THE CAVES

Kogelbeen Cave

The cave is historically well known, thus Rogers (1907) mentioned caves at 'Kogel Fontein'. In the speleological literature the cave was first described by Smith (1964), who penetrated to the Water Passage but not as far as the water table. Hitchcock (1980) published the first survey. The cave is a declared Natural Heritage Site (number 3) under the South African Natural Heritage Programme. A popular account of the cave was recently published by Avenant et al. (1998).

Description (Fig. 2)

The cave entrance is a 90 m x 30 m doline leading to a 30 m x 15 m central sinkhole with vertical sides, and a floor sloping to a maximum relative depth of -8 m. There are some minor holes in the doline walls, but the main cave starts at the deepest, southern, part of the doline. Above the cave entrance is a short, dusty section (the Dry Passage) on two levels leading for 70 m towards the east. To the north of the entrance is a short section behind a collapsed overhang. The main cave descends steeply in solid rock to a small chamber at -22 m, where it doubles back under itself before continuing to the Main Chamber at -31 m. Left (i.e. south east) off the main chamber is a long, relatively straight passage (the Bat Passage) with a few minor parallel side passages, sloping gently upwards and ending after 120 m. Especially towards the end, this passage has a very high ceiling. Returning to the main chamber, along the north wall is a tiny hole in the floor (blocked by water-borne stones during our first visit) that leads steeply downwards to a narrow, moist passage (the CO₂ Passage). We penetrated this for 30 m to a relative depth of -43 m before lethal CO₂ levels prevented further exploration. According to Hitchcock (1980), the continuation here is a single, narrow, sloping passage ending in a wide sump about 20 m further. Returning to the main chamber and carrying on to its western end, there is a tiny crawlway which leads through an awkward drop into a wide, low passage (the Water Passage) filled with a series of shallow seepage pools. At -57 m the water table is reached. The composite total cave length is 788 m.

There is at least one important difference between our survey and that of Hitchcock (1980). The latter managed to penetrate the CO₂ Passage to its end at the water table, and makes no mention of CO₂ - in fact, he says 'the air was very good'. While his water table level in the Water Passage (-53 m) is comparable to our measurement of -57 m, his water level in the CO₂ Passage is given as -73 m. Such a large vertical discrepancy over a horizontal distance of only 60 m may be explained if the higher water level represents a perched water table, as e.g. found in the Twyfelfontein Wondergat (Martini et al. 1991). A true ground water level of -73 m is given credence by the fact that water depths in boreholes in the vicinity are generally 100 m or deeper (J. Cornelissen, pers. com.). The difficulty with the perched water table theory is the fact that we found stygobiotic amphipods in the water at -57 m. In our experience, these amphipods only occur in groundwater, never in perched water tables. Current lethal CO₂ levels in the passage concerned makes it impossible to verify Hitchcock’s measurements.
Figure 2: Plan of Kogelbeen Cave.
Climate

Single point measurements were made during the visits of both 1991 and 1997. The Main Chamber has a temperature of 19°C, rising to 21°C in the Bat Passage and 22°C in the Water Passage. Relative humidity reaches 100% in both the Water Passage and the Bat Passage, and drops to 98% in the Main Chamber, and 80% in the Entrance Passage. Water temperature of the main pool is 21°C.

Subjective comparison of CO₂ levels indicates an increase over the past two decades. Hitchcock (1980) penetrated both the Water Passage and the CO₂ Passage and mentioned no CO₂. In 1991 there was high CO₂ presence in the Water Passage, and lethal levels in the CO₂ Passage. In 1997 conditions in the Water Passage were much more uncomfortable than in 1991, and in the CO₂ Passage it proved impossible to reach the point where surveying was stopped in 1991.

