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Number 5 January 1968

E D I T O R I A L

The last few months have seen cavers and farmers mourning their losses together. The recent epidemic of foot and mouth disease has almost completely curtailed caving in this country for the time being. In fact, members of I.C.C.C. have eloped again to the Dent de Crolles region in France since meets to Yorkshire and Ireland both had to be cancelled. It is hoped that their activities will be recorded in the next issue.

In spite of this, we have gone ahead with the production of this number. Surprisingly it is the largest one that we have yet published containing as main features a scientific exposition on helectites, and an article (inc. survey) on Ogof Ffynnon Ddu.

Further copies of the journal may be obtained from R. C. Lethbridge, Zoology Department, Imperial College, Prince Consort Road, London, S.W.7., at 1s. 6d. inc. p. and p., or 5s. 6d. for one year's subscription. This address will change in July 1968 and will club librarians please note this change from last year's. Copies of the Tackle List Supplement (Yorkshire Potholes, 1s. 3d. inc. p. and p.) are still available from the Hon. Sec. I.C. Caving Club, Imperial College Union, Prince Consort Road, London, S.W.7.

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SOME OBSERVATIONS ON HELECTITES

Introduction

Helectites, despite their relatively small size, are amongst the most bizarre and fascinating of all cave formations. Over the years a good many cavers have been driven to speculate on their formation, and some of the ideas suggested are a good deal more outlandish than the formations themselves.

In fact, helectite formation is not at all the mystery which many would have us believe, and many of the more recent students of the subject seem to have overlooked all the earlier work on the subject when producing their own novel hypotheses.

In this article, therefore, it is proposed to revies very briefly the literature on the subject, to show that helectites may be classified into different types, and to develop further some of the arguments about their mode of formation.

Previous Work

Most of the early work on helectites seems to have been done in the U.S.A. towards the end of the 19th Century. Some really intriguing suggestions were put forward, such as lateral outgrwuths from cave fungus (Hovey 1886), and even by deposition of calcite along the filaments of a cave spider's web (C. S. Dolley 1886). In 1896 Blatchely suggested that the irregular formations were due to varying currents of air, which, he suggested would force tiny drops of water on the formation first from one side and then to another, and thus determine the direction and growth. While air currents alone arenot responsible for helectites, we will see their significance later on. Another school of thought started in 1906, when F. S. Greene put forward the idea that the irregularly curved forms were due to the twinning tendencies of calcite; and similar hypotheses reappear from time to time in different shapes and forms in several later papers. Lubeck (1929) and McGill (1933) suggested that impurities of one sort or another might be responsible for promoting helectite growth.

There is a fairly good account of recent work in 'British Caving"so this will be very briefly summarised here. Prinz and Glory (1935) considered that liquid percolating through very fine openings leading from a central channel might be responsible, while several other authors state that breakout through the sides of a straw, after it had become sealed by one means or another, caused the growth of irregular forms, (e.g. Corbel 1942, Townsend 1967). Interference by mud particles covering the calcite surface (Trombe 1949) and other minerals such as gypsum (Holden 1938, Foster 1950) interfering with normal growth have also been proposed.

There have also been several hypotheses bases on crystallographic properties, for example those of Moore (1959) and Schofield (1966).

One paper however, is of fundamental importance to the subject, and seems to have been completely overlooked by modern authors. This is L. C. Huff's (1940) paper on "Artificial Helectites and Gypsum Flowers", in which he describes how he was able to produce these formations in the laboratory, using chemicals such as potassium dichromate and sodium thiosulphate. His very simple apparatus is illustrated in Fig. 2, and consists essentially of a porous cork through which is passed a very slow, regular flow of solution.

Several important points appear from his work:-

(1) The flow-rate of solution in helectite formation is extremely slow; slow enough for evaporation to prevent the accumulation of drops of liquid. As soon as flow becomes just enough for drops to appear, a "straw" type of formation starts to grow.

(2) Growth takes place by addition of material at the tip, rather than the base of the formation. This is the reverse of the situation in formations such as gypsum flowers, which grow by addition at the root, in exactly the same way as feathery growths of aluminium oxide grow on a sheet of aluminium which has been "wetted" by mercury.

(3) The geometry of any particular helectite is the result of the chance orientation of the crystals at its growing tip, and is not dependant on any other medium such as fungus or spider's web for support.

(4) A significant hydrostatic head of solution was required in his apparatus to promote helectite growth. Simple capillarity was not sufficient.

Classification

Before going on to discuss Huff's work and its application to natural formation it might be best to show that helectites can be grouped into different types, and therefore that there is no unique hypothesis to account for their formation. When first thinking about this article, I set up a 3-fold classification of helectite shapes which I later discovered was to all intents and purposes that put forward by Géze et al (1956). This emphasises I think that this is a "natural" classification which should be capable of general application.

Type I "Deviant Straws" These are helectites which develop from a simple straw, see Fig. I and, for a photograph "British Caving" Plate XI. They consist of a casing of relatively coarse new calcite around the straw tube, which is almost always eccentrically placed. Serial sections across such formations show that the new calcite is often radially arranged near the straw, but forms a randomly orientated mass of crystals further away. Concentric growth zones are often present, indicating the shape of the formation during succesive stages in its growth. Fig. 2.

Type 2 "Vermiform" This is a very common and distinctive type, consisting of relatively thick, wormlike or fingerlike forms growing out roughly horizontally, either from the rock wall of the cave, or from a stalactite. See Fig I and for photos, "British Caving" Plates XXXVI and XXXVIII. Almost always they show an upward curve, and generally have rather smooth outlines, although there is of course an enormous range of possible shapes. Internally, they usually consist of relatively fine-grained calcite, sometimes with a suggestion of radial arrangement. I have not found any specimens exhibiting growth zoning, nor an internal canal.

