COCKLEBIDDY CAVE

The Proposed 1983 Expedition

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With no end to this cave system in sight, further plans are being made to continue cave diving exploration in Cocklebiddy. Air-carrying capacity is the major limiting factor in this type of cave diving, and this is directly affected by air consumption rates, which in turn can be influenced by many factors including mental and physical stress. Thus a limit may well be reached where attempting to carry more air by conventional SCUBA techniques will increase air consumption to such an extent that little extra ground will be covered. The future may see rebreathing apparatus using electronic oxygen/inert gas monitoring systems; however cost and availability are currently prohibitive.

The next push dive planned for Cocklebiddy Cave will see an increase in the number of scuba tanks and equipment carried, this will be achieved using 3 one-man underwater sleds rather than one large one. Also, communications equipment is being designed to allow contact between the parties in the rockpile chamber or Toad Hall and the surface. Such a communications system allows for a more flexible exploration plan with the likelihood of an overnight camp at Toad Hall, to combat physical fatigue and allow time for the de-compression of nitrogen from the divers bodies, now a distinct probability.

INTRODUCTION

Beneath the arid Nullarbor Plain 14 kilometres northwest of Cocklebiddy in Western Australia lies Cocklebiddy Cave. A black hole at the base of the northern end of a large collapsed doline marks the entrance to this, Australia's longest cave in a straight line. A short drop then a steep rockpile leads 100 metres below the plain to a large subterranean chamber and lake. Here the cave diving begins.

Over the last ten years, through many cave diving expeditions 4.5km of this incredible cave have been explored. The cave passage has a few slight bends and apart from an occassional rock collapse, has railway tunnel dimensions; 3.5km of the passage is below the water table and totally flooded. The most recent expedition (August 1982) achieved this 4.5km mark and in doing so added further to the longest cave dive penetration in the world (as reported by P. Rogers, 1982 Expedition). The limit this expedition reached was a 400m long rockpile which rises 10m above the water, named Toad Hall. Here the plans for the 1983 Expedition were conceived.

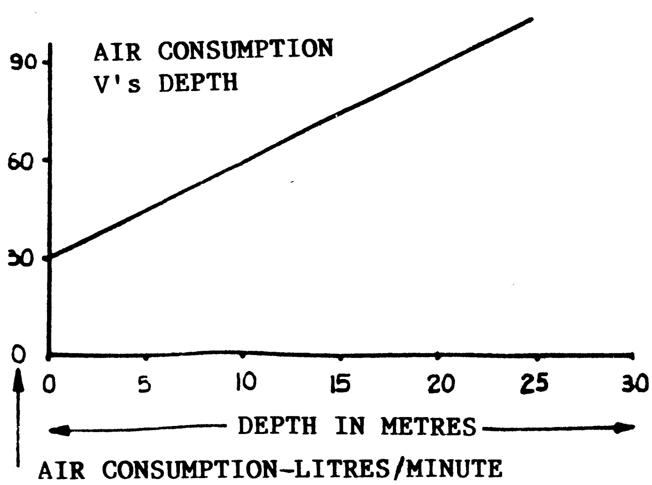
"With one third of our air consumed we surfaced into Toad Hall; the long rockpile was crossed and at its far end another lake; the passage seemed to continue due north. Sitting at the lake, ideas for the next dive evolved" these are now becoming plans for the 1983 Cocklebiddy Cave Expedition.

If it wasn't for Toad Hall the 1982 dive would have involved a single dive over 5km in length and taking approximately six hours, this perhaps being the limit using conventional air SCUBA techniques. In 1983 Toad Hall will be used to give the divers breathing space to recuperate from the physical and mental stress of a continuous dive. The following discussion reveals the requirements of air consumption and decompression, discussion that shows us a three-day underground duration with two nights at Toad Hall is essential for the next push dive.

AIR CONSUMPTION: How not to drown in the Nullarbor

The amount of air contained in a diving cylinder is represented by the volume it would displace if released at sea level (1 ata). A typical aluminium SCUBA cylinder has an internal volume of 11.1 litres and is filled with air to a pressure of 27 MPa. The capacity is approximately 3,000 litres.

An air consumption figure of 30 litres/minute is often quoted for a SCUBA diver at sea level (1 ata) - this increases proportionally to the absolute pressure when at depth i.e. at 10m (2 ata) the consumption is 60 litres/minute. (Figure 1).