Biospeleology

The usual mammals utilise the doline and entrance: baboon *Papio ursinus*, hyrax *Procavia capensis* and porcupine *Hystrix afericaeaustralis*. It also serves as a roosting and breeding site for rock pigeons *Columba guinea*, palewinged starlings *Onychognathus nabouroup* and barn owls *Tyto alba*. In 1991 there was a remarkably large unenclosed honeybee *Apis mellifera* nest above the entrance, but this was gone by 1997. The doline also acts as a refuge for a number of moisture-loving taxa that are otherwise rare or absent in the semi-arid surroundings of Kogelbeen. In 1991 two *Cacosternum boettgeri* frogs were found in the Paddagat (Fig. 2). In 1997 an opilionid spider (*Polycoryphus asper*) was found at Kogelbeen, several hundred kilometres from the nearest other locality from which any Opiliones have been recorded (Lotz 1999). Collembola, a group rare in arid areas, are also common in the doline.

Kogelbeen is an important bat roost. Herselman & Norton (1985) recorded three bat species from Kogelbeen: *Miniopterus schreibersii*, *Rhinolophus clivosus* and *R. darlingi*. They estimated the population size of *M. schreibersii* at 60000 individuals, and the *Rhinolophus* spp. together at 5000 individuals. Avenant in Irish *et al.* (1997) traced additional museum records of *Rhinolophus denti*, *Nycteris thebaica*, *Myotis tricolor*, *Eptesicus capensis*, and *Tadarida aegyptiaca* from Kogelbeen. The bulk of the bats live in the Main Chamber and the Bat Passage. Small numbers of *Miniopterus schreibersii* only live in the Dry Passage, and only single individuals were seen in the Water Passage. Considering the number of bats, guano deposits, though ubiquitous, are surprisingly thin.

A number of primary consumers live directly on and in fresh guano. A white fungus grows on guano and bat carcasses. Psychodidae flies (Diptera) are common in the Bat Passage, and nematocerous larvae, presumably theirs, are found in large numbers in wet guano. At least three species of small flies occur in large numbers in the cave. One is an undescribed Camillidae (D. Barraclough, pers. com.), and the other two are still unidentified.

Detritivores that feed on generally older guano throughout the more humid parts of the cave include isopods (cf. *Oniscus* sp.) and tiny red mites of the family Uropodidae. *Lepidospora* sp. (*Thysanura, Nicoletiidae*) were found only in the CO₂ Passage. Crickets (Orthoptera, Gryllidae), Ptinidae beetles (*Mezium* sp.) and unidentified Psocoptera are found mainly in
the Dry Passage, and *Eurychora* sp. (Coleoptera, Tenebrionidae) exclusively so. Large hairy caterpillars (Lepidoptera larvae) are common throughout the main cave.

Predators include mainly spiders (Araneae). Gnaphosidae, Dictynidae and *Ariadne* sp. (Segestriidae) are found in and near the entrance, with *Pholcus* sp. (Pholcidae) also ranging into the Dry Passage, while *Vidole schreineri* (Amaurobiidae) are conspicuous in the Bat Passage. Chilopods (*Lamyctes* sp., Lithobiomorpha) are also found in the Bat Passage, and pseudoscorpions (*Beierius walliskewi*, Cheliferidae) in the Dry Passage. A large Diplura (*Japygidae*) was encountered in the CO₂ Passage. Assassin bugs (Reduviidae) of the subfamily Erminae occur in the main cave, while those of the subfamily Piratinae are more common in the Dry Passage. A Carabidae (Coleoptera) species is found in the main cave, and small red ants (Formicidae, Ponerinae) also occur.

Parasites include the mite *Argas* sp. (Argasidae) that feeds on bats and birds. Parasitic bat flies of both the families Streblidae and Nycteribiidae were found on *Miniopterus schreibersii* in the cave. The latter flies are probably the 'short-legged fat-bodied spiders' Hitchcock (1980) saw on some bats.

Aquatic fauna includes the stygobiotic amphipod *Sternophysinx basilobata*, only known from Kogelbeen and the Boesmansgat cenote near Danielskuil (C.L. Griffiths, pers. com.). Hitchcock (1980) first noticed these as 'shrimps'.

It follows that five distinct life zones may be distinguished in the cave, each with faunal elements found only there:

1. The entrance zone, comprising the doline and twilight cave areas, with seven taxa.
2. The dry dark zone, comprising the Dry Passage, with nine taxa.
3. The wet dark zone, comprising the Main Chamber, Bat Passage and Water Passage, with 24 taxa.
4. The CO₂ zone, comprising the CO₂ Passage, with two taxa.
5. The aquatic zone, comprising the groundwater pools, with one taxon.