Type 3 "Filiform" Very long, thin erratic helectites, which have a significantly different length: thickness ratio from that of type 2 forms. Type 3 formations are probably the most erratic of all cave formations - it would not impress me to find a knot tied in one of these ! See Fig. I, and photo in "British Caving" Plate XXXVII. I have no data on the internal structures of these forms.

Although this is a strictly a morphological rather than a genetic classification, I hope it will become apparant in the succeeding paragraphs that it does also have some genetic significance.

Discussion on Origin

With this classification in mind, we can now examine the conclusions reached by Huff in his laboratory studies, and see to what extent they hold good for natural helectites in their underground environment.

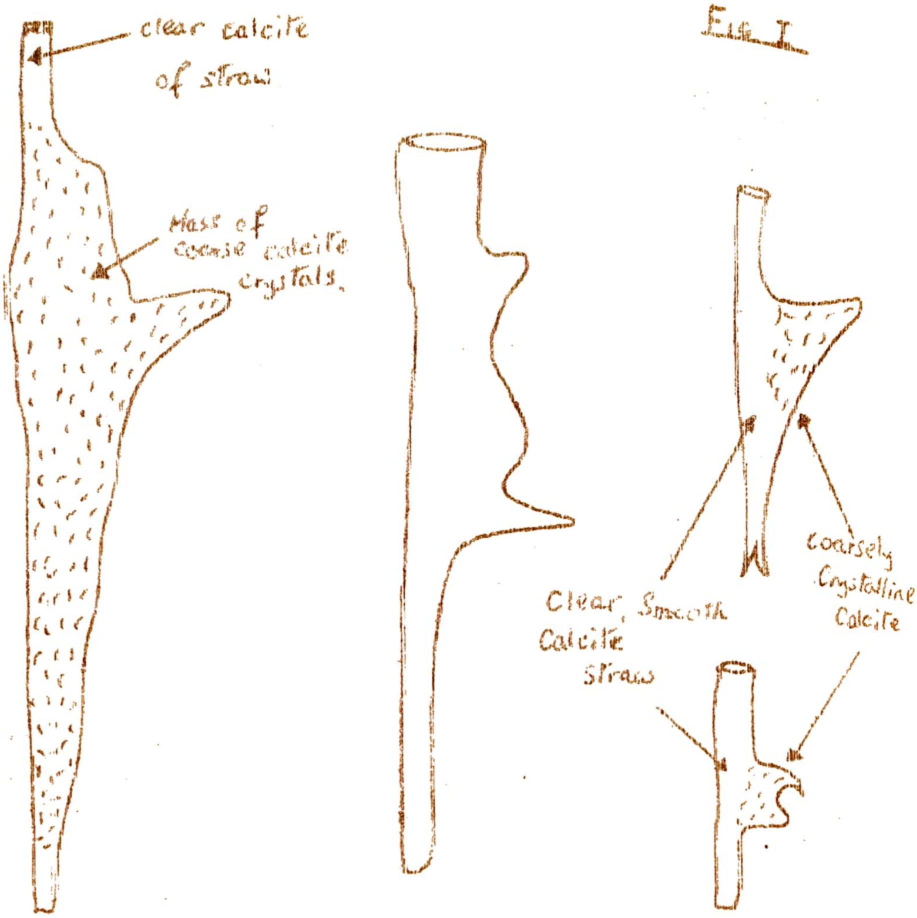
(i) Slow flow rate of solution. This is easily confirmed by observation of the sort of environment where we find helectites - they are most characteristic of the large, dry airy upper series of cave systems, where there is a noticable lack of free water. It should be a matter of common observation that Type 2 helectites are very often found growing in lines on the cave wall; the line following some particular geological control, such as bedding or jointing, along which a slow ooze of solution can take place. If local conditions change to an extent that drops of water can accumulate, growth of straws will start immediately.

The slow flow rate of solution may also have something to do with the apparently anomolous development of large numbers of helectites in particular localities all pointing in the same direction.

TYPE 1

"DEVIANT STRAWS"

Fig I



TYPE 2

"VERMIFORM"

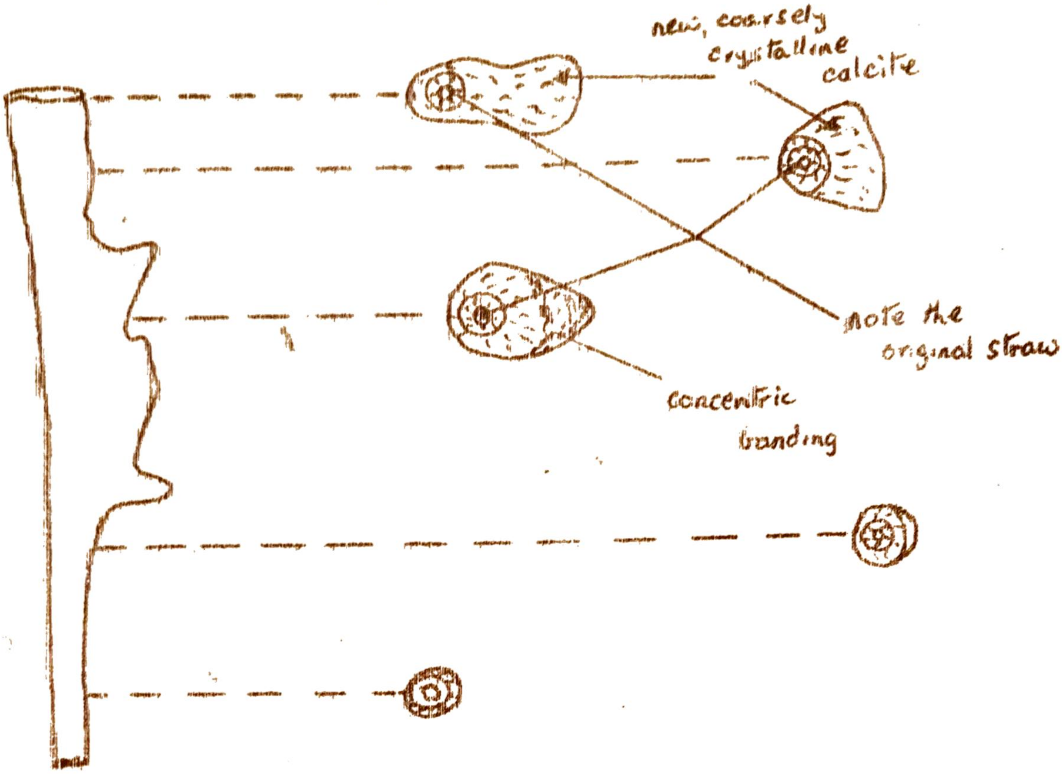
Simple straw developing at end.

