THE GOUFFRE BERGER, 1971

A. C. Waltham

The Gouffre Berger is probably the most widely known cave in the whole world, but this is a title which it justly deserves. It is situated on a limestone ridge no more than 10km west of the city centre of Grenoble; consequently, but for a few kilometres of walking through the forests, it is very accessible. Unfortunately it no longer holds the world depth record, as the Pierre St. Martin system, in the Pyrenees, is just 11m deeper. But the Pierre St. Martin has been explored by way of a number of "back-door" entrances, and the Berger still holds a purely sporting record, for the deepest descent into any cave that has yet been made is the journey from its only entrance to the sumps, and back.

Exploration of the cave

The entrance to the cave was found by Jo Berger in 1953, in an area of spectacular, thinly wooded limestone pavement. The exploration, over the next 3 years, has been well described by Jean Cadoux in his book "One Thousand Metres Down," so is only briefly summarised here.

In 1953 the explorers found a series of 30m shafts and narrow meanders leading to a vast river gallery, where they were stopped for that year by a lake at a depth of 372m. They also dyed the stream, and when the fountains in the village of Sassenage turned bright green, they realised they had a potential record-breaker to explore. Over winter, snow makes the plateau, where the Berger lies, inaccessible, but the next summer saw the explorers quick to return.

They continued down the main river gallery — one of the finest passages in the world, in many places being over 30m high and wide. Parts of it are also fabulously decorated, and the Hall of the Thirteen, with its now-famous gourpools and stalagmites, provided the first underground camp site. Further down there are long deep canals, and a suberb active streamway canyon containing dozens of cascades. Highest of these is Claudine's Cascade — just 16m from lip to floor. But these were "pre-exposure-suit days", and the original explorers spent a considerable time over complex acrobatics with boats, maypoles and bolts in order to descend the shaft dry; today's cavers would barely have slowed down at such an obstacle. 1954 saw the French explorers stopped at the Grand Cascade, 903 metres down and with the world record firmly their own.

The lower reaches of the cave were proving difficult to explore. The vast size of the Grand Canyon gives way to wet cascades, increases a little to Joly Hall, but then the passages shrink to the top of the Little Monkey Pitch. In 1955 exploration terminated here at a depth of only 985m. So a massive expedition was organised for 1956 and the last few wet pitches were passed to a huge gallery ending in a sump. In quick succession both French and international teams reached the bottom of the

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Berger as it was then known, 1,122m below the entrance and an impressive world record.

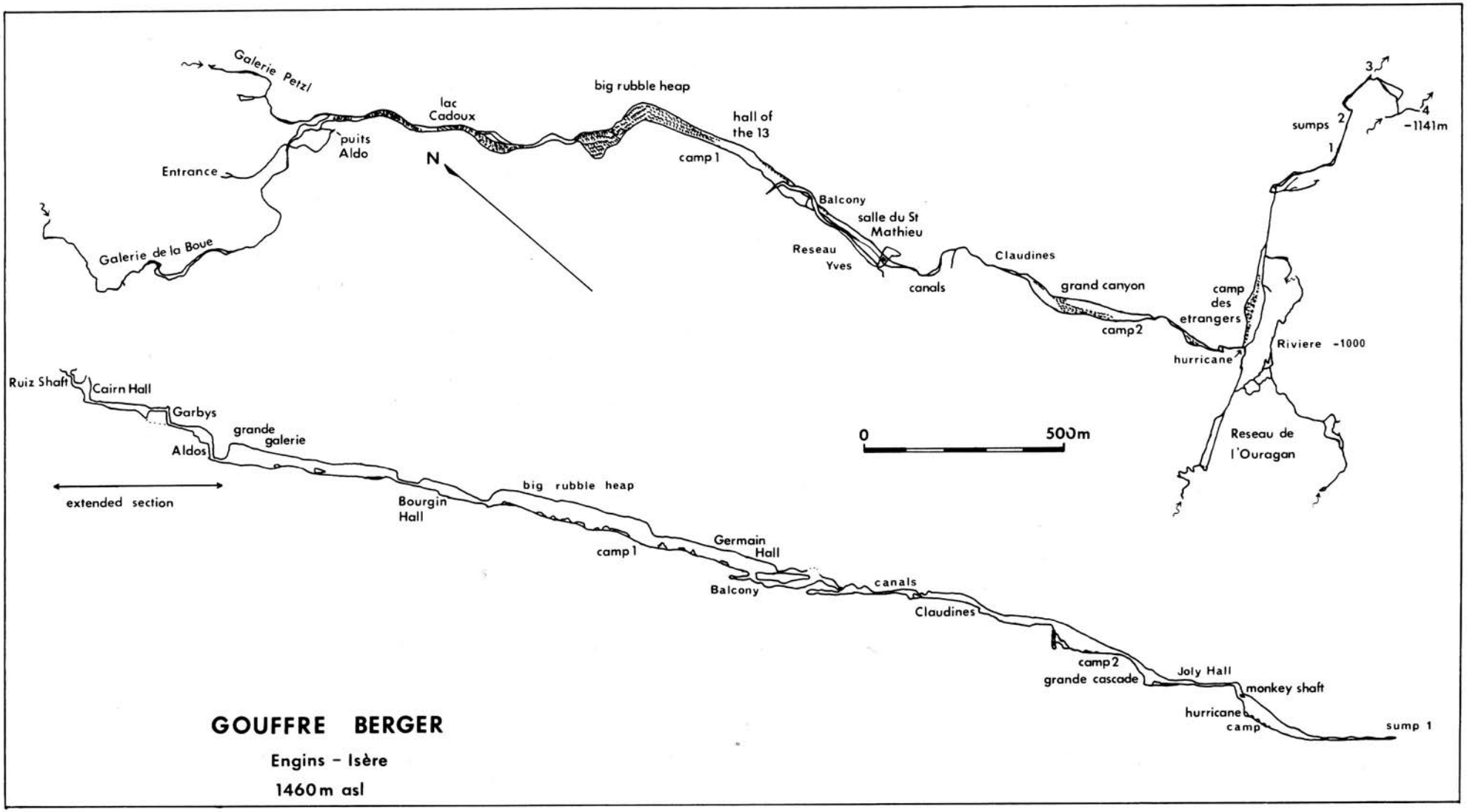
Now that the sump had been reached, the initial exploration fever quickly wore off. In the same year, 1956, the sumps in the Sassenage Cave (the resurgence of the Berger water) were dived with little success. 1961 saw the exploration of a nearby cave, the Puits Benjamin. It has an entrance higher than the Berger — hence the interest — but it was blocked 200m down and the connection to the Berger was not made.