Local inhabitants believe there is some sort of disease in the cave, and refer to an unspecified person said to have died as a result of entering the cave 'many years ago' (S. Janssen, pers. com.). Smith (1964) reported that members of his party became sick, possibly with histoplasmosis, after a visit. Hitchcock's (1980) party wore masks as a preventative measure during their exploration. We were unaffected.

**Development potential**

In 1997 one of the authors was approached by the Griekwastad Publicity Association to do an assessment of the suitability of the cave for tourist development (Irish *et al.* 1997).

Kogelbeen Cave is a unique and interesting natural phenomenon in own right, and is situated in a picturesque area. Unfortunately the cave itself has little to offer the visitor: there are no speleothems ('cave formations'), movement in the cave is difficult, conditions are frankly unpleasant, and the spectre of histoplasmosis cannot be discounted. Given the importance of the cave as a bat roost, and the unusually diverse invertebrate assemblage, non-development of the cave must be the first option.
Should development take place, however, any infrastructure serving visitors should be located at least one kilometer away from the entrance, in order to prevent the bats being disturbed by lights, smoke, noise and human movement. Visitor access to the cave should be strictly restricted to the relatively safe doline and Dry Passage only. Movement here is easier, bats are uncommon, and the invertebrates belong to taxa widespread elsewhere. A bat grid on the main entrance should prevent access to the main cave. Any human movement near the entrance should cease before sundown.

Eye of Kuruman Cave

The presence of the cave from which the copious spring at Kuruman issues has been well known since the early nineteenth century. Truluck & Craven (1996) listed early references to the cave. Rogers (1907) published the first sketch map of a total of 138 m of the major passages.

Description (Fig. 3)

The cave consists of a series of cracks in a dolomite outcrop, from which a stream of water flows strongly. An artificial shaft with a ladder enters the cave at its furthest upstream reach, 60 m south east of the resurgence. There is a 14 m long dry passage south of this point. Towards the north the passage is initially about 3 m wide and the floor is covered in water. This issues from a few small openings against the southwestern wall, near some concrete footing which previously accommodated water pumps. Downstream the passage splits. To the left (west) it continues for 20 m at about 3 m wide before a dry section is reached. To the right (north) a narrow (1-1.5 m) passage continues for 30 m before also reaching a dry section. Both water passages have minor parallel water-filled connecting passages. A dry transverse passage connects the dry ends of the two main water passages. At the southern end of the dry passage, a very low (<0.5 m) and narrow (<1 m) crawlway in shallow water extends for about 20 m before it gets too narrow to proceed further. A side passage off the narrow passage also becomes impassable after 15 m. The northern end of the transverse dry passage constricts the water flow, and it gushes out forcibly on the downstream side. At this point there are two short dry side passages to the west, but the main stream passage continues straight ahead for another 7 m. Here there is another side passage to the left, which becomes dry after 6 m and leads to an easy outside entrance that is closed by a metal gate. The water continues straight ahead and emerges at the base of a cliff in the resurgence known as 'Die Oog'. Another metal gate closes the narrow contorted passage that ends here. The composite total passage length is 261 m while the deepest water depth is ca. 1.25 m.

The output of the spring, and hence the water level in the cave, may vary. During Truluck & Craven’s (1996) visit the water level was approximately 1 m higher than during our survey, and some minor passages were submerged.

Biospeleology

Herselman & Norton (1985) recorded Miniopterus schreibersii and Rhinolophus clivosus from the Eye of Kuruman Cave. We saw only a few single bats. Bats generally avoid areas of similarly high humidity, and the cave has almost certainly had a long history of human disturbance. At least two individuals of the sharp-toothed barbel Clarias gariepensis were
EYE OF KURUMAN CAVE
(Ooggrot)

261m

J. Irish, E. Marais, 5.XI.1991

Figure 3: Plan and section of Eye of Kuruman Cave.
seen in the deepest part of the cave, and appear to be resident there. Both *C. gariepensis* and *Tilapia* spp. are found in the lake outside the entrance, but only the former enters the cave. This is interesting against the background that the only troglobitic fish in southern Africa, *C. cavernicola*, belongs to the same genus. It is also known that *C. gariepensis* can live in caves for extended periods; thus of six individuals artificially introduced to the Harasib Sinkhole in Namibia in 1963, one survived till at least 1988 (Kruparz 1966; Mosich 1967; Marchant 1976; Maxwell 1996).