TYPE 3

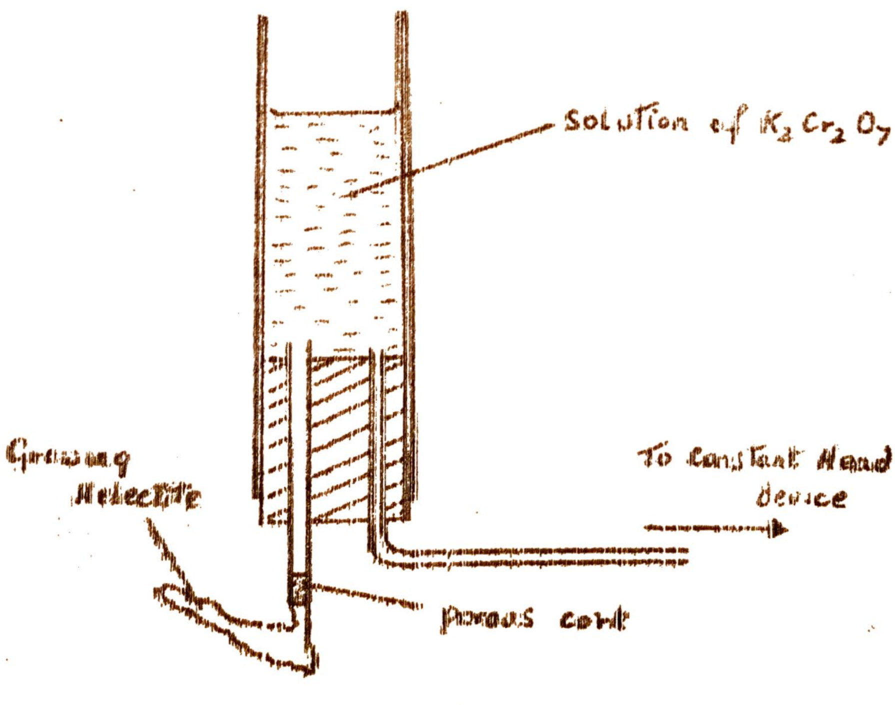
"FILIFORM"

All Sketches Life-Size

FIG 2



SERIAL SECTIONS THROUGH A TYPE I HELICTITE.



HUFF'S APPARATUS.

One obvious hypothesis advanced to account for this was the action of currents of air, but this was countered by the observation that perfectly vertical straws may be seen growing in the howling draught of some mine ventilation systems.

Such straws, however, are extremely fast growing (relatively) and it seems to me that with a much reduced rate of solution flow the effect of draughts would be more significant - unless this is the case, it is going to be very hard to explain observations such as one recently reported from O.F.D. (South Wales Caving Club Newsletter) of hundreds of helectites all pointing in one direction, in a passage notable for its draught.

(ii) Growth at the base. If helectites did form by addition at base, one would expect the resulting formation to be a single crystallographic unit, as in the case of gypsum flowers. No natural helectites fit this bill. There is a slight possibility that such a mechanism might play a part in the formation of Type 3's, to explain their excessive length, but I have no data on this subject.

However, it seems to me that "surface" growth rather than "tip" growth would be a better description of the growth mechanism of Types 1 and 2 - Type 1's for example, very often show regular growth zones which suggest that addition of new material took place all over the surface simultaneously, rather than at any particular extremity. The mechanism of this process will be considered shortly.

(iii) The shape of any particular helectite is a result of the chance orientation of the crystals in the growth zone. This seems to me to be amply demonstrated by Huff's practical work, and it would be difficult to elaborate on it without degressing too deep into the realms of crystallography. It may be worth pointing out, however, that the smooth surface typical of many helectites is merely a result of crystallization taking place in and under the very thin film of solution on the surface of the formation. Close examination of the surface under a microscope will often reveal that its apparently smooth surface is in fact made up of many tiny crystal facets.

(iv) A significant hydrostatic head was required to promote helectite growth in laboratory conditions. This, I think, may be due to the inevitable inadequacies of laboratory work in this field - you cannot compress time, even in today's laboratories. I suggest that natural solutions evaporating at geologically realistic rates, many times slower than in Huff's laboratories, would not require such a hydrostatic head, and that capillary flow would be quite adequate to keep the growing formation supplied with fresh solution.

Let us now examine the various types of helectites, and see if a mode of origin can be ascribed to each, bearing in mind the various conditions outlined above.

