downflow of the source volcano. Downstream of the main (Bushbuck) collapse, the Mud Hall Series continues descending downflow to Forest Collapse, a number of ox-bows and a braided side system being encountered mid-way along this series. From Forest to Compass Collapses the angle of descent gradually decreases. Compass Collapse marks the first break in continuity 3.5 km from the Terminal Choke and with a vertical range of 305 m.

The next 2.5 km segment of the main passage - Goliath Passage - has some impressive 'canyon' like cross-sections up to 15 m high and though it drops only another 100 m to Pottery Collapse it is a very wearying section to traverse with its great slippery breakdown piles. It was along this series that several new and previously unsuspected branch-passage systems of 0.3 and 0.4 km were discovered running parallel to the main tube and connected to its upper levels. Pottery Collapse marks the second break in continuity, downstream of which it is mostly easy walking for the next 2 km to a 100 m

long liquid guano crawl in boulders marking the present 'end' to the cave. A disappointing finish to a magnificent lava cave, though it is suspected that the tube continues much further beyond this choke as many kilometres of lava still lie ahead.

Geologically the cave exhibits some fine lava tube features. Not only are the passages of unusually large dimensions, varying from smooth ovals to high canyon-like areas often with 'key-hole' cross-sections rather reminiscent of vadose stream passages (which technically they are), but many lavatites and 'mites' abound. Large 'box-work' areas of sharp pointed 'tite blades are common and the lower end of the cave contains a profusion of curly 'pipe-stem' varieties and weird lavamites built up of solidified lava pellet upon pellet. Lava columns are also present and some of an incredible blue-grey colour have been noted. Small rosey lava pavements, often forming solid seals in small passages, were of a fascinating salmon-pink colour. Of particular interest are a series of unusual lava outgrowths on the edge of a bench which are dendritic in character and greatly resemble ferns. Burst blister formations were observed in both the walls and roof in certain passage sections, the former consisting of pockets surrounded by solidified jagged lava protuberances and the latter by deep pearl-shaped scoops where lava had trickled out at the lower end and down the walls. Long benches marked former levels of molten flow and in places coalesced to form natural bridges and tubes within tubes.

Secondary formations, probably of silica, were not common but of surprising length and beauty - a yellowish to orange colour being prevalent. Both stalactites and stalagmites (with some 'fried-egg' examples) and some long columns occurred.

Biologically the cave was only briefly investigated, the capture of cave life being undertaken by the expedition's zoologists. Three types of insectivorous bats were taken, species of Rhinolophus, Miniopterus and Hipposideros - the latter forming a large colony at the very end of the cave and being of an attractive orange colour - and one species of Rousettus fruit bat which occurred in many hundreds. Bat parasites, springtails, small flies, beetles, two varieties of cockroach and even some scorpions were collected. Of the cockroaches one small type is transparent, blind and apparently a cavernicole likely to be entirely new to science.

Many pottery fragments and some incomplete pots of two different decorative styles were found at and in the tunnel beyond Pottery Collapse and are thought to have been left by poachers.

During eight full days almost consistently underground, two teams tackled the survey of the great cave, often working ten to thirteen hour daily stints in order to complete the task during the time allotted. Excepting for many roof holes in the main passage line which almost certainly give access to additional upper levels which time and equipment did not permit entry, the greater part of the

cave was completed revealing a total surveyed passage length of 11 km! A pretty impressive total. Total depth, by vertical range, came to 470 m over the 8 km distance from top to bottom 'end'. In addition, it was found that the tube in which the advanced base camp was established was itself a braided upper level system with an estimated 1 km of passages and a link with Leviathan is expected.

Expedition personnel consisted of the following C.E.G.E.A. members: Jim W. Simons (Expedition Leader), Bob Davis, Graham Cole, John Youngs, Peter Roe, Dr. Alison Hillman and Chris Hillman. The team was assisted by James Kitheko (Base Quartermaster) and three porters Mutuku Mutinda, Mulatia Ngovia and Bernard Michael.

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NOTE

The above article was kindly provided by Jim W. Simons of the Cave Exploration Group of East Africa.