No aquatic invertebrates were seen inside the cave. A single water skater (*Veliidae*, cf. *Rhagovelia*) was found on the water surface inside the cave.

The short dry section harboured some terrestrial invertebrates. The detritivores included unidentified Isopoda, Diplopoda of the Polydesmida, Psocoptera (Psocidae) and Blattellidae. The predators included spiders of the families Amaurobiidae, Pholcidae and Sicariidae (*Loxosceles* sp. nov., L. Lotz, pers. com.). Cixiidae feed by sucking the sap of plant roots that penetrate into the cave. Unidentified small flies (Diptera) were also seen.

**Climate**

Air temperature 21°C. Water temperature 21°C. Relative humidity 99 to 100%.

**Koningsgrotte**

Rogers (1907) mentioned the existence of caves 'on the Kono Reserve'. They are well known in the local community as 'Koningsgrotte' (Koning = Afrikanisation of Kono; D. Coetzee, pers. com.).

**Description (Fig. 4)**

At the southern edge of a polje (panlike depression), at the foot of a low cliff, there are five cave openings. The eastern four (E2 to E5) are interconnected. At a maximum distance of 45 m from the entrances, the essentially level passages become too narrow to penetrate further. There is one surface connection (E6) here. Towards the west is a second cave (E1) at a higher level, not directly connected to the others but part of the same system. At the opposite (northern) side of the polje, approximately one kilometer away, a resurgence emerges from a narrow crevice. Originally this water re-entered the ground through cracks in the southeastern corner of the polje, but the landowner later canalised it to enter the cave. If additional parts of the cave were originally accessible, as locals suggest, they have since been silted up or submerged. Above the southwestern corner of the polje, there are two parallel crevices, of which one shows minor cave development at its lowest point. The composite total lengths are 253 m (E2-6) and 79 m (E1).

The cave is developed as a series of solution cavities on joints in massive dolomite. The dolomite is cherty and contains 5 - 10 cm thick chert bands at distances of 0.5 - 0.3 m from each other. Scallop in the roof indicate that the cave is of phreatic origin. There are a few old speleothems in the process of redissolving, as well as the remains of massive stalagmites in places currently open to the surface.
KONINGSGROTTE
253m (E2-6) + 79m (E1)
BCRA Gr. 5D
J. Irish & E. Marais, 6.XI.1991

Figure 4: Plan and sections of Koningsgrotte.
Biospeleology

Because of its small size, and the limited extent of any truly dark zone, the fauna is impoverished. A few *Rhinolophus* bats were seen. The only invertebrates recorded were Collembola (Entomobryidae), Psocoptera, Diptera, Lepidoptera larvae and a Pholcidae spider. In the water an unidentified fish, and frogs of the genera *Xenopus* and *Rana* were seen.

Climate

Due to the good ventilation of the cave, relative humidity is low, and temperature is expected to fluctuate. Measurements in the main chamber were 77% R.H. at 21°C, in a sheltered side passage 88% R.H. at 18°C, and in a side passage with flowing water 96% R.H. at 17°C. The water temperature at the deepest part was 25°C.

Kono II Cave

This cave is well known to inhabitants of the area, who pointed it out to us. Tracks and smudge marks on the walls in the cave indicated that the Main Passage had been partially explored before. Due to the complexity of the cave, we were unable to complete the survey in the limited time available, and circumstances have prevented us from returning since.

Description (Fig. 5)

Two proximate cave entrances (E1 and E2) are situated on an open plain. There are two other small surface openings in the vicinity, but neither has yet been positively connected to the surveyed cave. The first has been artificially blocked with stones, and is situated near the westernmost point surveyed underground. The second is open, but very tight and vertical. It is situated about 30 m further southwest. A small blind doline 30 m northwest of E1 completes the surface karst features.