However, air consumption is not that simple; it increases with increased work, e.g. pushing sleds (Figure 2) and physical fatigue that results from long duration of sustained work and exposure to cold water. (Figure 3). The actual percentage changes are different for each individual.

Figure 2

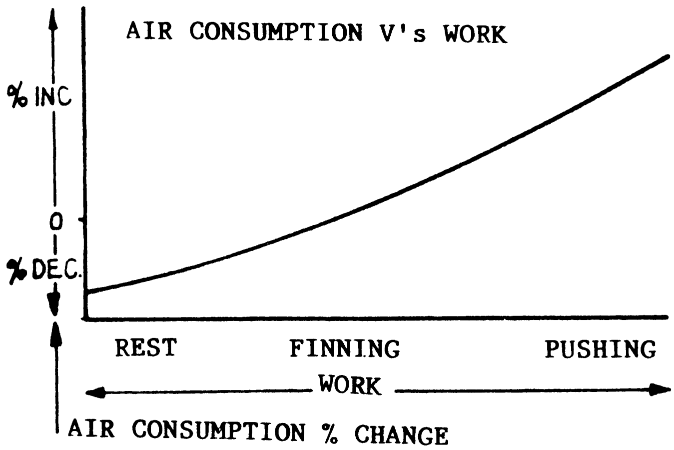
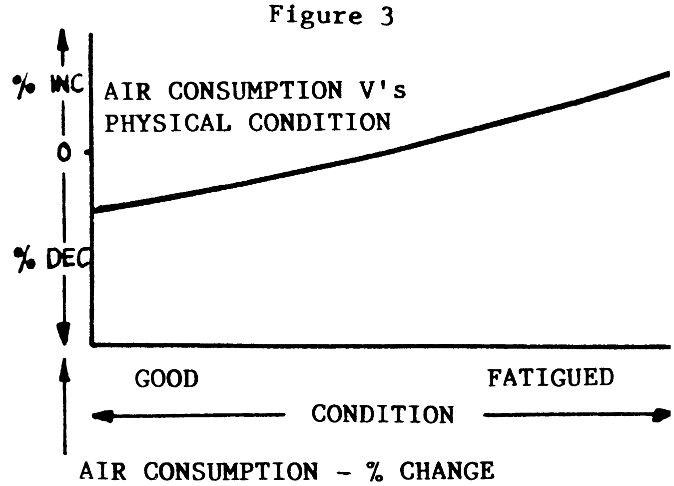
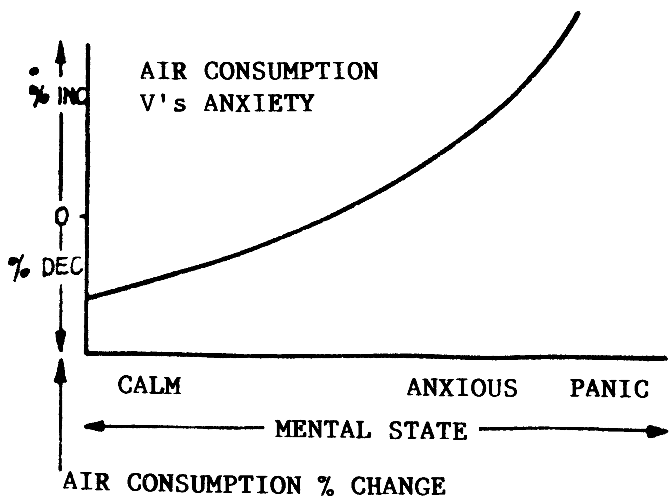


Figure 3



The divers mental state is also a major influence - a calm experienced diver has a lower demand for air than someone ill-equipped and inexperienced. If a situation arose where anxiety increases then air consumption would increase dramatically. (Figure 4).



As a rule for cave diving a "one third" rule applies i.e. 1/3 return and 1/3 reserve. From our experience the following consumption rates apply for Cocklebiddy Cave:

DIVE 1

Entrance lake to Rockpile: Distance 1km; Depth 10m; time underwater 50 minutes.

Air consumed to Rockpile is approximately 2000 litres. However if load is increased, e.g. pushing sleds, then 3000 litres would be consumed.

DIVE 2

Rockpile to Toad Hall: Distance 2.55km; Depth 14m; time underwater 195 minutes.

Air consumed is approximately 8000 litres by each diver. This includes pushing one 15 cylinder sled 1800m, then continuing using triples on back.