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NOTES ON SOME CAVES ON BUKA ISLAND

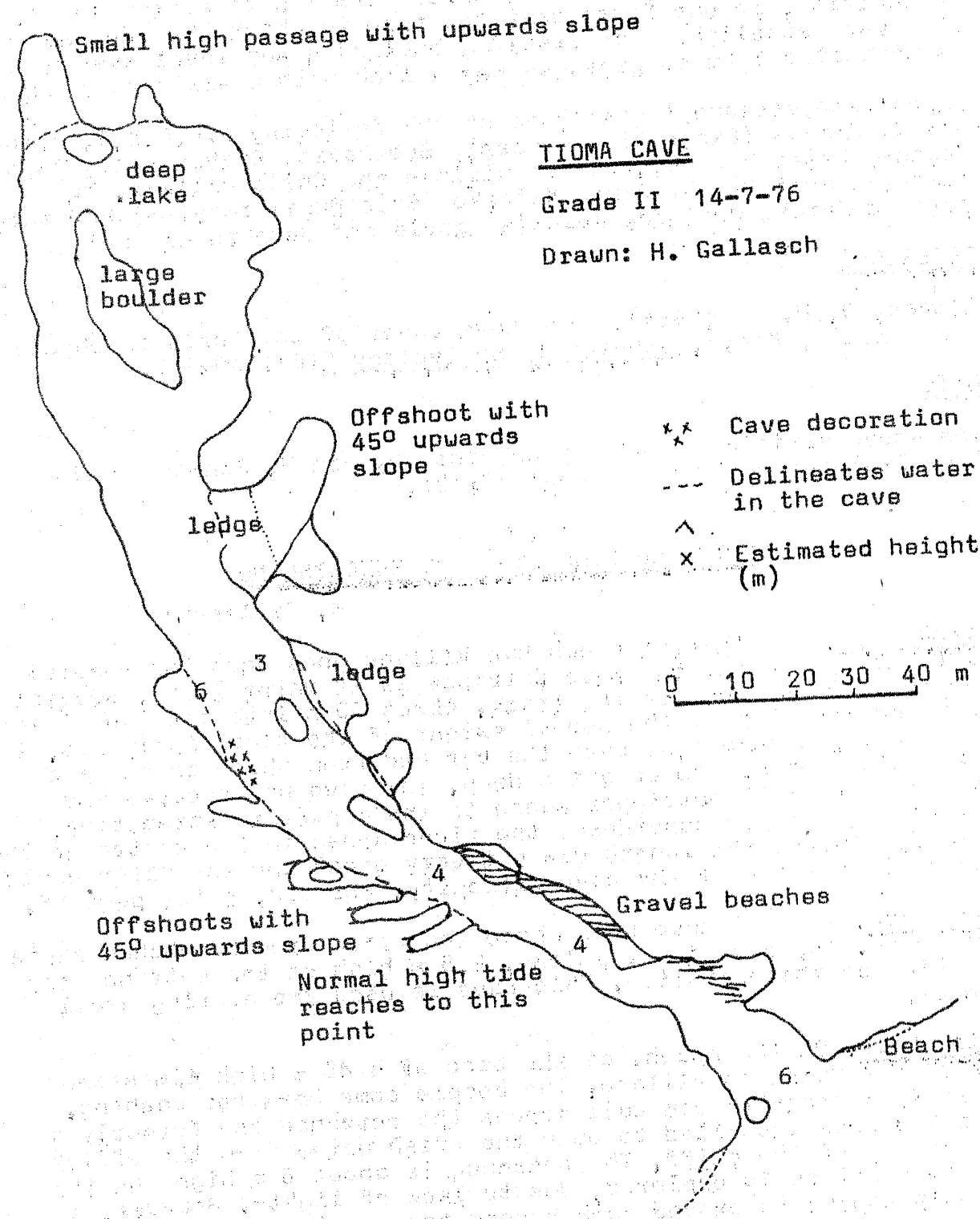
H. Gallasch*

Tioma Cave. A path from Lonuhahan Village goes down the coastal cliff to the beach. The cave entrance is at water level, several hundred metres south of the track. About 30 m into the cave is a rock and gravel bar, the normal extent of the tidal influence. A fresh water stream runs over the bar and from there in forms a lake which appears to be quite deep. The cave was entered and explored by small outrigger canoe to its apparent extremities. The village people considered the river arose in the centre of the island, however the length was not very great and the water would appear to resurge at the cave extremity. For map, refer page 26.

Busu Cave. A small cave near where the track from Lonuhahan abuts the beach. The cave is 22 m long, 2.5 m high at the entrance and 1 m high at the extremity. This cave is used for storing small canoes.

Esila Cave. On the beach, at the base of a 40 m high limestone cliff near Malaseng Village. The people come here for washing. There is a concrete dam wall across the entrance and formerly a pump had been installed to pump the fresh water from the efflux to the top of the cliff. The entrance is about 5 m high and the cave was not fully explored, due to lack of lights. However, it doesn't appear to extend much beyond the penetration of daylight, perhaps 35 m.

