ANDYSEZ 50
LAMPENFLORA PART 3

- Andy Spate

Well… the big five-OH I hear you cry! Well actually it isn't because I muddled up the numbering years ago – and your esteemed editor didn't pick up on it at the time so I expect he will want a few more from me…But let's blame him for poor editing back then – makes me feel a bit better! Or bitter?

I want to try and wrap up this subject in this ANDYSEZ and provide some recommendations – but I expect that we will still have new, perhaps square, wheels invented over the years to come.

INORGANIC CHEMICALS

The following table sums up the results of the various applications outlined in ANDYSEZ 49. Also included are a few results from various unpublished notes and reports (most supplied by Dave Smith). Unfortunately there are many ways of expressing concentrations of chemicals like hypochlorites so I (with the help of Marj Coggan) have attempted to standardise these to 'available chlorine'. But I am not guaranteeing anything!

Source	Chemical	Concentration[1]	Time[2]	Remarks
Williams	Ca hypo	1.2-2.4	20-30	
Harper	Na hypo	3	a while	
Clark	Na hypo	5	instantly	
Houshold	?Na hypo	2-3	?	
Spate – Yarrangobilly	Ca hypo	0.7-0.9	few hours	
Spate – Wellington	Na hypo	1.5	minutes	
Spate – Wellington	Ca hypo	4	hours	less effective
Aley and Aley	Na hypo	4.2-5.25	3-5 days	
Nelson	Na hypo	3.8-7.5	10	
Aley	Na hypo	5.25	-	
Coumartin	Formalin	4	?	didn't work
Coumartin	Formalin	30	?	didn't work
Faimon et al; Kubesova et al	Hydrogen peroxide	15	months?	
Houshold	Hydrogen peroxide	?	?	very strong needed
Grobbelaar	Hydrogen peroxide	200-500 mg/l	5-30	repeat as needed

Notes: [1]All % - for hypochlorite expressed as available chlorine.
[2]Minutes unless otherwise stated.
Only Aley & Aley, Faimon et al and Grobbelaar can be considered properly conducted experimental trials.

I do not have room or the energy to discuss all the trials and published material in detail but it does seem that sodium hypochlorite is the agent of choice – and concentrations less than Tom Aley's 5.25% can be effective. Many other inorganic agents have been tried with much less success. Faimon et al (2003) state that hypochlorite and peroxide solutions can acidify cave waters and some calcite solution can occur from this source. Ionic strength increases and 'redundant sodium and chloride ions' may also increase calcite solubility. These affects will be small.

ORGANIC CHEMICALS

In ANDYSEZ 48, Grant Gartrell suggested the use of organic herbicides such as Simazene.

Johnson (1979) trialled Diquat and Diuron at Waitomo without success. Chemical data sheets and other information on the web suggests that Diquat will not be effective against the sorts of plants we get in caves and Diuron might work against moss but may not have any effects on algae. Grobbelaar (2000) tried Atrazine and Simazene in Cango Caves. He states that Simazene was not suitable owing to acetone odours and that the "ethanol fumes [from Atrazine] could hardly be noted"! He goes on to say that "visually the treatment with either… was a disappointment since the green colouring… persisted". However, more sophisticated observations indicated "that the algae where photosynthetically inactive". But… soon to start up again?

Oosthuizen (no date) reported good results using butyl alcohol concentrate at Cango. Unfortunately there are no other details of strength etc. Web surfing has not revealed much about the use of butyl alcohol as an herbicide beyond the mention that it is used as such. It may be worth looking into this simple chemical – but it is toxic!