The cave is a typical structurally-controlled phreatic maze, developed in dolomite on a relatively flat plane at an average depth of 11 - 12 m. There has been extensive post-phreatic collapse. Walls are scalled, the roof is often composed of talus (also visible in entrance shaft E1), and the floor is composed of soil. The few chert bands are broken and discontinuous. Occasional geodes with quartz crystals 1 to 1.5 cm in length were seen.

There is only one broken Main Passage where a semblance of normal human movement is possible. Almost all cave development is west of this Main Passage, with almost nothing to the east. Side passages are generally narrow (0.5 - 1 m diameter). Even narrower (0.25 - 0.5 m diameter) long cracks abound. In many cases, as entering these cracks would have damaged speleothems, we decided against doing so even though light beams penetrated many metres deep into them. In general, movement is difficult, the cave is intricate, and it is easy to become disorientated. Despite the small size of the surveyed section, it should be considered a dangerous cave and unsupervised access should be strongly discouraged.

Opening E1 descends subvertically to a depth of 9 m into the northern end of the Main Passage. There are narrow cracks and mazes leading off on all sides. About 20 m southeast of the entrance, an inconspicuous upward climb through a squeeze leads into a wider but
Figure 5. Plan of Kono II Cave.
still very broken continuation. To the north here it is possible to proceed upwards through a
series of low crawls and climbs to emerge in a flat chamber housing the second entrance,
E2.

Proceeding further along the Main Passage, two main side passages to the northwest lead
into a series of high but narrow anastomosing cracks. In places this section is developed on
two or even three levels. At the far end, the section breaks down in a wide flat collapse
chamber. Surveying this proved particularly disorientating, as what was believed to be the
chamber’s walls proved again and again to be merely the edges of ever narrowing cracks
between collapsed boulders within the same chamber. This area is situated approximately
underneath the artificially blocked surface opening, but the opening could not be positively
identified from underground.

The Main Passage was reconnoitred for a short distance beyond the survey’s end point,
with no immediate end in sight. The composite total surveyed length is 663 m and the
maximum relative depth reached was -22 m.

Biospeleology

Due to the erroneous belief that we would be able to return to the cave soon in order to
finish the survey, detailed biospeleological work was postponed. Nycteris bats were seen.
There was a baboon skull 30 m in from entrance E2. Incidentally collected invertebrates
include Acari (Parasitidae, Phityogamasus sp.), Pseudoscorpionida, Agelenidae (Araneae),
Blaberidae (Blattodea), Eurychora sp. (Coleoptera, Tenebrionidae), unidentified small
Coleoptera and Diptera, and Lepidoptera larvae.

Climate

Relative humidity is very high throughout all parts of the cave away from the immediate
vicinity of the entrances. Temperature in the relatively larger Main Passage ranges from 16°
to 17° C, but rises to 20°C in constricted side passages with poor airflow. Actual
measurements: 100% R.H. at 17°C; 99% R.H. at 20°C.

Kono III Cave (Fig. 6)

An insignificant hole, two metres deep, with two surface openings 4 m apart, containing a
dead dog during our visit. It is included here only because the locals believe it is much
larger.

Soetfontein Cave

Locally well known and regularly visited. There are graffiti against the roof dated 1928.
This is possibly the same cave as the ‘cave on Sweet Fountain’ mentioned in Speight (1944).
Previously visited by CROSA (J. Viljoen, pers. comm.).
KONO III Cave

Sketch map by
E.Marais, 9.XI.1991

Description (Fig. 7)

The entrance is a sinkhole in a depression on a low calcrete plateau, and the cave is wholly developed in this calcrete. The entrance leads over a few vertical drops to a single 40 m diameter semicircular chamber. Towards the north is a low wide continuation at a slightly higher level. During the exceptional rains of 1955, the main chamber reportedly filled with water. Watermarks are still visible against the walls and roof at a relative depth of ca. -9 m. The composite total length is 120 m and the maximum relative depth is -16.7 m.

