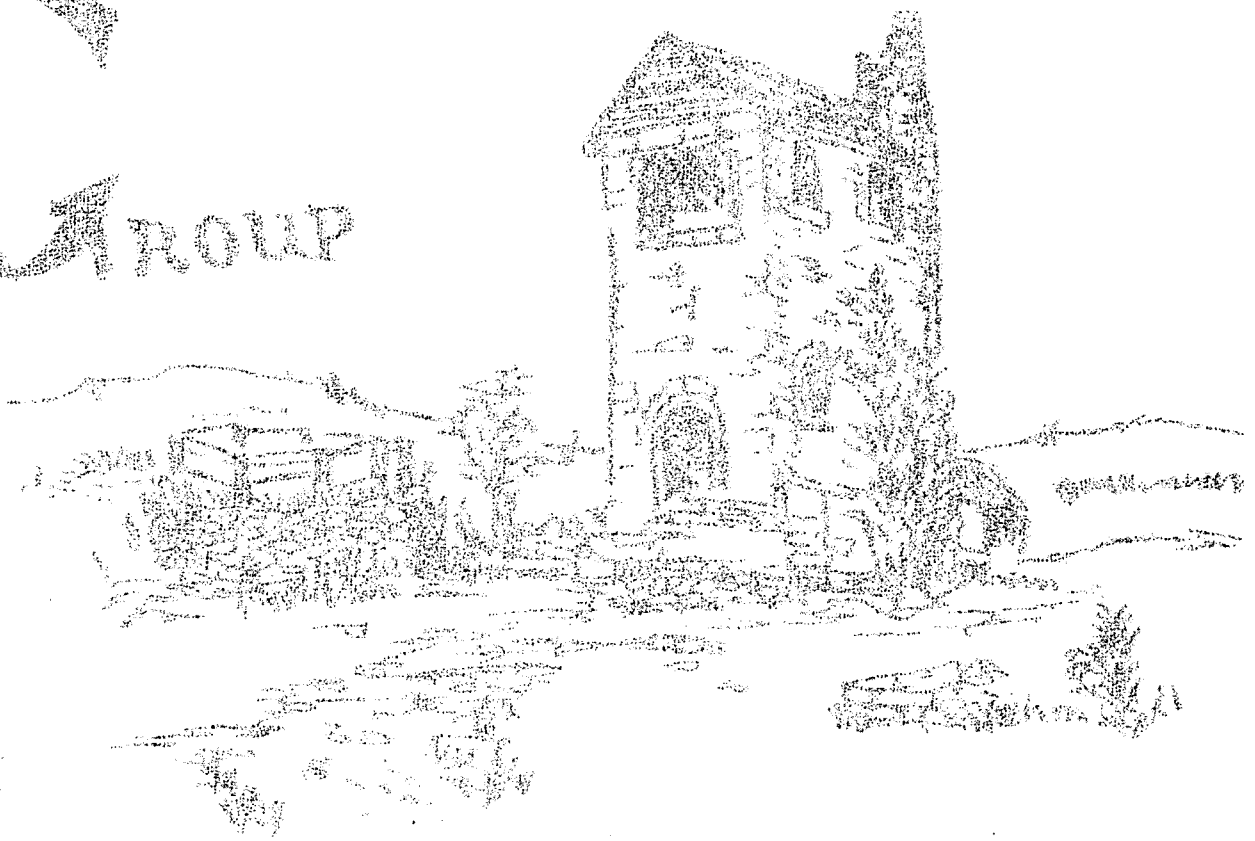
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PLYMOUTH CAMRA GROUP



NEWSLETTER & JOURNAL

PLYMOUTH CAVING GROUP

Newsletter and Journal

June, 1972 Number Forty-Four

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Editorial

As you will see, the greater part of this edition is taken up by Paul, our learned Secretary with aspirations, 's article on limestone solution, etc., Therefore I am seizing this chance as an exsuse not to ferret around for a subject for the editorial this month, quoting lack of space as a further excuse.

Some may feel that this article is too long to be included in its entirety, or in one piece, in the newsletter, but I believe that all club members will find it interesting, or, at least, informative. Dividing it into two parts would have spoiled the continuity.

I do feel, however, that the following letter to the Editor merits inclusion - I make no comments on it, my own views being well known to club members! -

Dear Editor,

Re; the Pridhamsleigh Cave Rescue Practice. May I congratulate Dr. O.C. Lloyd and Rescue Teams from Seale-Hayne College, D.S.S. and especially the nine members of the P.C.G. who turned up and did a very efficent job of rescuing me from the far side of the 'Deep Well'.

But, may I enquire as to the whereabouts of the other members of our club, who shoubd have, but did not turn up; and who, yet again, let the club down. I refer, of course, to our Kitleyites; to our members digging for 'master-caves' in other parts of Devon; to our members who were home in bed; to our members 'without transport'; and, of course, to our members who were just 'armchair cavers'.

You see, yet again we could have done a better job if we had more manpower; IT TOOK OVER THREE HOURS TO TRANSPORT ME FROM THE WELL TO THE ENTRANCE.

I know I'm not a married man with kids to look after; I know I don't have a quarry full of caves to manage; I also have my own dig in Devon; I also would have liked to stay in bed; there was plenty of transport this time.

We never have been a really enthusiastic club as a whole, but, for God's sake, just for once, let us have a decent turn-out of members on the next rescue practice. Let us have all these 'Experienced cavers' and 'miners' put their heads together at Afton Red Rift, where, I am told, the next practice is to be held. That is where the real problems of cave rescue appear in Devon and that is where YOU will be needed.

Brian Lewarne

Odd's End

Radford Cave is now closed. So do not do as Bob did, and travel all the way from Exeter with some of his mates (does he have them, too?), collect his gear from Thraddle, and then go to Radford Dip, change, spend half-an-hour lighting carbide lamps, get soaked walking through the freshly-rained-upon bushes, and then find they

Odd's End (cont.)

plonked the pipe on but forgot to open the gate first.