Type 1

These start off as normal straws, which later on become erratic. The most likely explanation of this change in growth style seems to me to be a reduction in the rate of flow of solution, due perhaps to an exceptionally dry period of surface rainfall. This would cause the liquid held in the straw-tube to become static, and to crystalize out crystals of calcite within the tube itself which would thus become rapidly blocked. Many other mechanisms for blockages in straws have been suggested, such as grains of sand being worked into the tube or growth of gypsum crystals and so on, and these might have some relevance in particular cases. On the whole however, there is little to suggest that any other material than calcite is involved.

When the straw becomes blocked the slow flow of solution into the formation will not stop completely, but the solution will now move gradually through the walls of the straw, by capill ary flow along the intergranular boundaries of the calcite crystals This might be localised initially in places when crystallization of calc te within the straw tube has caused rupture and subsequent re-crystallization of the tube-walls. The solution reaching the surface will evaporate, and deposit new calcite, wh will gradually build up to produce the thick jacket or casing of new calcite so often seen in this type of helectite.

Whenever the capill ary flow happens to be particularly fast depositions will be more rapi and a "nose" or protuberance will be developed. Deposition by this mechanism over a large surface area will lead to the production of large irregular crystals, and no special radial arrangement is necessary.

Any sceptics who doubt the feasibility of capill ary flow along the grain-boundaries in helectites should be convinced by the following very simple experiment:- Obtain some helectite material (don't knock it off from a cave!) and place one end of the formation in some coloured ink, and come back in some minutes. Some specimens give particularly spectacular results, indicating a flow of ink through the helectites of the order of 1 inch per hour.

Type 2

These often appear superficially to be merely extended forms of Type 1, and this may be the case in some examples, but on the whole I think there is some difference in their origin, particularly since they are noticeably finer grained than Type 1, and do show some sort of radial structures in some cases.

Presumably Type 2 helectites start life with a slow ooze of liquid down the surface of the cave wall .

Whenever there is an irregularity, such as a slight hump on the surface, the liquid film will tend to thicken, and if enough liquid is present, a droplet will accumulate. If the rate of evaporation is fast enough, or the flow rate slow enough, a drop will not form, and deposition of calcite will take place. Initially, This will form a smooth film over the rock-surface, but gradually thicker deposits will accumulate at points where the liquid film is thickest, and thus an embryonic Type 2 is born. How these develop into helectites miles long is a much more difficult problem, but I think that there are three possible methods by which the formation is kept supplied with fresh solution to extend itself.

(i) Simple capill ary flow through the formation.

(ii) Development, during the embryonic stages of a radial structure, which propogates itself, and aids flow by the development of more and better intergranular passages.

(iii) Persistance of a surface film of liquid. This hypothesis relies on the surface tension properties of water, which may make it possible for a continuous thin film of water to be maintained over the surface of the formation. This would explain the rather smooth rounded "fingers" common to this type. In is probable that a combination of all these methods is more likely, rather than any one by itself.

Type 3

Not having examined closely any material of this type, I leave the question of mode of growth open, and look forward to hearing some reader's ideas on the subject. There is plenty of scope for imagination.

Conclusions

In this article, I hope I have been able to show that helectites are not entirely enigmatic, and that even the most brief examination reveals that their formation is controlled by perfectly ordinary straightforward physical principles.

There is, of course, still a great deal of work to be done on the subject, and I suggest that interested cavers should look more carefully at helectites; make note of what types grow where, what formations they are associated with, and the actual environment in which particular types are found. Does a particular type grow on walls or other statactites? Do helectites grow on curtain formations and if not, why not?

There are many such questions to answer, and I hope that there will soon be some new observations to answer at least some of them. I look forward to hearing them.

P. W. Francis

Selected References

Standard

British Caving 1953 Ed. C. H. D. Cullingford Pp. 96-98
(Contains a good guide to literature after 1930.)

Haff L.C. 1940 Journal of Geology Vol LVIII Pp. 641-59.
(A good summary of the early literature)

Recent

J. I. Townsend Speleologist Sept. 1965
J. N. S. Schofield Speologist April 1966

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O.F.D. II

This superb system was recently opened to non-divers when a route was traced from the OFD II streamway through a series of large dry passages and the 'final' boulder choke of Cwm Dwr, several months ago. SWCC members explored the inlets along the main streamway and were well rewarded for their efforts with the discovery of the Marble Bathroom Series and the Clay Series - leading to OFD III (less spectacular than II, which is estimated to be about a mile long). Reports of the original explorations can be read in the SWCC journals, although other clubs, mainly local, have helped in the explorations.

I.C.C.C. first visited the complex series on October 28th - 29th and on the Saturday two parties had a most enjoyable trip down O.F.D. I, the rest going down Cwm Dwr and the Top Entrance (which had been blasted open a few weeks before). On the Sunday an exchange was made between the two entrances, while less energetic members avoided the flooded streamway and sweated round the clay series, which is liberally decorated with mud, and calcite formations. Impressed by these assorted subterranean boggle-pieces three of us returned the following weekend; our object was to photograph and survey from the Top Entrance to the streamway, for twp reasons: Firstly, so that we could find out where we were; secondly, the Series is an excellent place to practice surveying technique. It was not intended to survey the whole system as this is being done by SWCC members.

On the following Saturday, therefore, three of us surveyed from the Top Entrance down to Trident Chamber and along Trident Passage to the Wedding Cake. The survey was to C.R.G. 4, using an ex-Army prismatic compass, reading to one degree, and a 100' steel tape. Inclined sights were not necessary, and no vertical survey was attempted. The only two closed traverses (in the Arete Chamber area) of about 600' and 1000' both closed with an error of less than 0.25%. The survey was drawn up at 50 feet to the inch and reduced photographically for publication.