To make significant impact the 1983 Expedition plans to have 54,000 litres of air (18 cylinders) for the dive beyond Toad Hall. This will take the three divers approximately 2km, if the cave continues at approximately 10m in depth.

The physical effort that is involved at Toad Hall to set up the push dive is as follows:

Three divers to carry 18 SCUBA cylinders, sled, 3 sets of diving kit, guide line, lights, photographic equipment etc.

The 400m across the unstable rock floor to the north lake - trips totalling several kilometres per person is required to complete the set up.

The diving schedule is detailed later; however before starting the push dive from Toad Hall the divers must have:

1) Completed Dive 1.
2) Completed Dive 2, pushing a sled the 2.55km.
3) Completed the set up of camp and communications.

This will involve 8-10 hours of hard, sustained labour.

Lighting, communications, dry clothing, sleeping kit and warm food will be available for the divers to recuperate. This is essential for the divers to gain maximum mental and physical conditions, to make the best use of the available air on the push dive.

DECOMPRESSION: No Bends at Cocklebiddy

When a diver descends under water the increased partial pressure of nitrogen gas in breathing air will cause some of the nitrogen to diffuse into body tissues. If the time and depth of the dive is sufficient then decompression stops must be made before surfacing to prevent the onset of Decompression Sickness (the Bends). Using the United States Navy air decompression tables the following decompression procedure is necessary for the dive to Toad Hall.

DIVE 1

Entrance to lake to Rockpile Chamber: Distance 1km (700m dive) Depth 10m; Dive time 45 minutes.

No compression stop is necessary; however, some residual nitrogen is retained by the body tissue for several hours after the dive (represented by a letter in the United States Navy tables).

After surfacing from Dive 1 we are in group 'E'. An hour later some of the nitrogen is eliminated; the group is now 'D', as calculated by 'Surface interval' Credit Table.

DIVE 2

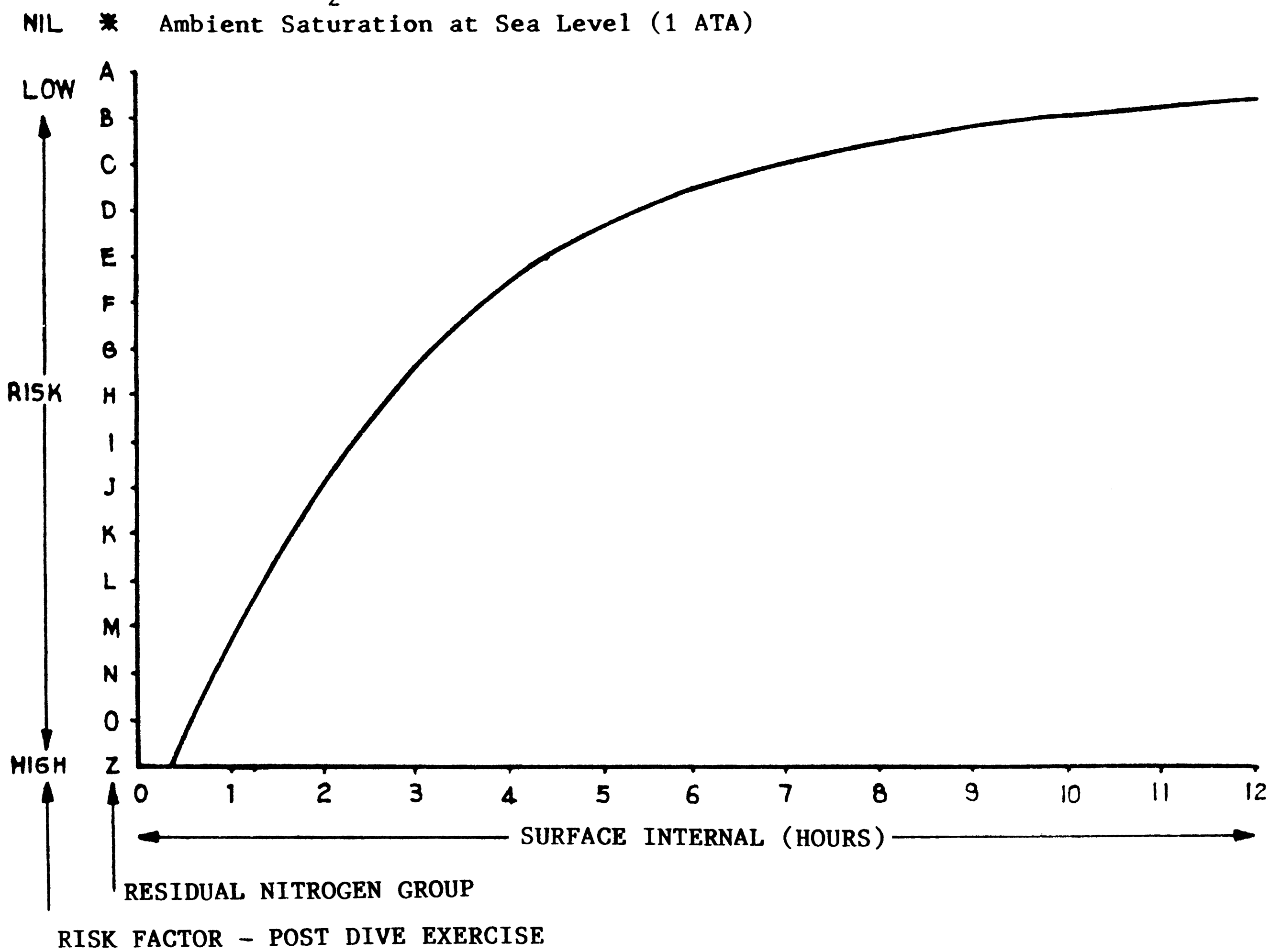
Rockpile Chamber to Toad Hall: Distance 2.55km; Depth 14m; Dive time 180 minutes + residual nitrogen time.