Then, in 1962, the "British phase" of exploration began. A large expedition reached the sump, the first team to do so since 1956, and among its members were Ken Pearce and Pete Watkinson. The following year, with a small but spectacular expedition, Pearce returned to the Berger and dived through sump 1 to gain a new world record. But only a few metres of canal saw him stopped at sump 2.

Consequently two British expeditions returned in 1964. Watkinson and his team climbed into the roof just below camp 1 and found a short, decorated passage known as Pegasus Bridge — not the hoped-for sump by-pass. Appalling weather and continual floods stopped Pearce's diving party even reaching sump 1. But six of his team did at least appreciate the dangers of flooding in the lower parts of the Berger; they spent 48 hours in Joly Hall jumping up and down to keep warm while they waited for the floods to abate so that they could re-ascend to camp 2. No permits were available for the British in the following two years, and in 1966 French teams made two small discoveries. They extended Pegasus Bridge a short way, and also followed the stream of the entrance series down the meanders, to re-appear just beyond the foot of Garby's pitch — at least this scotched the rumours about the "dreaded" meanders being "200 feet deep" — they can be little more than half this depth.

An Italian team opened the 1967 season by getting two men to the sump — the first non-British team to bottom the cave since 1956. But they were quickly followed by a mass descent by the British teams — twenty cavers reached the sump, and set the fashion for future years when it has become quite apparent that modern caving standards have "caught up" with the difficulties of the Berger. The events of the 1967 expeditions are well enough documented, and the most important result was Pearce's solo dive through sumps 1 and 2, to discover a short passage ending in a pitch. He turned back at the top of this, at a depth of 1,123m (though he had reached 1,133m in the first sump). In turn, French teams followed down the cave and climbed the 17m cascade in the inlet below Hurricane pitch — but were very shortly stopped by a sump. The same summer saw the French continuing exploration in the Gouffre Engins — situated right next to the forest path to the Berger entrance. The water in the Engins was expected to flow to the Hurricane inlet, and its entrance was well above the Berger entrance. A series of very tight meanders and pitches was blasted and pushed to a depth of 200m where a 70m shaft was found — ending in an impossible choke.