Seriously though, don't rush into things. The gate will be put on very soon, and aceess controlled.

Congratulations are due to one of our members -

Dr. David Michael Hobson, B.Sc., Ph.D.

who, as yku will see, is now to be referred to as

Doc the Hobbit

If you were not aware, the Wednesday evening Junior Club is going strong. The cry is - Will some-one come and help out in the taking of these lads caving. Help is also required on Wednesday evenings.

The club is now converting to Jumars (this is not offical policy, but a few revolutionaries feel they must be one up against these Northern twits, and have decided it is for them).

We were pleasantly surprised to have Oliver Lloyd in Devon once more recently. He hopes to visit us again, and is interested in out 10th. Birthday celebrations next year.

10th. Birthday, 1973. All members past and present will be welcome, plus relations, friends, and the pet budgie.

Personal

Will Steve, please, keep a close watch on Sir Robert McAlpine.

Correction, that should read Sir Alfred McAlpine. Sorry about that, Freddy, boy.

Fred McAlpine and his band of Navvies are, at present, tearing to shreds the field outside Prid, including the resurgence. They are also blasting more of the limestone out of the near end of the Ashburton by-pass, and may well expose something.

Bulleycleaves Quarry! Are we to permit this outrage! They are, at present, drilling for more blasting.

Limestone Solution, Precipitation and Cave Developement

Solution

Many cavers know that caves originate from the solution of limestone rock, but how many know exactly how this occurs and the affects this has on the caves' developement?

Carbon Dioxide is a gas which exists in the atmosphere in concentrations of about three parts in ten thousand. Small quantities of this gas will dissolve in water droplets during a rainstorm. The pH value of the water then drops from neutral 7 to as much as 4. This increase of acidity is a direct consequence of the formation of carbonic acid and the bicarbonate ion produced by a reaction shown by the following simplified equation:

$$1)\ CO_2 + H_2O \rightarrow H_2CO_3$$

The formation of this bicarbonate ion in solution is vitally important as it combines with the calcium radical in insoluble calcium carbonate to form the soluble calcium bicarbonate ion. This is often shown by the following simple, but highly inaccurate equation:

$$2)\ H_2CO_3 + CaCO_3 \rightleftharpoons Ca(HCO_3)_2$$

Organic-derived acids will give the same effect. These are found in waters draining peat deposits and can lower the pH value to 2.8. The pH value gives the concentration of H^+ ions in a solution. It can easily be seen that increased hydrogen ions correspond to increased bicarbonate ions (equation 1) and thus more solutional activity. The organic-originated acids have not got constant values and variable concentrations may be found in any one stream. It is, therefore, easier to deal only with atmospheric-derived carbonic acid, which gives a more constant value and takes place directly in the equilibrium pattern.

Thus the calcium carbonate has been converted into a soluble form, calcium bicarbonate, and it appears that the solutional cavity (i.e. cave) is well on the way to formation. But, as you may have gathered, the actual limestone solution is very complex; the processes only occurring when a delicate balance of chemicals are disrupted. Many things complicate the reactions. For a start, they are easily reversed. The reactions always move in directions of highest concentration, e.g. the bicarbonate readily loses its carbon dioxide content in an atmosphere where the gas content is a fraction more than in the solution, and the carbonate is precipitated as a calcite sinter deposit. It can be seen that the directions in which the reaction occurs depends upon the quantities and proportions of the constituents. An equilibrium must exist in which the quantity of bicarbonate ion equals that of the hydrogen ion. When this does not exist, the calcium bicarbonate will go into solution with the acidic water which is flowing down the ever-widening joints and bedding planes in the limestone.

Temperature changes do not appear to make any significant contribution to solutional rate. What does, however, are pressure effects by the hydraulic action of water in sumps and Mischungkorrosion effects by the mixing of equal volumed streams. Both of these increase aggressiveness capabilities.

The active cave systems of the Mendip Hills give excellent

/examples

/excellent
examples of temporary halts in solutional developement; the caves of the Charterhouse district especially. In August Hole/Longwood Swallet and Rhino Rift, the upper series consist of large canyon-type passages. As in the rest of the caves in this district, the passages seem to peter out at a certain depth. This is due to a halt in solutional activity of the stream, due to bicarbonate ion saturation. The passages peter out in a bed of limestone containing large quantities of silicified fossils and so it is evident that the saturated water has found this bed almost impossible to remove by solution. Perhaps larger passages exist below, enlarged by streams that have been re-juvinated by carbon dioxide absorption during almost total vadose action.

Swildons Hole Test Case

The origin of this Mendip cave was wholly due to solutional activity. The term 'Phreatic Developement' is often given to describe this, but it is a somewhat misleading statement. The precise start of cave formation is due to the gathering of thin films of water in the narrow fracture (joint and bedding planes) in a limestone mass. The water is constantly moving through the rock mass. It has to, if it is to enlarge by solution, the limestone, becasue a thin film of water will have very little solutional power before reaching saturation point. The degree to which these fracture planes are enlarged depends on certain determining factors. A limestone plateau showing karstic characteristics will give the ideal conditions:

a) Limestone mass with a large area directly in contact with the surface.
b) Direct entry of the rainwater into the limestone mass.
c) Percolation downwards simplified by well-jointed and bedded mass.
d) High vertical range of limestone mass enabling the build-up of water in joints to give the necessary hydraulic pressure to force the water through the lower reaches.
e) Underlying impervious layer enabling a local spring line to form.

Under these conditions a cave will rapidly form. Unless the water is continually replaced, the solution of the limestone will be a very slow process. (It can be seen that, under such conditions, there will be no general water table in the limestone mass. The head of water building up in the joint network will vary with an adjacent network, depending on surface weather conditions.) There could be water being forced through fracture planes a great distance below spring zone, and, so, the phreas zones cannot be specified at this stage.