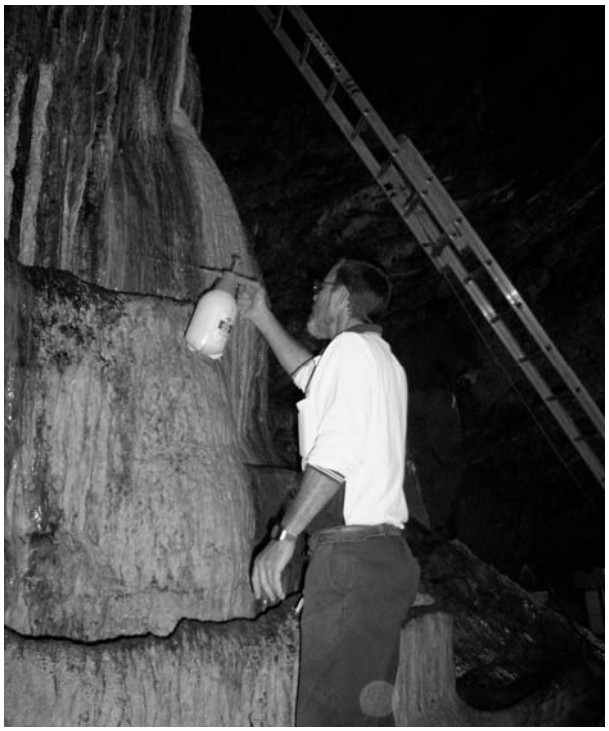
Incidently, Oosthuizen includes the following enigmatic statement:

> *Perhaps it is worth mentioning that a solution of butyl-alcohol and Epsom salts* [magnesium sulphate] *is producing positive results with the "rejuvenation" of the so-called "dead formations."*

What can this mean?

I have had a hunt round on the web and in various chemical catalogues and the only other chemical that might be worth trying is Dichlorophen – perhaps better known as the 2,4 D part of Agent Orange. Or perhaps not…

Bruce Day applying calcium hypochlorite in Cathedral Cave, Wellington. Photo Andy Spate



OH&S ISSUES
Anything that kills lampenflora may have nasty impacts on the cave manager who applies them. None of the chemicals discussed here are benign and should be handled with due care including the use of protective clothing, appropriate respirators and an understanding of any first aid procedures that could possible be required.

There is also the matter of OH&S for cave creepy crawlies – they will be affected but there seems to be little work published on this. See Ian Houshold's comments in ANDYSEZ 48. Faimon et al (2003) cite unpublished speleologist's reports of bats dying 'as a consequence of hypochlorite cleansing'.

Tom Aley's last word
I have misplaced the source of this comment of Tom's. It does, however, does seem to sum things up:

> *... First, it is not just algae that is responsible for the "green growth" in caves. It is algae, cyanobacteria, and mass protonema. Light intensity and duration are important controls. Green light would help, but we don't want caves to be green. It is not so much the color balance of the lights, but instead light intensity. The paper apparently recommends dilute hydrogen peroxide; 3% is mentioned. Nice idea, but it shows a lack of understanding of plant physiology. Plants have a light phase and a dark phase. The light phase is when the plant is photosynthesizing; the dark is when it is not. Plants make a number of changes when they go from one phase to the other. One of the chemicals created during this phase change is hydrogen peroxide. This does not damage the plants because the plants have peroxidase compounds which destroy the hydrogen peroxide. I have tested moss protonema and algae in caves with solutions of up to 30% hydrogen peroxide and these solutions do not oxidize or kill the plants. The most effective agent for removing exotic plants from cave surfaces is 5.25% sodium hypochlorite, normally sold as bleach. Don't dilute it; that only requires the use of more chemical. Don't use calcium hypochlorite. I don't know why people keep trying to re-invent square wheels without apparently even taking them for a test drive.*

My last word
Well, I couldn't let Tom have the last word, could I? I am sure that we haven't heard the last of this saga. There **is** room for further, well-conducted research into the role of more exotic chemicals but in the meantime it looks like the ongoing use of sodium hypochlorite is indicated. The fact that some have found the use of calcium hypochlorite effective indicates that it might be worth using if a) it works in your situation and b) you are worried about excess sodium ions in your cave environment.

But remember to think about your lights, their intensity and placement, and the substrate upon which they shine.

The next ANDYSEZ will have you shaking in your boots – the subject will surely resonate with members in seismically active environs.

Acknowledgments
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Faimon J, Stelcl J, Kubesova S and Zimak J 2003 Environmentally acceptable effect of hydrogen peroxide on cave "lamp-flora", calcite speleothems and limestones, *Environmental Pollution 122*:417-422 [and emails to and from Dr Svatava Kubesova]

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Oosthuizen H no date Blue-Green Algae in the Cango Cave System, unknown origin (supplied by Dave Smith)