Pearce's exploits prompted the French to terminate the "British phase", and organise another expedition in 1968. They established a third camp in the chamber below Hurricane pitch and so enabled two divers to pass the two sumps. They passed Pearce's limit of exploration, and followed only a short streamway to a third sump at –1,133m; a side passage also led them to a parallel streamway, sumping in both directions — downstream at a depth of 1,141m. Both downstream sumps were briefly examined and found to be too tight. At the same time a Belgian team had



GOUFFRE BERGER

Engins – Isère

1460 m asl

climbed into the roof at the start of the canals, (at –620m) and found a large ascending high-level system (Rèseau Yves) passing clear over the top of the Pegasus Bridge passages. The retreat of this large expedition did not run quite as smoothly as did the main objectives. One of the divers was injured by stonefall on Garby's pitch, and another caver tried to abseil down Aldo's pitch on the wrong half of a doubled rope — he broke a number of bones when he hit the floor. But a Belgian caver had the misfortune to fall off a climb just near the Balcony, nearly 600m down, and the rescue teams took four days to get him out of the cave. A flash flood also caught some teams in the cascades around Claudine's; though the equipment was firmly roped up, much of it was swept away by the water and two cavers spent a considerable length of time jammed in the roof parts of the streamway.

Another result of the 1968 expedition was the discovery of the Hurricane System, and its exploration and survey were completed the next year. This series is entered by a very difficult traverse straight on across the top of the Monkey pitch; the rather exposed route is more than 100m above the floor of Hurricane pitch before the large inlet passage is reached. Two kilometres of passage have been explored by the French teams in this system, which contains another large stream, the "River –1000". All the upstream leads finish at avens, and downstream sumps are met well above the main Berger stream sumps.

The 1970's have seen only smaller, lighter expeditions in the Berger. When the cave was completely laddered in 1970, Etienne Lemaire, a very fit Belgian caver, did the complete trip from surface to sump and back in only 17 hours! The following year a party of five English cavers, unfamiliar with the Berger, put in ladders and spent only four easy days on a visit to camp 2. Then later in the summer of 1971, two French cavers, with no outside assistance, rigged (and derigged) the Berger with ropes only, and visited the sump in a trip of only 72 hours — a magnificent contrast with the four years taken on the original exploration.

Present situation

The length of passage in the Gouffre Berger is now over 8,000m, and just under half of this forms the main cave from entrance to sump. It is therefore not an unusually long cave and indeed it is not very difficult to explore. A number of artificial aids — bolts and traverse wires mainly — have undeniably made its exploration easier than it once was. As far as camp 2, at the foot of the Grand Canyon, the Berger must offer one of the most pleasant and enjoyable caving trips in the world, and though the lower passages of the cave do take on a more serious nature their main difficulties are logistical and the danger of flooding without warning.

The Berger has not held the world depth record since 1966, when the Pierre St. Martin was explored over a range of 1,152m. A surface survey over the Berger by Paul Deakin (of the 1967 expedition) cast some doubts on the accuracy of the depths quoted in the French cave surveys. Neither figures are proven, and debating them seems barely worthwhile now that a record is not at stake; the French figures are used here.

The chances of making downstream extensions in the Berger seem almost nil. The cave entrance is at an altitude of 1,460m and sump 3 is at 327m, though the side passage can be followed down to a level of 319m. The water is next seen in the Vats