* D.P.I., Keravat, East New Britain, Papua New Guinea.



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THE BRITISH NEW GUINEA SPELEOLOGICAL EXPEDITION, 1975

Reviewed by R. Michael Bourke *

Brook, D. (1976) (Compiler). The British New Guinea Speleological Expedition, 1975. British Cave Research Association Transactions 3(3,4):117-243.

Available from D. Brook, 40 Broadgate Crescent, Horsforth, Leeds, United Kingdom for £2.50, including surface postage. Air mail postage £1.70 extra.

The report of the British speleological expedition to Papua New Guinea has been published just over a year after the completion of "the most ambitious speleological expedition ever launched" (to quote the foreward). The report is substantial in both content and size with 127 pages plus 3 large maps. It follows the now standard format for expedition reports of diary, caves and karst descriptions, special studies and expedition reports.

The diary (D. Brook and H. M. Beck) is concise and well written and after reading it one has a general picture of who did what and when. The sketch maps of expedition routes are not referred to adequately in the text and finding the locations is not easy, especially as the two sketch maps are 14 pages apart.

The section Caves and Karst rightly occupies much of the report, about a third in fact. It consists of regional setting (S. Crabtree and A. J. Eavis) and descriptions of caves and karst for each of the 11 regions investigated by the expedition (various authors). Cave descriptions are brief and generally adequate and are not cramped by numerous descriptions of minor caves. They are quite uneven however. Thus the Star Mountains (A. J. Eavis) is described in detail although only a few minor caves were found, whilst cave descriptions from the Fault Controlled Valley (K. Wilde and others) are very brief and contain material that belongs to the diary.

I thought the more important cave and other discoveries could have been given more emphasis, perhaps in the Foreward. One only finds out about the 232 m pitch in Tina Bu Tem by looking at the map and neither in the text nor on the map could I find the length of Selminum Tem, now the longest recorded cave in the Southern Hemisphere.

The cave maps are generally well done, especially Selminum Tem which is on a large sheet contained in a folder. No consistent cave numbering system was used. In the Fault Controlled Valley three unit numbers (000, 001 etc.) have been allocated to karst features but in the Urupmin region the prefix D and a unit

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(D1, D2 etc.) were used. A mixture of the old Imperial and S.I. units is used throughout the report which is a pity as S.I. units are standard in Papua New Guinea and the BCRA Transactions requests them to be used wherever possible. Generally the metric equivalent is given in brackets for each figure. The conversion factor used for feet to metres was an approximate one ($\times 0.3$), although sometimes the exact conversion ($\times 0.3048$) seems to have been used.

There are four papers under the special studies section: The Karst and Cave Development of Finim Tel (D. Brook); Speleobiology (P. Chapman); Telefomin Anthropology (K. A. Wilde); and The Language and Origin of the Telefomin and Their Neighbours (P. S. Everett). The first three papers are comprehensive and technically sound, as far as I can judge. One can imagine that they will be frequently quoted in the future. Chapman takes an ecological approach to the cave biology rather than simply descriptive. Wilde's paper consists of a description of the local anthropology, mostly taken from other authors, and original recordings of legends, rock-art, ancestral and prehistoric sites as published in Niugini Caver 4(4). I imagine that the enlightened attitude to Papua New Guineans in the field and evident in the publication is largely a result of Wilde's influence. Everett's paper adds little new information on the Telefomin languages. His theories on the origins of the people would have been better omitted as he does not seem aware of the body of literature on the prehistory of the highlands.

The expedition reports (logistics and finances; communications; equipment; food report; photography; documentary film report; medical report; and notes on histoplasmosis exposure) finish off the publication. They are sound and make good reading although I would query the need to provide so much detail. On one occasion severe damage occurred to a rope going over a clay bank in which a sharp boulder was buried - a situation to be watched for by others using S.R.T. The documentary film report (S. Perou and N. Plumley) is unusual and consequently interesting. The final note states that histoplasmosis testing showed that two members showed evidence of histoplasmosis infection in Papua New Guinea.

There are 22 photographs in the book and on the cover. Technically they are all good, but I felt a greater diversity of subjects would have given better value as most are underground shots in Selminum Tem. Perhaps the proposed book will offer a greater photographic range?