The following day we grovelled around in Cwm Dwr, returning a fortnight later to finish the survey, when the party was rather predominantly U.C.L.S.S. As the weather was dry (even if it did snow overnight !) two of us had an excellent 12 hour drip to the Far North in Dan-yr-Ogof, the party of six being led by Alan Coase. The next day we had a late start as we had to repair out wet suits etc. and so did not have time to complete the survey from Trident to the streamway (as foot and mouth restrictions prevented anyone from using the Top Entrance), but this was not considered really necessary anyway.

The following description is an account of the trip from Cwm Dwr to the Top Entrance, which, when foot and mouth restrictions are lifted, may be opened to cavers outside the S.W.C.C.; it may become a "personal" S.W.C.C. or rescue entrance. In view of the protection this would provide for the formations this is a justifiable attitude, even if it does at first appear selfish, for even in the brief time the entrance has been open a considerable amount of damage has been done by the large number of parties (many of which consisted of inexperienced cavers) wandering around without suitable leaders. As no firm decision appeared to have been taken up to the time of our last visit, anyone wishing to know the situation should write to John Osborne (S.W.C.C. Sec.). In any case, S.W.C.C. control access.

Anyone thinking of exploring the Clay Series from Cwm Dwr must therefore remember that the following trip may well have to be reversed, and the trip time, which depends on experience, number in the party and knowledge of the cave, would then take a minimum of eight hours.

Entering the sewer piper pitch to Cwm Dwr (a 25' ladder will be found useful on the way out and a ladder is available from the SWCC hut, where rescue times should be left) and dropping down the rift below it, we followed the stream, which entered further on, until it entered a high narrow rift; at this point we shuffled off into a sandy passage which degenerated in style to an abyssmal grovel. The crawl was followed until we reached a boulder choke, just before which a stream entered. A brief thrutch upwards led into a large airy passage (Yama); we wandered off to the left, until the floor dropped down into a stream passage crossing the Yama. We continued straight on at this cross-roads, climbing up the boulder slope opposite; a second crossroads soon after was similarly ignored, and shortly afterwards the terminal boulder choke was seen. Examining the right-hand wall just before this, a tatty piece of flex was soon sneaking into a low crawl; this was followed through the boulder choke (quite safe by comparison with many others in D.Y.O. and O.F.D.) into a high gallery which rambled away to the left of the crawl exit. Dodging around the large blocks littering the floor we bore right at the end of this chamber, taking a slightly descending passage instead of the moreobvious ascending sandy passage.

There are several routes to the streamway from this area, and the following description is not of a route I used (which even with a SWCC member in the party acting as guide, was different when leaving from that used when entering).

The above passage is followed t.. a cross-roads, and the left hand branch is taken; this involves easy traversing along a rift passage which has a boulder choke wedged in it. After climbing down from this, the left-hand passage is taken at the following fork (a cairn being in front of the other passage to the right) and a sandy tube followed to the next junction. Following the passage to the right of the cairn, you will reach a third cairn at the junction between this sand-floored passage and a large tunnel, running at right angles to it, with a mass of boulders forming the floor. Turning to the right, you will find holes in the floor leading down to the stream, their depths varying from 40 to 10 feet, this one being near the left-hand wall a few yards from the junction.

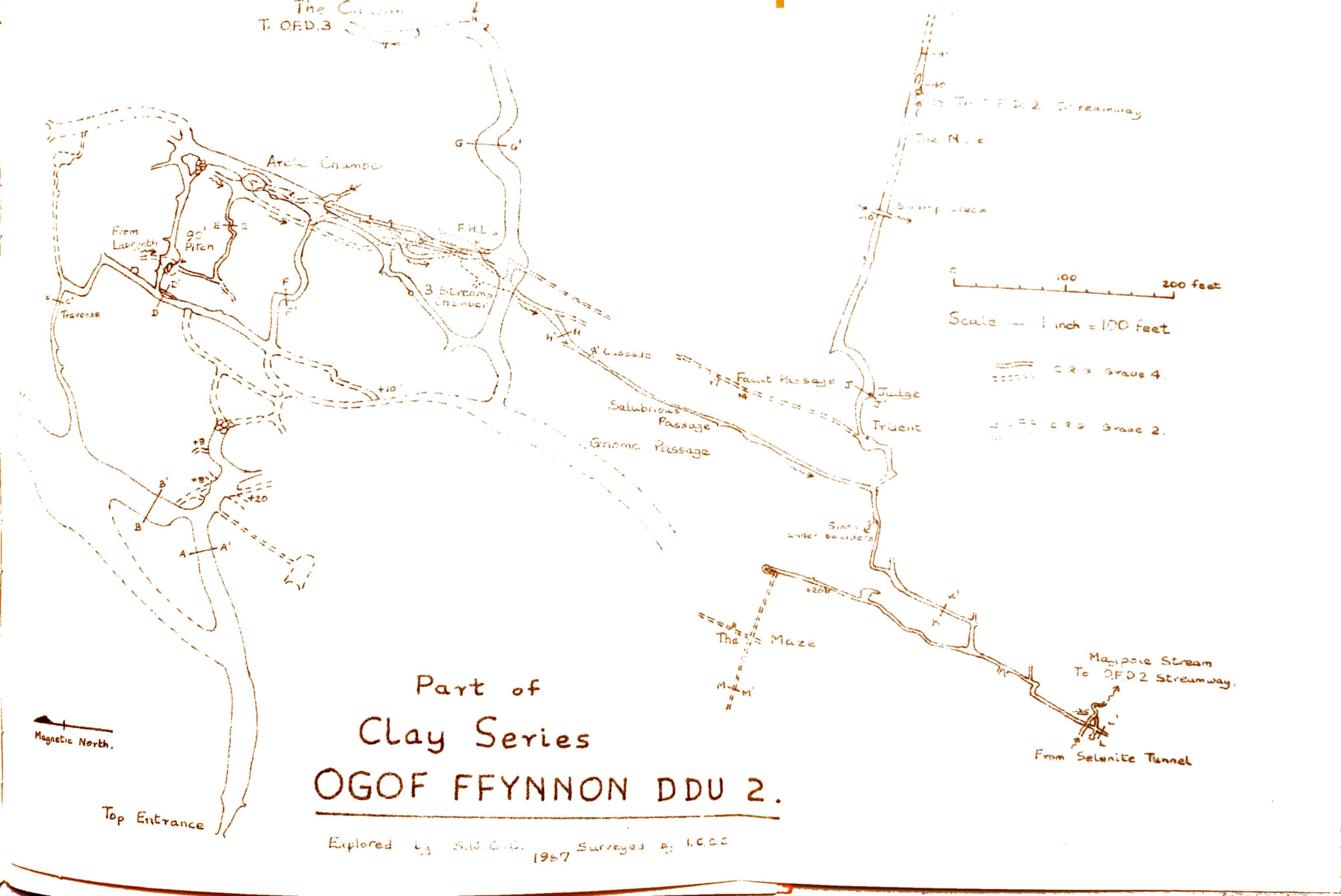
The hole drops into the Cwm Dwr stream, which you follow down, until a waterfall is reached; this ay be climbed; alternatively an oxbow leads off on the right, providing a bypass. The winding streamway is followed until a crawl about 3' high, 5'wide, with a boulder floor, is seen leading to the main streamway on the left. Downstream from this leads to a sump.