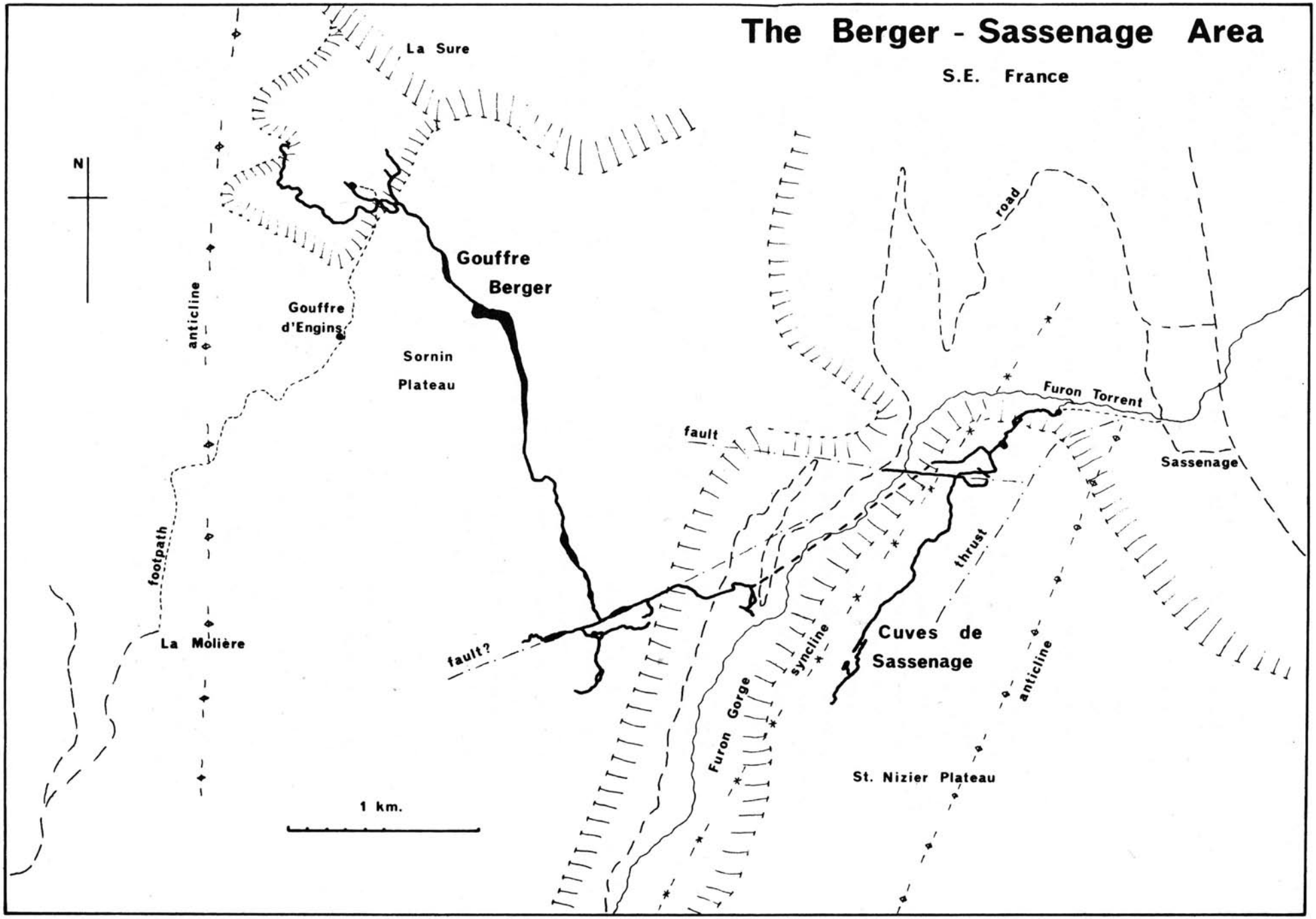
of Sassenage where it flows from a sump at a level of 318m, the final resurgence to daylight being at 297m. Horizontally the unknown gap measures just over a kilometre, so it is most unlikely that a passable connection will be found without resort to dry, high-level passages, should they exist. Furthermore, the cave owner has banned any diving in the Berger, in case accidents should result in pollution of the Sassenage water supply.

Just after descending Aldo's shaft, the caver enters the massive Main Gallery. Downstream is the way on, but upstream the Mud Gallery continues the same size. Also a few metres downstream the left wall opens to reveal the huge tributary passage known as the Petzl Gallery. This has been connected to the surface now for many years by the Puits Marry system. However this route is very unpleasant, involving tight, wet and muddy pitches and meanders, and the entrance is at the same level as the main Berger entrance, so it offers little attraction. The Mud Gallery can be followed upstream for a considerable distance to where the water emerges from impossibly tight rifts. It has been dye tested from a sink, which has its entrance 100m above that of the Berger. This too has been followed down to where it is impassably tight, and the vertical gap now stands at 100m with the horizontal gap considerably larger. Though a connection would recoup the record from the Pierre St. Martin, the situation is apparently rather hopeless.

The Berger has remarkably few significant inlets, and the only other important one is the waterfall below the Hurricane pitch. A short length of the streamway has now been found in the Hurricane System. There have been hopes of finding a deep system leading to this — namely a system largely parallel to the Berger instead of tributary to it; but such parallel systems are hard to find in the forested lapiez fields of the Sornin Plateau.

Only 300m straight above the lower streamways of the Berger is the floor of the Furon Gorge. Also some of the inlet water in this part of the cave is anomolously warm, suggesting a surface origin at a much lower altitude than the Sornin Plateau. There are many small fragments of cave passage known in the Furon Gorge, but no sinks. Quite possibly though, a relatively short cave may one day be found leading from the region of the gorge into the bottom of the Berger — but from the sporting point of view it may be better that such a link is never discovered.