Cave developement now begins on these wider planes. A small groundwater stream becomes localised, and starts to widen a specific channel. These localised channels take on the shape of tubes, with water generally flowing down dip tubes and up joint tubes in steeply dipping limestone (Mendip), and along bedding planes and down joint tubes in horizontally bedded limestone (Yorkshire). Total localisation of groundwater is the turning point of corrosion to corrasion. Ford (1968) states that Swildons was probably due to variations in spring height. This means, when the base level of the stream is lowered, the groundwater level also lowers, causing water-filled passages to become vadose type or even dry.

The model cave system consists of vadose, epiphreatic, phreatic and resurgence zones - in that order. Complexities of this pattern

/pattern
exist in most active stream caves, especially if the beds are dipping. Swildons I Streamway appears to be totally vadose at present, but, in fact, solutional activity by the stream does take place. This cannot be readily detected along the streamway because the stream is constantly replenished from absorption of carbon dioxide which is abundant in most cave atmospheres. This absorption takes place in conditions of excessive turbulence, e.g. rapids and waterfalls. From Sump I onwards, the streamway shows complications of this basic pattern.

Solutional activity by streams will occur in any zone of a cave, whether it be phreatic or vadose. Vadose solution is not the important erosive feature in a streamway, but corrasion is. Where corrasion and attrition ceases, total phreatic solution begins. Thus, the slower the water movement, the more the phreatic conditions. Vadose enlargement involves corrasion, cavitation, attrition and hydraulic action apart from the normal corrosion associated mainly with phreatic enlargement.

Going back to Swildons, the epiphreas conditions are to be found in the areas off ducks and passages leading up to the sumps. The 'Master Cave' type passage of Swildons II and IV is a mixture of epiphreatic constantly modified by vadose. Sumps contain slow moving water under hydraulic pressure, and, because there is no mechanical erosion to speak of, the enlargement process is phreatic.

The hardness, or calcium carbonate content of the water has been shown to increase down the 1500m. main streamway (from the Entrance to Sump XII), in Swildons Hole. There appears to be a marked decline in the rate of increase in the lower reaches. This shows that 'saturation point' of the bicarbonate ion in the stream is being reached. It is not saturation in the true sense of the word because the stream may be rejuvenated if carbon dioxide is absorbed through turbulent action. Carbon dioxide absorption will produce bicarbonate ions which will increase the stream's aggressiveness. Hydrogen ion content will likewise increase and so pH values will alter. As can be seen, pH values and hardness are closely related.

If accurate measurements of these variables could be taken simultaneously at equal distances along the streamway, the results would show some interesting things. A graph drawn, showing pH values or hardness against distance would not show a uniform rate of increase. Carbon dioxide absorption due to turbulent vadose conditions, increases solutional capacity. Increased solution under epiphreas and phreas conditions directly lowers its solutional capacity. It can be seen that consistent alterations of the basic pattern in a cave system (sump to vadose conditions down a streamway) will disrupt the graph curve.

Solutional activity could well occur in pulses. If this were so, it would make all correlation of the variable measurements impractical unless the frequency of these pulses could be determined. This would be even more impractical due to continual changes of frequency and, especially, amplitude, (highest concentrations of hardness and pH values) due to changing surface conditions, e.g. rainfall.

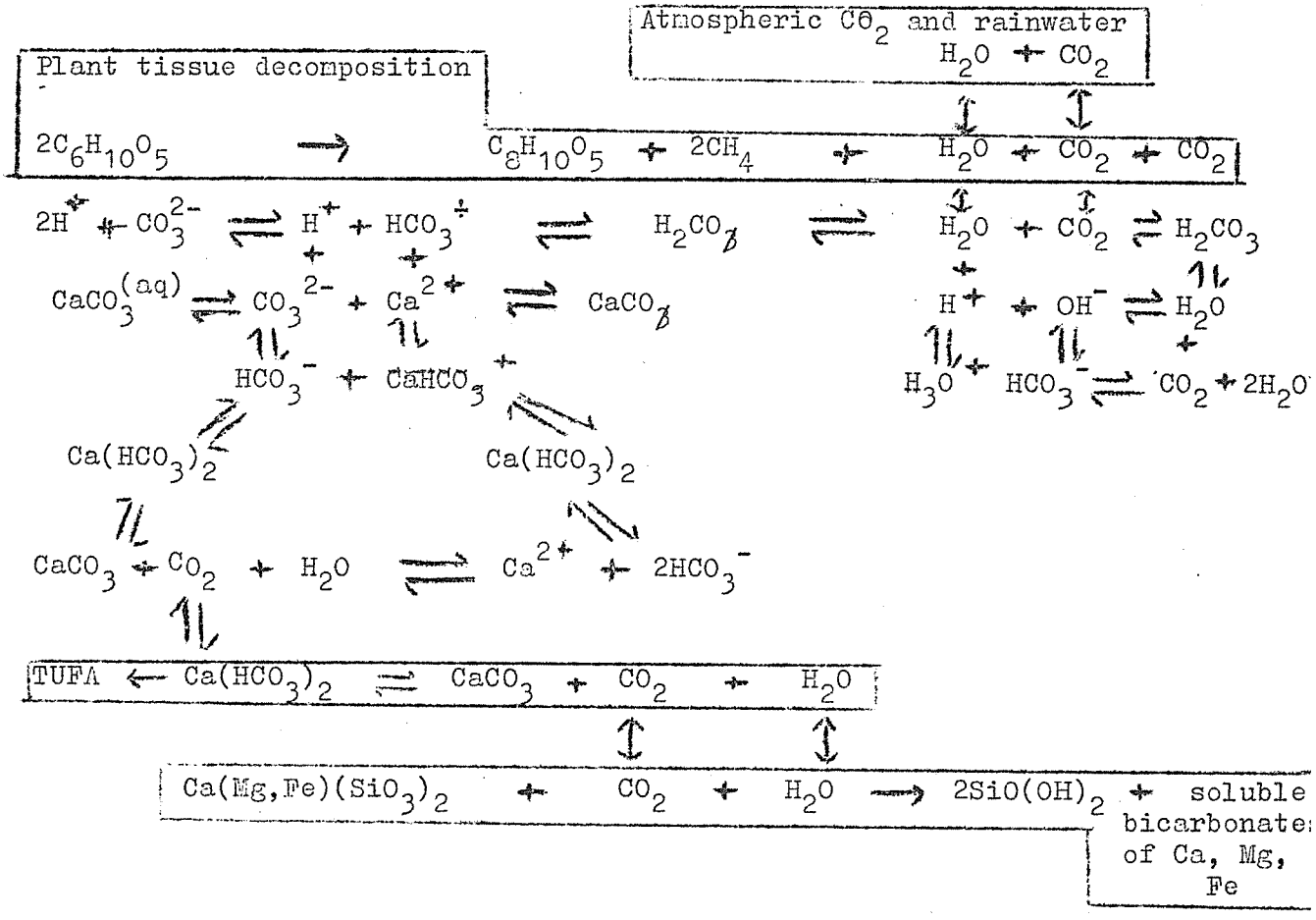
Limestone is an extremely complicated process, and although much work has been done on the subject, a lot remains to be done. Below is given an equilibrium pattern of calcium carbonate solution