From 'Repetitive Dive Timetable' the time one must add is 29 minutes; the new time to calculate for decompression stops is 180 + 29 = 209 minutes. The decompression stop required before surfacing is 40 minutes at 3m. The new residual nitrogen group at the end of decompression is group 'Z'.

The residual nitrogen group 'Z' is the highest safe saturation point of nitrogen that can remain diffused in the body tissue. We are a walking fizzy drink - if knocked or spilt we would erupt with many nitrogen bubbles forming in our tissues. To avoid decompression sickness we must rest, avoid physical activity or injury for several hours after a dive. Figure 5 represents the de-saturation time to eliminate the nitrogen and to reduce the risk factor of getting 'Bent' as derived from the United States Navy tables.

Figure 5

POST DIVE N_2 DESATURATION CURVE (Group 'Z')



A few hours rest is essential before transportation of equipment over the rockpile to reduce the risk factor. To avoid getting into decompression times on the push dive we will spend a minimum of 12 hours at Toad Hall. It would be a wasted effort to carry our air just for decompression or to have to limit exploration due to excessive decompression requirements.

NEW EQUIPMENT: Sleds under the sand

The most significant change for the 1983 Expedition will be the construction of four sleds from aluminium. It will feature:

1) A cradle-type construction to house 4 sets of triple cylinders.
2) Two floodable bouyancy chambers, each having 25 litres capacity.
3) One-man bouyancy control SCUBA feed and dump valve fittings.
4) Two dry storage chambers for clothing, sleeping bags etc. for the facilities required at Toad Hall.

The new type of sled will speed up loading and unloading of cylinders and equipment as required at the surface lake, the Rockpile Chamber and Toad Hall. (Figure 6).

Under way it is intended to be pushed and controlled by only one person.

It is planned that each diver can consume air from three cylinders on the sled during the 2.55km dive between the Rockpile Chamber and Toad Hall. On this dive the divers will be wearing triples (three cylinders on back) which will be full, as an emergency supply. The sled could be ditched and left if necessary.

Bouyancy control is essential to replace the sleds displacement as air from two cylinders is used. (Approximately 37kg of air is contained in the 12 cylinders). Factors affecting the divers own bouyancy is compensated for by carrying a bouyancy compensator attached to the triple backpack.

PROPOSED DIVE PLAN: Toads of Toad Hall

The dive will consist of five stages as follows:

1) A set up dive to the first Rockpile Chamber.
2) The dive to Toad Hall.
3) The exploration dive.
4) The return dive from Toad Hall.
5) The recovery dive from Toad Hall.