The Vats (or Cuves) of Sassenage, situated in the very suburbs of Grenoble, have had their own long history of exploration. They were extended beyond the first few chambers in 1946, when a decorated series of passages led to a number of avens and a sump in the main streamway — containing the Berger water. This was dived in 1956 by the leading French divers in the Clan des Tritons. They passed the first sump of 25m, explored 100m of open passage, and dived for 100m in the second sump where they stopped at a depth of 15m; the sump continues, deeper, but seems to offer little hope for extensions towards the Berger. Then in 1959 some of the avens were climbed to an ascending series of passages, and more discoveries in 1966 took the explorers to a height of 450m above the entrance. But this was not beneath the Sornin Plateau; instead these passages are east of the Furon Gorge, and comprise the drainage routes of the St. Nizier Plateau. More climbing is now needed if these galleries are to be linked to the sinks on the surface — and this completed system would have an overall depth of 670m.


The Berger - Sassenage Area
S.E. France
N
La Sure
Gouffre Berger
Gouffre d'Engins
anticline
Sornin Plateau
footpath
La Molière
fault?
fault
road
Furon Torrent
Sassenage
thrust
Cuves de Sassenage
syncline
Furon Gorge
anticline
St. Nizier Plateau
1 km.

Geology of the area

The Vercors region, in which the Berger is situated, is formed of a sequence of limestones, named as follows:-

Senonian limestone	300+m
Albian beds	10m
Barremian beds (Urgonian limestone facies)	300m
Hauterivian marly limestone	100+m

The succession is not stratigraphically complete, but ranges from beginning to end of the Cretaceous period.

Lowest in the exposed sequence is the dark, rather impure, marly limestone of the Hauterivian, in which most of the larger passages in the Berger are developed. It is particularly impure in its upper beds where it contrasts distinctly with the pure, white, massive Urgonian limestone. These contain the narrower passages of the Berger and also form the best developed of the lapiez fields on the Sornin Plateau. The Albian beds are composed of sandstones, shales and limestones; these may provide a significant hydrological barrier in the karst environment, but they are extremely poorly developed in the Berger-Sassenage area. The overlying Senonian limestone is slightly impure, compared to the Urgonian, but is again white and massive. It forms most of the St. Nizier plateau but only forms outliers on the higher parts of the Sornin. It is the Urgonian and Senonian limestones together which form the spectacular, deep karst regions of the Vercours and the Chartreuse, respectively south and north of Grenoble.

A feature of both the Urgonian and Hauterivian limestones, in the Berger at least, is that they are very massively bedded. There is a general lack of non-limestone horizons, such as shale-beds, and this does tend to promote the massive scale of cave development.

The Berger is situated in the strongly folded marginal section of the Vercours anticlinorium. The cave entrance lies almost on the crest of an anticline with a nearly horizontal north-south axis. Westward the limestones dip away at angles up to 60°, but the cave runs down the eastern limb where the dip is mostly about 30° in a direction well south of east. Almost along the line of the Furon Gorge, lies the axis of the complimentary syncline, plunging at about 10° to the NNE. Still further east, the spectacular overfold of the St. Nizier anticline is clearly visible in the cliffs above the village of Sassenage.

Both faulting and jointing have affected the limestones, but the details of the structures are only known locally. The largest single fracture is the thrust in the overturned limb of the St. Nizier anticline, but this lies just beyond the known limits of both the Berger and Sassenage caves. Within the Berger, the most important single fracture is that oriented WSW-ENE through the Hurricane shafts; in all probability this is a fault, lying parallel to a known fault almost through the village of Engins, though its influence does not seem to be felt on the plan-form of the Sassenage cave passages. Oblique to this is a major fault zone oriented east west through the Sassenage cave, and, in turn, this is not recognisable in the Berger; however, a series of deep shafts are known along its line on the western flank of the Furon Gorge, and there is every possibility that these will connect with the West Gallery in Sassenage. Two main joint systems are present — oriented roughly east-west and north-south. The latter are the more important and are particularly prominent in the Great

Rubble Heap in the Berger; here they dip about 80° to the west and contain vast amounts of secondary gypsum.

Hydrology of the Berger

Hydrologically, the Berger is remarkably simple, as it mainly consists of a single stream route, with very few major tributaries, though the lack of drainage off impermeable rocks means that there are no individually large stream sinks.