/and precipitation

/solution
and precipitation. The equilibrium pattern is followed by a short explanation, but, first, I have given a list of all the compounds and ions that take part in the reaction.

CO_2	..... Carbon Dioxide	H^+	.....Hydrogen ion
H_2O	.....Water	H_3O^+	.....Hydroxonium ion
H_2CO_3	.....Carbonic Acid	Ca^{2+}	.....Calcium ion
$CaCO_3$	.....Calcium Carbonate	$CaHCO_3^+$	.....Calcium Bicarbonate ion
$CaCO_3(aq)$	.....Calcium Carbonate (aqueous)	OH^-	.....Hydroxide ion
$Ca(HCO_3)_2$	.....Calcium Bicarbonate	HCO_3^-	.....Bicarbonate ion
$Ca(Mg,Fe)(SiO_3)_2$	....Ferro-magnesian salt	CO_3^{2-}	.....Carbonate ion
$SiO(OH)_2$	.....SilicicAcid		

Equilibrium Pattern For the Solution and Precipitation of Calcium Carbonate



Solution action by a cave stream is neutral in respect of electrical charge, when in complete equilibrium. Thus, if there is no charge produced during the solution or precipitation of calcium carbonate, the whole reaction must take place simultaneously. The reactions always go in the directions of highest concentrations until an equilibrium is reached. It is interesting to notice that the whole reaction is reversible.

Carbon dioxide and water come from the atmosphere, plant tissue
/decomposition

/tissue
decompssition and run-off waters from peaty soils. A pattern occurs concerned with water ionisation, which gives the acidity (carbonic acid). The formation of a bicarbonate ion from the carbonic acid is the main unit of the equilibrium pattern.

Other reactions may occur under certain conditions. The formation of tufa, travertine, decomposition of ferro magnesian salts, formation of colloidal clay and many others are foreign to the main equilibrium pattern and have been shown in boxes to separate them. The majority of these reactions occur in only one direction and have the effect of increasing the streams' aggressiveness.

The calcium bicarbonate is unstable, so the carbon dioxide and water which formed the ion, may easily break loose to take place in the above reactions. A good example of this would be the presence of 'foreign chemicals' in the stream deposits (sands and silts) from a granitic originated stream. This stream sediment may contain feldspar minerals, which will decompose with the help of the bicarbonate ion, which is free in the stream.

Precipitation

Percolation water filtering down from the surface through joint and bedding planes will eventually reach saturation point in respect of bicarbonate content. A droplet of water will no longer be able to enlarge, by solution, the weakened planes in the limestone mass. The saturated droplet of water may now reach a chamber and a sudden drop in temperature on reaching the cool cave atmosphere will cause precipitation of calcite. At this same moment, carbon dioxide is lost by the water to the cave atmosphere. The cave atmosphere will have a carbon dioxide concentration slightly more than that of the water droplet. Water evaporation also causes precipitation and more of this occurs on the cavern floor than from a drip hanging from a stalactite (as is wrongly assumed).

The degree of calcium carbonate precipitation in the crystalline form of calcite in a cave is determined by three major controlling factors:
a) sudden decrease in temperature
b) carbon dioxide loss
c) water evaporation.
Rapid stal growth will occur if all three are fulfilled.

The quantity of water present during precipitation of calcareous sinter greatly influences the crystal lattice structure, which, in turn, directly influences the external shape and form of the calcit formation. Gravity exerts an important influence on the shape of roof formations, the droplet always following the steepest route downwards.

Rate of Calcite Growth

The age of dripstone formation is difficult to determine, but it can be calculated. There are, surprisingly, several ways of working out their ages.
1) Carbon 14 Dating

As has already been stated, carbon dioxide plays an important part in calcite precipitation; calcite is the crystalline form of calcium carbonate. Both contain the element carbon. A very small percentage of carbon is radioactive, having the isotype form of 14 instead of the normal 12. Radio-carbon, as this isotype is called,

/decays

/called,
decays at a known rate, giving off radiation. Every 5,600 years, carbon loses half its radioactivity and this is known as its half-life. After 28,000 years only one-thirty-second part of the radio-activity remains. Thus, by measuring the amount of radioactivity present in a dripstone formation, the age of the formation can be calculated. This method, although accurate, can only be used up to a time-span of 50,000 years.

2) Change in Thickness of a Stalagmite

This shows an alteration of the rate of supply of water. If a palaeoclimatological change is known, then a rough estimate of the age can be guessed.

3) Tectonic Movements

These movements may produce a crack in the formation or cause it to be broken off. This could show that the rate of precipitation is slow, especially if the formation has hardly been recemented by calcite.