DIVE 1: Support

Support divers using triples (three cylinders on backpack) will push 46 full cylinders and all necessary equipment for the dive and underground camp, on four sleds to the Rockpile Chamber. Three sleds, 45 tanks and the accessory equipment will be carried over the rockpile (one cylinder, one sled left) and re-assembled as three sleds with 12 tanks each and three triples to be used for the next stage. All divers return using the same triples; these now are two-thirds consumed, requiring recharging for the next dive.

DIVE 2: Build up

The three push divers using twins (two cylinders on back) dive to the first rockpile; there, one-third consumed twins are left for Dive 4. The divers cross the Rockpile and check the set up equipment, then wearing the triples, each pushes a sled the 2.55km to Toad Hall. Three cylinders from the sled are allowed for the dive. The triples worn are the divers emergency supply of air. After rest, the camp is set up, the Radio Direction Finding equipment and communications are made ready for use. Eight trips - each over the rockpile - are required to carry one sled, 18 tanks and dive kit to the next lake, and assembled as one sled with 9 cylinders and three triples to be used for Dive 3.

The divers consume warm food with rest or sleep before commencing Dive 3.

DIVE 3: The Push

The divers, wearing triples, will push the sled using one cylinder from the sled for the outward journey; the sled is parked by inflating the bouyancy chambers. The divers continue with triples using one cylinder to continue the outward journey. It is expected that 2km of passage could be travelled underwater before having to return; a guide line will be layed to safeguard our return and to be left to aid future expeditions. With one-third of the air consumed the divers return to the sled, which is used to return to Toad Hall. One-third of the air remains at the end of the dive - this air will be the divers emergency supply on the dive. The divers could be away for 4 hours, possibly longer if air chambers are found. The divers consume warm food and rest or sleep again before Dive 4.

DIVE 4: Wind Down

The 18 cylinders and sled are carried back to the start of Toad Hall. Seven empty and three full cylinders are mounted on each sled; all equipment will be removed from Toad Hall. The divers - all wearing full triples as emergency supply air - push one sled each back to the Rockpile Chamber using three remaining full cylinders on sled. The divers cross the Rockpile and return to base using twins left on Dive 2.

DIVE 5: Recovery

Support divers using triples will recover the 45 cylinders and accessory equipment on the four sleds left on the far side of the Rockpile Chamber.

A number of days will be taken to recover the equipment from the cave.

AIM OF 1983 EXPEDITION: It's only for Science

As well as a push dive the group intends to:

1) Survey Toad Hall.
2) Locate Toad Hall relative to the surface using R.D.F. (Rockpile Chamber has been completed).
3) Set up communications equipment at the surface lake, Rockpile Chamber and Toad Hall.
4) Take powerful flash equipment to photograph the event, including the push dives.
5) Construction of adequate lighting plant.
6) Use measured guide line to assist underwater survey on the push dive.
7) Plan a suitable diet for the camp at Toad Hall and have heating facilities for food if considered necessary.
8) Have a training programme prior to the event, to include support divers.
9) Consider whatever else has not been mentioned.

The length of Cocklebiddy Cave is unknown; the 1983 expedition may gain only a few metres if the passage is blocked by a rock collapse or it plunges in depth. It could surface into dry passage several kilometres in length or just continue as it has for the past 4 km. We are not diving for a world record; whilst the cave continues, efforts will be made to penetrate it. At present we are using compressed air SCUBA equipment; if Cocklebiddy Cave continues, research will evolve new technology for future expeditions, short cuts will not be taken at the expense of safety. The experience of past expeditions has helped develop SCUBA diving as a safe sport; with future expeditions it will become an even safer sport.

DISCUSSION

The 1982 trip had intended to have powered sleds but the reliability was found to be low and the duration of the batteries was short so that no sled was taken. If used, the divers could traverse more cave in a shorter time using less air when submerged. However, each diver would need to carry enough air to swim back without the sled and carrying the heavy sled and batteries over rockpiles after a dive would negate much of its value. The abandonment of so expensive a piece of equipment would be a financial disaster.

In the future, inert gas apparatus could be used in push dives but this is expensive and will need sponsorship. However, owners of these devices will normally not loan them to persons who have not been trained in their use for years. They might wish to supply the users as well as the gear.

Rebreathing apparatus uses oxygen which becomes toxic below 10m depth. Cocklebiddy requires dive depths of at least 15m in places. Also, if bouyancy control fails, a diver could go much deeper.

At this time we are considering going further on the same air by better bouyancy control, more streamlining and more efficient design of the sled e.g. with clamps.