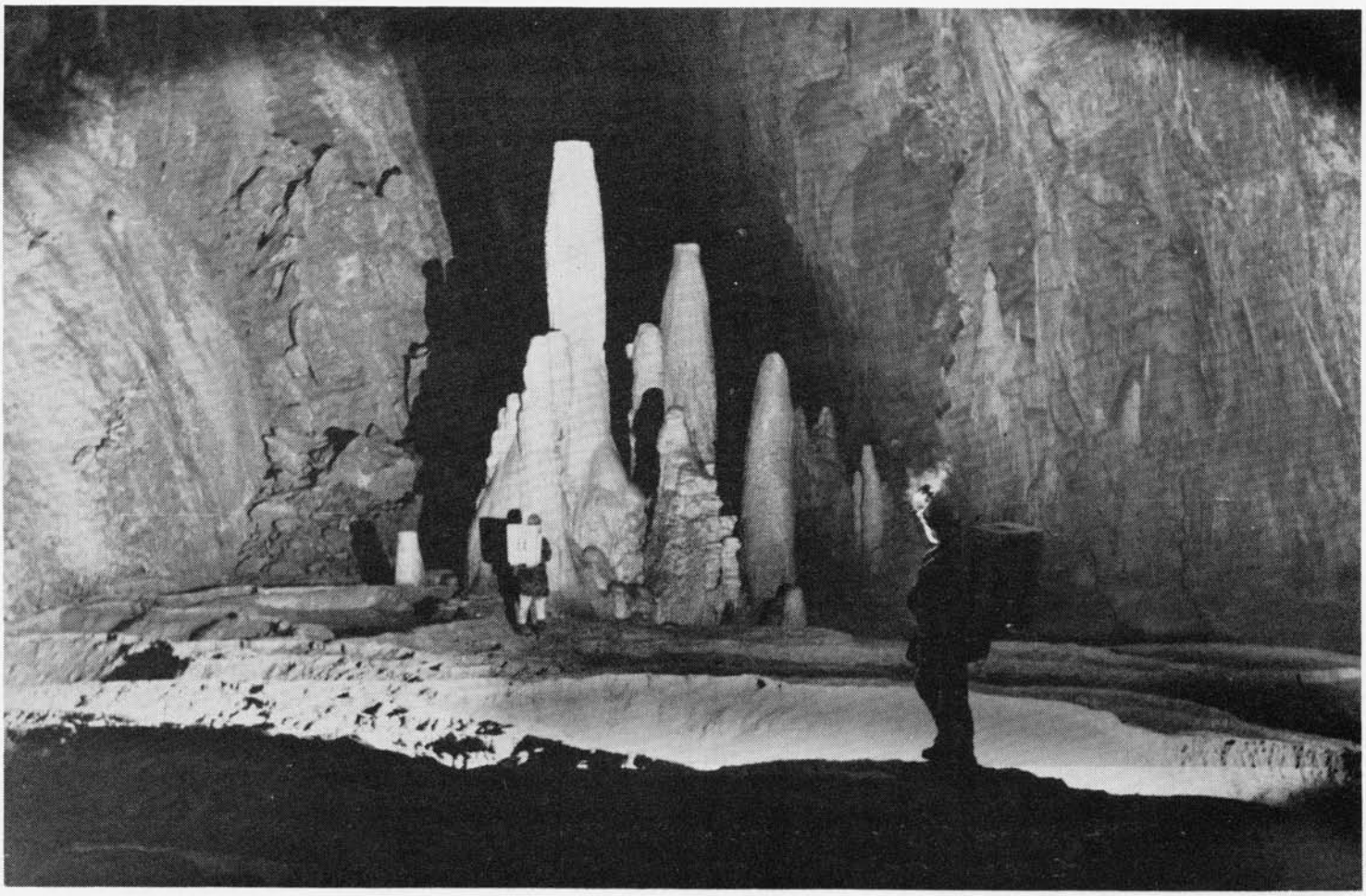
In "normally dry" conditions only small trickles of water are met in the entrance series, but both Mud and Petzl Galleries produce reasonable streams so that about 1 cusec flows into Lake Cadoux. Between the Petzl Gallery and the Hurricane shaft, there are no sizeable stream inlets, but there are dozens of trickles and tiny inlets so that the base flow at the Hurricane is nearly 2 cusecs. One notable trickle falls from the roof on to the upstream landing stage of Lake Cadoux, and another, one of the largest, pours from the roof of the Cloakroom — the upstream landing stage of the main canals! Another trickle feeds, and fortunately keeps clean, the magnificent run of gour pools in the Hall of the Thirteen.

The largest inlet in the lower reaches of the cave flows through the Hurricane System and drops down the waterfall inlet just upstream of Sump 1. This water is a few degrees warmer than the main Berger stream at the same point. The cave is only about 300m below the surface in this region, and it is therefore tempting to suggest that the inlet feeders originate at a lower altitude and have a shorter journey to this point than does the water from Sornin. The proximity of the Furon Gorge endorses this hypothesis, but these inlets quite possibly also account for water sinking in and around the Gouffre Engins. Finally, there is another independent stream in the passages beyond the second sump, before the Berger water is next seen as just a part of the complex hydrological systems in the Sassenage caves.