The streamway made a refreshing change from the dry tubes and tunnels of Cwm Dwr, and after wobbling upstream over head-sized boulders, which were scattered generously all over the floor of the clean-washed, high black passage, for several hundred feet, an easy climbable short drop was encountered; at the top of this was a sizeable chamber, of the order of twenty-five feet in diameter. Making our way upstream we soon came to the start of the 'pots' - holes in the floor which had assorted depths, and diameters ranging from two to six feet. These were generally separated by narrow ridges of rock beneath the water; these of course, were of various widths and depths to increase our chances of falling into a pot. The most amusing (i.e. largest) pot was one of the farthest upstream, and in really wet weather is extremely entertaining, as if you fail to get hold of the upstream wall after leaping across the pool at the waterfall, you tend to revolve for some time in the whirlpool at its foot until being casually removed by the nearby refuse disposal officer. After this deep pool the sixe and number of pots decreases until the sump bypass is seen, entering as the only obvious floor level passage on the left-hand side. This passage, a dry abandoned oxbow, is followed for several hundred feet; not long after entering there is an obvious easy climb up to a higher level, and this is followed to the left as a high narrow passage until it emerges about ten feet above the stream. It probably takes water when the streamway floods, backing up upstream of the sump. After traversing upstream down to the stream - this is quite straightforward, but may at first appear awkward - we continued to wander along the roomy passage, which is not quite as impressive or sporting as that below the bypass but is nevertheless exceptional.

The calcite veining and tension features, pure white in the black limestone, form the only decorations in the clean passage; harder bands of limestone have in several places produced interesting short climbs. Several hundred yards upstream from the bypass we reached the pitch leading up into the Clay Series. A passage can be seen entering about fifteen feet up in the left-hand wall, a small stream flowing over a pale brown calcite deposit at the top. A small ridge at shoulder height was reached by traversing from a yard or two upstream (the streamway is only about three feet wide here). When standing on this, one can see the large holds available for the climb up into the passage - if necessary the other wall can be used for the last few moves. After walking a few yards up this small stream we came to the foot of the maypole pitch. Here there is a wide ledge about seven feet up, followed immediately by another ledge; this is the foot of the fifteen foot pitch, against which the maypole was placed. It is best to hand a ladder from the top of the pole rather than attempt to climb the pole, as apart from being easier to climb, it will do less damage to the joints.

The passage at the top of the pole - Maypole Passage - is a most depressing meandering shuffle, comparable to the Crabwalk in Giants but possessing a sludge floor of water and montmorillonite. After floundering along this for about three hundred feet, past a small inlet on the right, we came to the climb up to the Clay Series proper. There are two routes up - the first being up over and amongst a series of boulders wedged in the passage, into a three - foot high sandy crawl; a cross roads is almost immediatly met; the left-hand passage leads to the maze and back to the streamway via a 50 foot pitch. To the right the crawl crosses over Maypole passage, joining the second route up the rift. The second route is reached by continuing along Maypole Passage, past the string of boulders in the roof, until a large calcite flow is found on the right-hand wall of the passage. Although a handline may be fixed around a rock wedged across the top of the rift, chimneying up the rift is quite straightforward.

Whichever route is used, a dry sandy passage will be reached leading off on the right-hand side. This soon becomes larger, being about 30 feet high and 6 feet wide. Passages on the left lead



Part of
Clay Series
OGOF FFYNNON DDU 2.
Explored by S.W.C.C. 1967 Surveyed by I.C.C.C.
T. O.F.D.3
From Labyrinth
90' Pitch
F.H.L.
3 Streams Chamber
Traverse
Salubrious Passage
Gnome Passage
Fault Passage
Judge
Trident
Sinks under boulders
The Maze
Magpole Stream
To O.F.D.2 Streamway
From Selenite Tunnel
0 100 200 feet
Scale — 1 inch = 100 feet
Magnetic North.
Top Entrance

to the Maze, a series of interconnecting impressive rifts and roomy passages which we did not have time to investigate. The first large dry passage on the right leads to the Trident - three superb orange stalactites up to eight feet long. Past the Trident is a static pool, on the far side of which hunches the Judge, a well-named large white stalagmite boss, backed by curtains and flow-stone trickling from a high aven.