4) Palaeontolical Deposits

Stalagmite growth sometimes occurs over bone deposits in a cave. It is possible to date these deposits fairly accurately and, therefore, the date from which the stal growth commenced is known.

5) Direct Measurement of Stal Growth Rate

This is a fairly new method and one which very few people know anything about. It concerns the direct calculation of stal growth. A formula has been worked out by detailed physio-chemical calculations. (H. .Frank 1965) When a method has been prepared to measure the rate of diffusion of carbon dioxide between air and water, this equation will be extremely accurate.

Classification of Cave Calcite

There are many kinds of cave formation. Some speak for themselves (phallactite??) but those listed below deserve special attention:

Stalactite	Stalagmite	Curtain
Straw	Eccentrics	Flowstone
Pool Formations (!!)		

Stalactite

There are two basic structures to these roof formations: those with crystal lattice structures and those with amorphous structures, consisting of concentric rings of calcite. Unless a fractured surface is exposed, the two cannot be easily distinguished in the cave environment. Depending on the amount of water present a crystal lattice will form. The whole situation is very complex, depending on the degree of bicarbonate saturation, carbon dioxide concentration, temperature, pressure and humidity. Cross-sections of stals often show conversion from concentric growth to highly crystalline growth, showing a cahnge of conditions within a cavern.

Stalagmite

A stalagmite shows similarity of growth to a stalactite. Calcite precipitation in a stal will be in the form of crystalline rhombic masses only when the cave's atmosphere is very humid. This will give the condition of a film of water over the whole surface of the formation allowing crystal growth on a very limited scale. Caves where water evaporation is the governing factor will give rise to concentric precipitation of calcite. Observations show that caverns

/completely

/caverns
completely cut off from the surface are decorated by crystalline stals (Lack of draughts will cause an extremely humid atmosphere). Another interesting observation (Franke 1965) has shown that stalagmite pillars formed from solutions of the same carbon dioxide concentrations are the same height but vary in width with the quantity of solution.

Curtain

A curtain is similar to the above example of a stalactite, the only difference being that the formation is not localised to one point and is formed in the characteristic sheets ahd flags - hence the name. A curtain forms on the steepest slopes of a roof.

Straws

The majority of straws consist of one calcite crystal, the growth of which being modified and impeded by lack of water in which to form a perfect crystallographic triginal lattice. The fact that this stalactite formation is one crystal, shows that there were conditions present which encouraged crystal lattice growth. This condition is to be found in a droplet of water which remains suspended at the end of a straw for a lengthy period of time. It is in this area of the straw where crystal growth occurs under conditions of total submergence in sturated water. Gravity causes the accumulation of the water at the end of the straw, and thus calcite is deposited only here. From this localised deposition, the straw formation is evolved. Straw growth only occurs along very thin fracture planes in the limestone bedrock. This hairline crack will result in a very slow accumulation of water at the end of the straw, giving the right condition for its growth. The straw deposit is cylindrical, the supply of water continually filling the tube and never drying up. A drop in the supply of water could cause the plugging of the central tube. This could cause the rupture of the side of the straw and the transformation of the straw to a stalactite. Surface tension plays an important part in the precipitation of calcite in the form of a ring, which slowly builds up into the tube.

Eccentrics

Of all the formations in a cave, these are the most interesting. They defy the simplest law of Nature, that of gravity. Why these fantastic and weird twisting shapes develope has been the cause of much discussion. They are to be found growing from a number of placesin a cave, such as calcite veins in the limestone rock, straws, flowstone, stalactites, stalagmites. It is likely that there are a number of forms, only one type growing under a certain condition. The theory of draughts may be excluded for all but a number of eccentrics. The draught which continues at a steady rate in one direction for many hundreds of years may result in a slanting roof formation. Many of these slanting formations have been found in the Rift Cave Extension, Higher Kiln Quarry, Buckfastleigh. Some are over 6ft. long and slant at least thirty degrees from the vertical. Erratics which grow from calcite veins are probably due, to a certain extent, to crystal twinning. The same applies, sometimes, to those found growing from flowstones and stalactites (helectites) and stalagmites (heligmites). Helectite growth from a straw is probably due to hydrostatic pressure.

Flowstone

This is a very general term, covering any calcite precipitation

/which is not

/precipitation
which is not isolated to one formation. The way in which the flowstone is deposited depends upon gravity and humidity. Where the cave atmosphere is highly humid, precipitation is caused by carbon dioxide loss, and thus the flowstone is very crystalline. A dry draught will cause precipitation by water evaporation and so the flowstone becomes amorphous calcium carbonate. These are the two extremes, most flowstone being a combination of them. Flowstone is often used to describe the 'organ-pipe' type of formation which looks like a frozen waterfall. The term also deals with all floor precipitation. Any irregularities in the cavern floor are rapidly filled by flowstone, or transformed into cave pools.

Cave Pools

This is the only media through which calcite crystals may be formed unimpeded by water/air boundaries. These calcite crystals are formed in saturated water (bicarbonate ion saturation) and so form mostly perfect prismatic Dogtooth or Nailhead crystals. Twinning will occur in some cases but, because the crystal is surrounded on all sides by the saturated water, the growth is normally uniform. When water is flowing into the pool a calcite dam slowly builds up at the outlet. Sometimes the water being held back by the calcite dam does not deepen at a rate faster than the crystal growth. The crystal now reaches the surface and the lattice structure is prevented from growing on the upper surface by the water/air boundary. A flat-topped crystal is formed and when calcite again builds up at the calcite dam and the water level rises, a hopper crystal of calcite is formed. This hopper crystal is normally triangular on the surface. A calcite skin is often formedon the surface of a pool of water. If the pool dries up, the skin collapses leaving flakes on the base of the pool basin. Progressive wet and dry conditions of the pool will cause the build-up of these flakes until the pool is finally filled up. This floor deposit is termed 'Corn-flakes' due to its remarkable similarity to the food counterpart.