The flow-rates of nearly all the Berger drainage units are strongly and rapidly variable with fluctuations of rainfall. In drought conditions, the entrance, Petzl and Mud Gallery streams all dry up, in that order, and Lake Cadoux is frequently found completely dry — it drains out through its sediment floor. Further down, little more than drips enter the passage and even the cascades of the lower series diminish to untroublesome proportions.

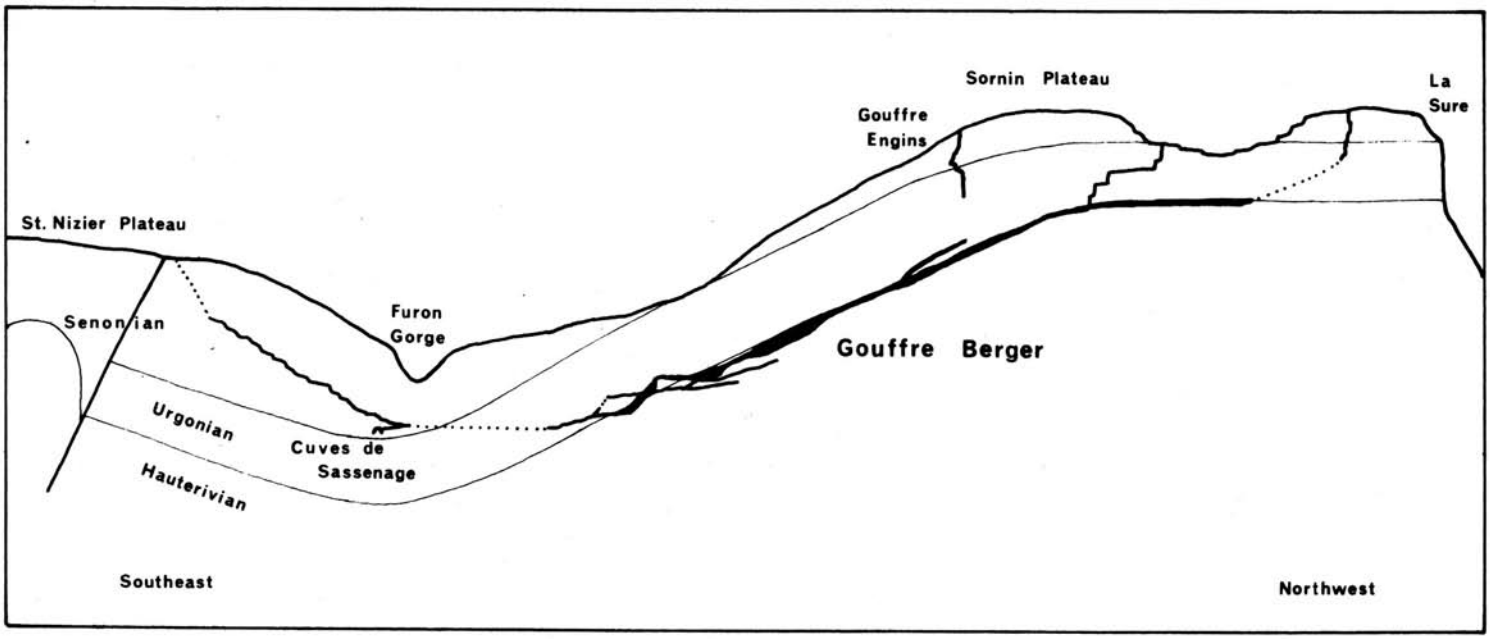
Flooding, due to the only-too-frequent summer storms, is on a most spectacular scale, in part at least due to the thin soil cover over the Sornin Plateau which has the minimum of damping effects on the flood pulses. A few hours of heavy rain, may result in enormous cascades down the Cairn Hall and Aldo's shafts, though the fossil pitches in between always stay dry. Below the Petzl Gallery, the stream, normally less than a metre wide, may cover the whole 10m wide passage floor and flow as a torrent over a metre deep. Even in mild flood, when the cave is still safely explorable, the inlets of the Hall of the Thirteen and the Cloakroom each approach a flow of 1 cusec. Stronger flooding results in streams metres deep flowing over the cascades, rendering them impassable, and isolating the groups of large chambers which always remain dry — Big Rubble Heap, Grand Canyon and Joly Hall.