There are quite a number of errors in the book that should have been picked up by the editor or compiler. For example on the first page (p117), Hayllar and Niugini are spelt incorrectly, the year Frank Salt was organizing the Star Mountains expedition (1963-4) and the length of Irapui (4 km) are given incorrectly and the reference Watson and Wilde (1972) is given as Wilde (1972). On Figure 1 Lae is located near Madang and Strickland is spelt incorrectly. The names New Guinea and Papua New Guinea are used interchangeably

throughout without any explanation. The purist might argue that the name British New Guinea in the title is unfortunate as this is the old name for Papua.

To summarize: The report of the most significant speleological expedition to come to Papua New Guinea is very good and is a credit to the compiler. It could have been even better with greater emphasis on consistency both in the field and in preparation. It is good value for £2.50 and I recommend its purchase.

* * *

THE CAVING SCENE

Since this is Number 1 for 1977 and the month is now July, there is quite a lag in the caving scene since the last issue.

Central Province. There have been quite a few trips to the Doo Village caves (Javavere) by the Pounds, Goulbournes and others this year, mostly familiarisation trips but some surveying and hydrology have been done. The Javavere Plantation has been reopened so access is now slightly easier. Jim Farnworth is now at Robinson River so we expect to hear of caves in that area in the future.

East New Britain. Mike Bourke and Russ Stephenson headed out to the Rapitok area in January for a look at some 'new' caves. The day went as a caving day should: A keen knowledgeable guide and four previously unreported caves. Being in pumice, all were small although the last one for the day at Rapitok No. 4 was some 80 m long and had an impressive entrance 15 m high. All four had streams effluxing at the entrance. The guide was keen to show ten more but empty stomachs overruled him.

Things will be quite on the Gazelle now after an active few years for caving there. Tim Sprod has gone finish and he and Anne are now off to England overland. Jim Farnworth is out of the area and the Bourkes have gone finish to Australia. Hal Gallasch is still in residence and reports a rumour of a new cave near Gaulim.

North Solomons Province. Hans Meier has been active here, with trips to Borumai and the Manatai area which is looking very good. Mal Pound was in Kieta for three months at the beginning of the year and visited Manatai with Hans on several occasions. A recent discovery is Puna which is the impressive sink of a river which was measured at about 5 m³/sec in average weather. The party penetrated about 20 m but this is definitely a cave for a dry period judging by the logs jammed in the cliff face about 10 m up. The resurgence is 2 km away.

Ian Wood from Sydney has shifted to Panguna with B.C.L. so the

Northern Solomon's caving scene should be quite active now.

Madang Province. Hal Gallasch went caving at Madang recently and explored and sketched two caves; one near Yagaum Mission Hospital and one near Omuru Agricultural Station. The latter is a river cave which has a potential length of several kilometres. It was entered through one doline and followed for several hundred metres until stopped at the top of a waterfall. Several kilometres further on the stream crosses the bottom of a 50 m deep doline which couldn't be descended without adequate equipment.

Highlands. Kevan Wilde reports that some knocked off his car from outside his front door. He recovered the vehicle but they kept his caving gear which was inside (maybe the locals are developing an interest in caving after all?) Kevan and Ron Britten have been on a reconnaissance to Kaijende (see report this issue).

The September caving meet is going to the Chimbu where they will concentrate on Angunga (sink) near Chauve which was partly explored in December 1975. This sink provides access to a major river cave which may connect with Kaimomo (Kiowa). Total depth potential about 300 metres and the distance between Angunga and Kaimomo is about 5 km. The system also extends upstream and is a good wet, sporting cave. Julia James will be coming up from Sydney for this trip in September and anyone who is interested in going should contact Kevan Wilde at once.

Karst Investigation. The Geological Survey have asked us to assist in the investigations of a limestone gorge on the Ok Menga where it is proposed to construct a concrete arch dam to supply power to the Ok Tedi copper mine. They think the gorge is a collapsed natural arch and it is not possible to enter without vertical climbing equipment.

Spanish Expedition. A group of ten cavers from Barcelona, Spain plan to come to Papua New Guinea in July-August 1978. They are interested in exploring deep caves and have their eye on an area around Koroba which has not been looked at by cavers yet. The ATEA, 1978 trip from Sydney organised by Julia James and Kevan Wilde will be in the area at the same time. The Spaniards are interested in having local speleologists join their expedition.

The Editor would be grateful to receive brief reports on caving activity in Papua New Guinea as an aid in preparing this column. This information also goes into the PNGCEG Library and forms very valuable reference material for future cavers in this country.

The next issue is planned to be published in August-September in order to catch up the backlog, so material for this column should arrive in Port Moresby before 31st August 1977.

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