The passage continues on, with calcite formations taped off at the foot of a boulder wedged across the passage, and two crystal pools can be seen further on; great care should be taken not to kick sand into these. Traversing over Swamp Creek, another route down to the main streamway, ending in a 100 foot pitch, we passed an aven containing a small stream, and a 40 foot pitch (short belay) marked the end of the Nave. A few yards from the foot of the pitch was an impressive deposit of pure white flowstone down the wall, in the shape of a wedding cake ± 40 feet high, with a base 5' wide. Continuing down the passage, we came to a 20 foot pitch over ex-tremely loose boulders. The main passage was followed from the foot of this, and was for the most part a narrow rift with rocks wedged in it somewhat dubiously. The rift ended in a small aven, the floor of which was a steep, extremely loose, dangerous boulder choke; at the foot of this a rift passage was found. This was about 60' high the entrance being in the roof, which was extremely well decorated - and appeared to lead back to the streamway.

Deladdering the 20' pitch we doubled back underneath the 40' pitch, ambling along a smaller passage until a 20' pitch was reached. We did not have time to ladder this, and it almost certainly leads back to the main stream, which could be heard nearby.

Just before turning into Trident Passage, a small stream is met trickling over the white clay floor; this disappears to the left of a large boulder choke - which makes a difference of 15' to the height of the passage - and may well be the one which reappears in Maypole Passage. Trudging up this squelchy streamway - Salubrious Passage - we passed an 8' cascade and traversed around a shallow pool, to the right of which two passages enter, one being silted up, the other wandering off. Soon after this, Three Streams Chamber is reached; a passage on the right at the downstream end forks about twenty feet in, possibly being the "upstream" end of Fault Passage, leading off opposite the Trident.

At the next widening of the passage a steeply ascending rift with a floor of jammed boulders leads off on the right to a ten foot climb with a fixed handline; it is free climbable on the left. A 10' ladder with a 10' belay will be found useful by the more tired/inexperienced members of the party.

Squishing along Salubrious Passage - ignoring the dry oxbow which enters on the left, opposite the above-mentioned rift (which incidentally, is the quickest known route into the top series) - we passed three passages on the right before entering Arete Chamber, where a stream runs over a hard and white clay deposit, the Moh's hardness value and consistency being similar to Spratt's Bonio. The passage forks here, and various passages lead to the Labyrinth, where one can, if necessary, amuse oneself for several hours by playing spot-the-passage, until flopping back to Arete Chamber through sheer boredom The Maze and Labyrinth, being connected form an interesting round trip. About 100' upstream of Arete Chamber the first widening of the tall passage marks the foot of the 90' pitch from the Upper passages.

Climbing up the Bonio - correctly called the Arete, after a feature which has since vanished - from the boulder choke at its foot, we followed a low passage containing static pools to a fixed handline, which led downwards for 15' to the top of the other fixed handline mentioned earlier. From the foot of the ten foot climb, to which this handline is attached, a second rift may be seen, on the right; this gives a view down a 35' drop into the upstream end of Three Streams Chamber (see section and survey).

The fixed handlines lead to the foot of a boulder slope which can then be followed upwards into an extremely large passage running approximately E-W. Following the passage eastwards we came upon two large boulders, just before the section G - G', which had fallen from the roof; they showed fine bedding place surfaces cut by slightly anastomosing phreatic half tubes about an inch in diameter. They are still worth studying. The passage, which had a floor of massive boulders, was well decorated with a large, dried, orange rimstone deposit on the right; at the eastern end a small stream entered, and to the left of this was a 25' pitch into the impressive Chasm - which thundered off towards OFD III, with a height of over ninety feet and a width of about twenty. This route, the one originally used to reach III, can now be bypassed by a passage leading from the end of Salubrious Passage; originally a trip to III required the best part of 200' ladder, but now virtually all the pitches have been bypassed and only 20' ladder is needed. This gives an idea of the complexity of the system.

Hopping between the boulders in the western end of the passage, we came to a fork at the white flowstone deposit; to the left Gnome Passage curves off into the distance, twenty feet wide and fifteen high - the floor being made of large blocks on which squatted gnome like stalagmites, sometimes huddled together in groups. They had probably dropped out of the well decorated aven in the centre of the passage and moved into positions where they are now to celebrate our arrival.

To the right of the white stalagmite the passage forks again; the left appears to choke; the right may be followed to a boulder choke, where a low crawl to the right leads to a low bedding plane chamber containing some good straws and columns. A crawl from the far side of this chamber leads back to a point above the boulder slope leading down to the fixed handlines (see section).

If, instead of entering this chamber, the main passage was followed, we come to a large block/shelf, on the edge of which was a stalagmite; the stream entering on the right ran down a 60' pitch on to the Arete climb half-way down. A hole on the left re-enters the pitch a short distance down (see section). A dry sandy passage leads off to the left of the block - there are some interesting unnoticeable calcite deposits on the floor which must be avoided. This passage, about ten feet high and five wide, leads back to Gnome Passage via two routes. An orange stalagmite heap will be found at a cross roads. To the left is a 10' drop, while straight on leads over a dried rimstone deposit, both passages going to the end of Gnome Passage. To the right a sandy passage meanders off. An 8' drop on the left along here leads back to Gnome Passage, and to the end of the Top Entrance Passage, while the passage on the right just past the drop enters a small chamber. The rift in the corner of this bells out into the 90' pitch we discovered and used on our first trip in the cave; we used a new method of reasoning: that if it's vertical it's quicker, and the longer the pitch, the quicker it must be to reach the bottom. Unfortunately in this case the assumption was wrong as well as erroneous. (A possible application of the SWCC's Sod's Law?) However, the pitch provided some entertainment, being free most of the way, and ending in a heap of nameless. It comes down upstream of Arete Chamber.