Biospeleology

Honey bees Apis mellifera nest in the entrance. Individual Rhinolophus bats were seen. The few invertebrates collected inside the cave include spiders (Hahniidae), Pseudoscorpionida, Isopoda, Psocoptera and a Carabidae beetle.

Climate

Both temperature and humidity increase with distance from the entrance. Three measurements progressively deeper into the main chamber: 96% R.H. at 18°C; 96% R.H. at 19°C; and 100% R.H. at 20°C.

Wonderwerk Cave

This is a well known archaeological site, known since the nineteenth century, as well as being a tourist attraction.
SOETFONTEIN CAVE
(Soetfonteingrot)
120m
J. Irish & E. Marais.
BCRA Grade 5D, 11.XI.1991

Figure 7: Plan and sections of Soetfontein Cave.
Description

A single passage, on average 15 m wide and 5 m high, leads essentially straight and level into the hillside for 139 m before ending abruptly. There are no significant extensions. The plan of the cave published in Humphreys & Thackeray (1983) being sufficient, it was not considered necessary to resurvey it.

Biospeleology

No trace remains of the guano deposits mentioned by Malan & Cooke (1940). The remaining substrate has been trampled to snuff by countless visitors. The result is a paucity of life forms. Only a few single bats are found, and the only invertebrates recorded were a single Psocoptera (Mesopsocidae) and a few Ptinidae beetles (Mezium sp.).

Gatkoppies Cave / Blinkklipkop Cave

This site was a prehistoric pigment mine (Thackeray et al., 1983). The cave is developed on a well-mineralised band of breccia containing abundant specularite and haematite, in banded ironstone. While most accounts imply that the cave is wholly man-made, we believe that it was a pre-existing cavity that has been enlarged and extended by mining activity. We base this on comparison with another mineralised cave cum pigment mine, Märcker Cave in Namibia (Irish & Marais 1992).

Thackeray et al. (1983), who investigated the cave’s archaeology, list historical references dating back to 1801. There are the usual exaggerated lengths and depths, and claims of previously more extensive workings now obscured by collapse. We saw no evidence of such collapse, and point to Rogers (1907) who reported a length of 40 feet (13 m) for the dark section, which is closely in accordance with our own measurements.

Description (Fig. 8)

The cave entrance is situated in a depression that shows extensive evidence of open-air excavation. The southern edge of the depression forms a 25 m wide overhang, which is the cave’s entrance chamber. The only significant extensions are in the western corner. A 12 m wide and 6 m deep sloping balcony is formed here. Below the balcony, a 2 m wide passageway leads down to a short dogleg section. The latter is the only truly dark part of the cave. The composite total length is 69 m and the maximum relative depth -8 m.

Biospeleology

No life forms were encountered. This is attributed to the limited extent of the dark section and trampling of the substrate by miners previously and tourists currently.

Climate

At the deepest point: 91% R.H. at 18°C.
BLINKKLIPKOP CAVE

(Gatkoppies Cave)
69.5m
J.Irish & E.Maraís, 12.XI.1991

DISCUSSION

Caves are popular targets for tourism development, and the tourism boom in South Africa since 1994 has seen a steady lengthening in the list of commercially exploited caves. Unfortunately, such exploitation is often done with little regard for the environment, while existing legislation providing for mandatory environmental impact assessments preceding development goes unenforced. In this regard the Griekwastad Publicity Organisation’s decision to obtain expert opinions on Kogelbeen Cave must be warmly commended. Visitors are currently allowed only in the less sensitive parts of the cave, under supervision. The end result is sustainable utilisation with minimal damage to the cave environment.

The high faunal diversity of Kogelbeen Cave may be contrasted with the absence of fauna in Gatkoppies Cave, and its paucity in Wonderwerk Cave. In both the latter caves, visitors are allowed to roam freely without supervision. The first result of frequent human visits to caves is a departure of the bulk of the bat population. Since bat guano forms the base of the food chain in most caves, this deprives other cave creatures of a renewable food source, and must ultimately lead to their demise. In some cases this demise is hastened by removal of