Secondary Mineralization

Many formations within a cave cannot be attributed to direct calcite deposition. Secondary mineralization thus deals with non-calcic formations or mineralization due to calcite decomposition by chemical or biological means. A list of the more important is below:

Aragonite	Travertine	Tufa	Gypsum
Ochre formations	Mud formations	Clay formations	
Biological Mineral Deposits		Moonmilk	

Aragonite

This mineral has almost the same composition as calcite but also contains small percentages of metal-based minerals, such as mossottie (strontium), tarnowitzite (lead) and nicholsonite (zinc). Aragonite can be found as cave formations in the form of long, slender needle growths, stalactite growths, and crystal bunches. Calcite crystallises in the trigonal system and aragonite in the orthorhombic. Therefore, calcite and aragonite have remarkably different physical properties even though their chemical properties are almost the same. Why the crystal lattice structure should alter is not quite known. It has been suggested that aragonite growth occurs in warmer solutions than that by which calcite is precipitated. This is supported by caves in Mediterranean climates abounding in aragonite formations. Unfortunately Napp's Cave near Ilfracombe does not support this theory, the Devonshire climate

/being far too cold

/climate
being far too cold to produce the warm solutions necessary. Perhaps the aragonite growth occursd in bygone days when the English climate was milder.

Tufa/Travertine

A stratified mass of calcareous tufa and/or travertine may be deposited around the mouth of a resurgence. This is due to the deposition of calcium carbonate as a basic constituent of tufa by reactions between the bicarbonate ion in solution and the brackish water at the surface containing algae. It can also be attributed to a magnesian content from a dolomitic limestone bed which may be lying within the main limestone mass. This hard crust could encourage the build-up of silt at a vauclasian rising and thus raise the overall base-level of the lower cave system. Eventually the resurgence could move to a higher opening in the emergence zone.

Gypsum

This mineral is hydrated calcium sulphate and it crystallises in the monoclinic system. When in the amorphous state it is white and crumbly. The crystalline form of Selenite may sometimes occur in a water-filled clay pocket. Gypsum is normally associated with evapourite deposits and so it is difficult to understand why there should be gypsum in a cave. To find the answer one must turn to the leaching action of some bacteria. Thiobacteria living on sulphur oxidise dissolved sulphides to sulphate. Together with the calcium radical present in the cave water, this sulphate forms cacium sulphate. As this ionic compound forms in conditions of water submersion, a lattice structure is developed and crystals form.

Ochre

Patches of ochre are often found on cave walls. This is due, mainly, to chemical decomposition of iron carbonate from within the limestone bedrock. A great deal of secondary mineralization is due to mineral decompesition by the reducing properties of the hydrogen ion present in cave water. This is the case here. Ferrous bicarbonate is often found in solution in percolation water due to the high carbon dioxide content. A decrease of carbon dioxide at one point, due, say, to calcium carbonate precipitation, will cause the formation of ferruginous clays. The latter is the main type within a cave, pure ochre being quite rare in large quantities. In a mine, the presence of a large proportion of iron carbonate in the form of iron ores such as siderite, prompt the formation of large quantities of ochre, Precipitation is the same as in cave calcite in respect of formation shapes. Many a caver is aware of the orange/yellow/red ochre which abounds in many a Cornish mine adit. Limonite is often found in caves in both stalactite and earthy deposits. It is formed by autotrophic organisms, a process which will be described later. Limonite is the major constituent of the red ferruginous muds and clays, having been leached out of the limestone by ferro-bacterial action. Carbonic acid must be present in order for this to happen and the rate of decomposition is slowed to an equable rate by the presence of chlorides and sulphates.

Biological Sources of minerals

Subterranean life can be divided into two types:
a) Autorophic Organisms living in the deep zone of a cave and

/synthesizing

/a cave and
synthesizing their organic material from inorganic sources.
b) Heterotrophic Organisms living in the periphery zone and unable to synthesize food but live off organic material and autotrophes.

We are concerned with the autotrophes, as it is these that convert one mineral into another within the cave environment. These bacteria can live quite happily on sulphur or iron oxide. After a thousnad years or so, the undisturbed bacteria may produce enough converted material to be quite significant. I mention undisturbed, because the sudden presence of Heterotrophic organisms (brought in, perhaps, by a bat) can destroy the autotrophes and start up another process mentionned next.

Moonmilk

This is a white, powdery substance when dry and has the consistency of concentrated milk when saturated with water. Heterotrophic micro-organisms are responsible for this. Although unable to reproduce under non-perphery conditions, their decomposition sets off a chamm reaction with the calcite and organic matter resulting in fermentation and corrosion. The end product of this is moonmilk.

Paul Hatherley

It's a Cave-In

The club is going to earn its kepp for a day during the near future. We are running a sponsored caving trip. The theory is simple.

Each club member persuades someone to sponsor him (e.g. at 1p per circuit of Radford Cave).

So the target is at least twenty members to complete at least ten circuits each, during a period of six hours. We will have an independent observer, and coffee, at the surface, and each member will have to report to the surface on completing each circuit.

The date will be July 16th., on a Sunday, starting at 11a.m.

No excuses for non-attendance; this could raise a lot of money for the club. There is no limit to the number of sponsors you can have and, theorectically, no limit to the amount of money for each circuit, but, please, be sensible about this - do not earn so much that your sponsors refuse to pay.

Sponsorship forms are the last page of this newsletter.

There is no truth in the rumour that Dave Curry is appearing in the Frost programme next month. (Or in the Christmas edition of Dad's Army!

Meet Report

31.12.71 to 3.1.72

Mendip

Members Present:

Fish	Liz	Paul Hatherley	Pete Gibson
Brian Lewarne	Martin Cox	Andy Leftley	

Pete, Brian and myself left Plymouth for Mendip on the Friday morning (New Year's Eve). About four hours and three pubs later, we arrived on Mendip. There being a few hours to kill before opening time, we did a mini-tour of the area. As we were running out of things to do, we looked at Wookey Hole (cringe, cringe, from Brian). We did the long, round trip, i.e. in the right-hand door and out the left. A local caver gentleman, who must be very keen because he's built himself a hut right outside the cave, showed us around. He was rather a peculiar, old chap, who kept on muttering things about 'show caves and witches', but he certainly knew his way around.