Not surprisingly there is a lack of data on flood flow rates within the Berger itself, but some idea of their scale may be gained from stage recordings at the Sassenage resurgence. Base flow from the Cuves is in the order of 4 cusecs — so just under half of the water is normally accounted for by the Berger. Quite commonly, the flow



The famous stalagmites in the Hall of the Thirteen

(Photo : J. A. Cunningham)



Diagrammatic section of the geology and caves of the Sornin – Sassenage area

from Sassenage reaches 130 cusecs, and in 1960 a flow of 400 cusecs was recorded. From these figures may be gained some idea of the magnitude of the Berger floods.

Development of the Gouffre Berger

The various high level inlets of the Berger drop through the Urgonian limestones as simple vadose systems formed down the gentle dip near the crest of the Sornin anticline. The normal entrance series is a classic development of deep meandering canyons connected by large fluted shafts; an initial phreatic tube is seen along the roof of some of the meanders.

There are two features which make it difficult to analyse the morphology of the main Berger passage — firstly the size, for the roof is rarely visible, and secondly the large amount of collapse modification. However the purely down-dip development as far as the Balcony does suggest vadose origins; the bend in the Big Rubble Heap is merely formed where the passage swings to the south to align with the major joints which are slightly oblique to the dip. The majority of the main passages appear to have developed at the Urgonian-Hauterivian contact, where the downward flowing vadose waters met the less soluble Hauterivian limestones. Enlargement of the passages has then been by erosion of the Hauterivian and some subsequent collapse of the undermined Urgonian roof.

The rather more complex development just below the Balcony, including the Pegasus Bridge, the Rèseau Yves and any high level continuation towards the Grand Canyon, is partly masked by extensive collapse and thick stalagmite development. But again the passages run down-dip, there appears to be no evidence to suggest phreatic origins, the locally reverse gradients on the cavers' route are merely over collapse heaps, and it is reasonable to infer just vadose development, even if of a multiphase nature.

From the Canals down to Claudine's Cascade is a vadose trench much smaller than the passages above and below it, suggesting that it is a younger feature incised in the floor of a slightly wider cave. However, the limestone is locally less jointed through this part of the system, and this feature alone could possibly explain the decreased passage size. The decreased gradient of the cave in the region around the Canals is due to local development of the cave along the strike, instead of down-dip, as it crosses from one major set of joints to another further to the east. The Canals themselves however are merely formed by damming of the water behind a collapse heap of rubble in the Coufinades Hall (the downstream landing-stage).

From Claudine's, down through the Grand Canyon, to Joly Hall is again a major down-dip passage most probably of vadose origin. But just beyond Joly Hall the cave is nearly horizontal, and sharply cuts across the still inclined limestone bedding, thereby climbing into stratigraphically higher beds.

This could well represent an old ponding level of the water, with the passage formed along the top of the phreas. However a rock floor is only seen just before the top of the Monkey shaft, so the original passage could have been a phreatic loop down-dip and then up a joint; the present passage would then have developed by sedimentation on the floor of the loop and equal erosion of the roof until phreatic conditions ceased with elimination of the reverse gradient. The overall horizontal development appears to terminate at the Monkey-Hurrican shafts, where the water drops down the massive fracture to much lower levels, and continues in a dominantly phreatic passage along the trough of the syncline to the resurgence.

It is uncertain whether the ponding level at Joly Hall was a purely local feature terminating at the Hurricane fracture or was of a regional nature. If the latter was the case then old high level passages should await discovery above the Hurricane chamber, leading downstream to old (beheaded and buried) risings in the Furon Gorge.

Particularly in the region of the Balcony, it is very clear that there have been at least three phases in the history of cave development — a major excavation, followed by extensive collapse and stalagmite deposition, and then a modern phase. Though at present the main stream is depositing calcite above the Big Rubble Heap in low flow conditions, the modern phase is dominantly erosional, the stream everywhere incising itself in the lower reaches of the cave. Similarly only the inlets above the Canals are depositing calcite, there being a complete lack of speleothems in the lower passages.

A chronology is beyond the scope of this account but it is tempting to relate the sequence of development phases to the climatic variations of the Pleistocene glaciations. Similarly if the Joly Hall horizontal development does relate to a fossil resurgence level, the abandoning of this could be due to glacial rejuvenation.

Acknowledgements:

The writer gratefully acknowledges a variety of sources for the information on exploration in and around the Berger — namely J. Cadoux's book "One Thousand Metres Down" (Allen & Unwin 1957), many caving reports in issues of "Spelunca", and a number of personal communications. The sections on the geomorphology are mainly based on the writer's own observations on two visits to the cave and descents as far as camp 2; however the stratigraphy is based on J. Bouchet's short unpublished report of 1965, and morphological observations in the Joly Hall area are those of D. Brook to whom the writer is especially indebted. The cave survey is based upon those made by various French teams, and was kindly redrawn by R. Bowser.

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