We met Fish, Liz, Edul and Mart in the Hunters that evening. Much beverage was consumed (and thrown around). The New Year was duly 'seen in' in the tradition and much merriment made by all.

Saturday lunchtime saw us all in the Hunters again, furiously planning the afternoon's caving. Three o'clock that afternoon, we arrived at Swildons entrance. The short, round trip was our intention. The trip was enjoyed immensely by all. Pete, Bri and myself had not much experience out of Devon so this trip was quite an eye-opener. Much fun was had in the Double Troubles and associated ducks. The cleanliness and cooling affect of the main streamway was most welcome after the 'mud sloggin' of the Dry Way. Sump I pr oved uneventful after Fish and Paul had shown the tyros how it's done. It was most amusing, watching people surface on the far side of the sump. Pete broke surface with his chin-strap arounf his neck. Brian failed to recognize the end of the sump and continued right on, past us, finally surfacing in a most ungainly fashion (dig, dig!) The trip took over four hours, much longer than the locals would take, but, obviously, experience and speed go hand-in-hand.

Saturday evening was spent guzzling beer in the Hunters and generally being merry.

Half-past-seven on Sunday morning is a very silly time to do anything other than sleep. I thought I was still dreaming when, through the mist of unconsciousness, I heard Fish saying, very enthusiastically,
"Come on, then, boys, time to go caving! Longwood - August this morning (grunt, grunt, press-up, press-up!)"

By the time we had finished breakfast, obtained the key, skirted the landowner's house, it was about 9o'clock before we were descending the entrance of Longwood-August. The entrance was dry, but quite impressive. The initial descent seems to go on and on. There are three short pitches (10-20ft.) down to the streamway. The cave was considered by all to be 'very sporting', especially the entrance series. The only notable happening was when Pete and I managed to separate from the party and wandered off in the wrong direction. Our absence was noticed when the rest of the intrepid

/band

/intrepid
band were assembled at the bottom of the first pitch. Brian, realizing where we had probably gone, soon came to our aid. We came out at about 2o'clock and managed to scrounge a quick pint in the Hunters before closing time. Liz, Fish, Paul and Mart left for Plymouth that afternoon. Pete, Brian and myself spent the rest of the day touring the area and inspecting likely holes. We had a look at Cheddar Gorge and it took great persuasion to get Brian away from ferreting and generally grovelling in every likely-looking hole.

On Monday everything seemed to go wrong. Apart from minor catastrophies such as the car having a flat battery and being verbally assaulted by an irate landowner, the most notable event was in Hunters Hole. After an initial pitch of 15ft. there is a small squeeze which opens to a 75ft. ladder pitch. This pitch we laddered all in one. After much tossing of coins and pulling of straws (vandals!!), I eventually set off down the pitch, lifelined by Brian. Half way down, it was discovered that we only had a 50ft. lifeline, (much to my consternation). Having to abandon the exploration was disappointing; getting 80ft. of tackle jammed at the bottom of the pitch was paramount to disaster! Anyway, after about an hour's tugging and heaving, somewhat peculiar contortions and a bit of help from another caver, we managed to retrieve it.

We left Mendip at about 7o'clock and, after numerous episodes such as the car breaking down completely and the car lights failing on the fast lane of the Plympton by-pass, we arrived back in Plymouth at 2a.m. On reflection, it was agreed by all that it was a most enjoyable weekend. Funny people, cavers!

Andy Leftley

A Niphargus Glennie has been seen at Pengelly.

The club and its members wish a speedy recovery to W. Joint, of Buckfastleigh.

The club now has a fair stock of cells and spares for sale. C/o B. Lewarne, P.C.G., Virginia House, Palace St., Plymouth.

Rumour has it that the club house will be demolished in 1974. New premises should be forthcoming from the Corporation.

Don't forget t0 get sponsors for the Cave-In.

Tower Rift Cave - is now 12feet long, and further digging could prove a connection with Rift Cave.

Meet Report

Wed., 12th. May

Poltimore Mine

St. Lukes College Caving Club
Bob Cawthorne Jim Hudson Keith Heather Nigel Carter
Chris Chivers

We arrived at the site at about 2.30p.m., unloaded the cars and shanged. Our first objective was the adit, located by our Inorganic Chemistry Lecturer, Dr. Oliver, who told us it was still open. It was, for all of thirty foot, before being blocked by a roof fall.

This meant Plan No.2, The Shaft, so we lugged 180ft. of ladder and a 300ft. rope 250ft. up the hill to the shaft. The ladder was soon rigged and I set off, down first. It slopes down for the first 30ft., as it has fallen in slightly. At this point one had to duck around a railway line wedged across the shaft. Below this is a ledge, luckily on the opposite side to where we had hung the ladder, as there were a couple of dead sheep on it. Wedged across here were a number of railway lines, leaning across the shaft, and I had to push several to one side before I could weave my way past. Below this the shaft drops, grimly and vertically, and, on descending another 30ft. or so, it was quite obvious that the ladder didnot reach the bottom, as I could see it swinging quite freely, and could not see the bottom. Various contortions showed that there were no apparent levels off either side, so I returned to the surface.

Here Jim lifelined the others down for a look-see, and I went to investigate another shaft. This proved to be, if anything, deeper. We then looked about for adits and found another two, fallen in. On the other side of the river are more dumps with fair mineral specimens.

Whilst scratching about here, we found another 3 or 4 filled shafts and, finally, about 10 minutes before the time we had decided we must leave, we found another open shaft, in the middle of a huge, funnelled collar, some 60 or more feet across. This, on stone-testing, appeared to be less deep but we had to leave as Jim had to be back early. So, putting our lives in the driver's hands, we diced with death on our way back to Exeter after a fair day out.

Bob Cawthorne

Brixton Quarry - who said there were no caves there? Could it have been D. (SCHHH u ho hu) Scend? On the sloping quarry face, below the entrance to the quarry, two six-inch wide rifts descend for over 40ft. (This is an estimation by Paul Hatherley, our club exaggerator.) Iam told 40ft. at least, and stones, when dropped in, fall free for 12 seconds. Correction, this should read RATTLE for 12 seconds. This rapidly widens out to 2ft., and is well worth blasting. When Fish goes to the Police Station to reknew his licence (HINT). The quarry has an outlet for water somewhere. Could this be a master-cave? (Brackets, a Master Cave, sorry, D. Send.)

Meet Report
Ambassador College.
Venture Club Caving Trip

Sun., March 12th.

Radford Cave

Leaders: Steve Harris (P.C.G.) George Watson (P.C.G.)

Party:	Reg Vernon	Peter Moore	Garry Hill
Bill Stratton	Ron Taylor	Pam Harris	Alan Harley
Tony Jackson	Cedric Johnson	Derek Taylor	Tom Shattock
Peter London	Cynthia Down	Joy Calver	Lorna Elliot

The group met at the Civic Centre Car-park, which we left at 11.30a.m. in a convoy of four cars for Radford Cave. After a can of lager each, we changed at Radford Dip, locked the cars up and set off to the cave. Fourteen of the group had not been on a caving trip before but the turnout in gear was excellent. We downed at about 12.15p.m., after having a photo taken of the group outside the cave as a 'before' shot. The cave was quite dry, considering the recent rain.

My sister, Pam, took two photographs of the group coming down Boulder Slope, a really tremendous sight. Everybody negotiated the Trumpet with little trouble and the Puddle without getting wet. By one o'clock we were all at the Belfrey end of Red Corridor, where it was decided to have lunch and another can of lager. At 1.30p.m. everybody was satisfactorily boozed and noshed, so we tackled the squeeze to the Inner Series. As a point of interest, it is possible to get seventeen people into the Ox-Bow Chamber. The group then proceeded to the series adjacent to Wherry's Squeeze. Having left a candle burning in Red Corridor, those who wished to see it from Ron's Window could do so. Again those who wished to partake in a little climbing could do so under supervision with rope assistance if required. One or two of the group who had mountaineering experience were at home in this section.

Time had progressed to 3.30p.m.; the group had expressed wishes that they would like to surface at 4p.m., but it looked as though the deadline would be missed by hours.

The trip out of the Inner Series was headed by myself, followed by George Watson (to supervise the group through the squeeze), third and fourth came Gary and one of the Petes, who were to be taken out via Boulder Slope by myself. The reason being they were duty cooks and had to prepare a meal for all of us when we surfaced.

Upon my return to the Red Corridor, the last of the group were coming out of the Inner Series exit squeeze. Pam Harris took a group photograph in Red Corridor, then set off for the exit via Terminal Rift. Another two photographs of members scrambling over the Stile were taken, and two of people as they came through Connecting Squeeze. The final one was of members disappearing up the Gun Breech.

One problem arose and that was trying to get the food rucksack along the Gun Breech. After much struggling, it was finally achieved. Two or three asked if they could try a different way out and that was up the passage just above Jacob's Ladder, which connects

with the Gun Breech. It took one chap about ten minutes to negotiate the squeeze at the end of this passage with the aid of two, pushing and pulling. George Watson gave up this route because of the lack of footholds and handholds and had to come out via the original route. I was the last to surface and brought the time to approximately 6o'clock.

Back at Radford Dip, two photographs were taken of the group to give the 'after' shot. Then the food was dished out. I must say the cooks, Pete and Garry, made a fine dish; it was great.

Looking back over the trip, I must comment on behalf of the Venture Club on the amount of organization that must have gone into the trip; it was very pleasing to see. I don't think anything coubd be improved upon for the next trip.

All fifteen members of the Venture Club made it abundantly clear that they were very grateful for the 'terrific experience' they had encountered and the new sport they had discovered.

My grateful thanks to George Watson, to all members of the Venture Club, and to those who were indirectly involved for the success of the whole trip. I think we are all looking forward to the next time.

Steve Harris

FOOTNOTE
I was appalled to see that certain familiar features have disappeared or have been damaged during the last 18 months since I was last in this cave. It is obvious that the planned gate for the entrance is urgently needed.

S.H.

Kitley Bang Cave - a new entrance blasted out of the cliff face at Western Torrs Quarry, some 40ft. below and to the right of SnailsCave. Length - 5ft. into a widening choke.

Creep Caves - The end of the longest creep cave, previously known to connect to daylight, has been discovered while digging the floor out around the large boss outside in the quarry. The end is in the side of the cave there, which still requires digging, and will probably be called Kitley Boss Cave. The excavation there has exposed many rimstone pools in the floor of the quarry.

Yealmpton Folley Cave - An entrance found in the right-hand side of the entrance to Yealmpton Cave, in Round's Nest Quarry. This was dug out, and found to be 12ft. long, ending in a narrow slit.

PLYMOUTH CAVING GROUP - Sponsored Cave-in

The Plymouth Caving Group are holding a sponsored cave-in around the Radford Cave at Plymstock in order to raise funds.

The money will be used to buy new tackle - principally for cave rescue and to maintain an economic caving service for the youth of Plymouth and South Devon.

Each participant will be expected to complete circuits of the cave including climbs, descents, rifts, crawls and squeezes - 1000 feet in all.

We are inviting sponsorship at 1p or 2p per circuit and stress that this is not a race and that all safety standards will be met.

Please give your support.

Sponsor	Address	Amount per circuit

This certifies that ..... has completed

..... circuits of Radford Cave in the sponsored Cave-in.

Signed .....