The other exit to the chamber at the top of the pitch may be traced around to a 60' deep hole in the floor, mentioned above. This is the "upstream" end of Arete Chamber, at a higher level, and the Arete Stream may be seen entering at the same level on the opposite side of the drop. The top of the Bonio climb is halfway down the far side (see section). A traverse along the left (eastern) side around the edge of the drop makes it possible to cross over to the sludgey stream. It is not possible to climb down Arete Chamber from this level without a ladder.

A large dry passage leads off to the left between the 90' pitch and the Arete. This may be followed for a little over a hundred feet before degenerating into two small passages; about thirty feet before the end it is possible to scramble up into a tall passage leading to a large aven. A rift passage with numerous avens leads back to the fifteen foot high passage which meanders past the 90' pitch from Gnome Passage. The passage leading off to the right at the junction between the above two begins as a traverse for twenty feet along a rift, starting with a large pointed slab, and leads to a large Hall. This seventy foot wide passage has a bedding plane roof ten to thirty feet above the boulder floor. By keeping to the right of this large tunnel the Top Entrance is reached at the western end of the Clay Series; after fixing its position by radio location the SWCC blasted and dug the passage out.

Keeping to the left-hand wall the end of the entrance passage is reached. In this area there are several interesting high level abandoned passages; the one nearest the entrance leads to a low, muddy, bedding plane chamber, which has two exits. One is choked, the other is a low gooey crawl which can be suffered for some distance; it heads back in the general direction of the entrance, possibly connecting with a choked crawl leading off to the right thirty feet from the entrance.

At the end the passage splits into three, at least two of these passages leading to Gnome Passage. Just before the split is an impressive cross-rift; here the roof is at a height of 45', a 20' climb up a sloping heap being necessary to enter the passage. Well developed rifts such as this are a common feature of the Clay Series, where the jointing - and probably faulting, have been well exploited in the development of the system.

One of the most interesting features of the Clay Series is the jointing control of many of the smaller passages. The principal feature is a fault along the line of Arete Chamber to the Trident; this is clearly seen in the floor of Fault passage, opposite the Trident, where it appears as a 12" wide zone of calcite veining. The joint pattern is obvious from the survey and one system is parallel to this fault, the second system being almost perpendicular to this - for example, aligned along the Nave.

The first formed cave passages were the large phreatic tubes, such as Gnome Passage, which were little controlled by the jointing. These passages show the good bedding plane development missing lower in the cave. However, a rejuvenation of the drainage resulted in the incision of dominantly vadose canyon passages which were largely developed along the joints. The first stream probably flowed down Fault Passage to Trident Chamber but then flowed along the second joint system - probably along the Nave, although some of the passages south-west of Trident chamber must also have been formed at the same time.

A change in surface conditions then resulted in vast amounts of sand and gravel being washed into the system, completely choking Fault Passage and also spreading out into the lower passages. The water then backed up 30 or 40 feet in the region of Arete Chamber and eventually broke into a parallel joint, close to the fault, and rapidly cut down to form Salubrious Passage.

Headward sapping has since removed much of the sand fill but Fault Passage is still completely choked for a short distance; the lower end of the fill shows the bedding of the sand superbly.

The effect of the main fault can still be seen where seepage water has formed the magnificent Trident stalactites.

As the survey we made was small compared with the total amount in the system, we are looking forward to seeing the SWCC complete version when it is published. Until then, I feel, that no outside member can really appreciate the size and significance of this outstanding system and the work that they have put into its exploration.

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The survey was mainly drawn by A. C. Waltham with some hindrance from J. Winterhalder and the beddingtime story was told by J. W. with the minimum help from A.C.W. In fact, you might say we were jointly responsible for any faults in the article. My God ! What a choke. I must go Gnome before a get any boulder.

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LOST JOHNS - WET PITCH

As many parties fail to reach the Master Cave in Lost Johns in flood conditions because of the apparent difficulties presented by Wet Pitch, those attempting to 'bottom' the cave who have not done so before might find a list of the routes at present available useful. They are:-

1. Old Route

The original method was to attach the Wet Pitch ladder to the foot of the Battleaxe Ladder; this required a total length of 100' ladder, 5' belay.

2. Rawlbolt Belay

A rawlbolt was put in the left-hand wall of the pitch about ten years ago, and this gives a much better climb than the previous belay as in dry weather the pitch is mainly dry - in fact completely dry if the stream is temporarily dammed by a body placed on Thunderstorm Depot in a sitting position with its feet handing down the Old Route. This method of laddering requires either a 10' belay and 60' ladder or a krab and 65' of ladder, as well as 45' ladder and 5' belay for Battleaxe.

3. Old dry Route

This has been used for some years, and is reached by traversing upwards (while lifelined) for about 15', above the Old Route. A ledge is passed on the right-hand side of the pitch before the leader reaches a broad platform on the left-hand side; this ledge is semi-circular in shape, as it curves away from the pitch then reappears about ten feet from Thunderstorm Depot, being separated from the original pitch in between by a large buttress. A small rawlbolt was placed at the top of the traverse in December, '66 by an I.C.C.C. party so that only one person need traverse - the rest use a 15' ladder, saving a considerable amount of time.

The ledge is in two sections: the high level opening out on to Thunderstorm Depot, and the ledge about eight feet below this, which gives access to the Dry Routes down, appearing ten feet from the Depot.

The large rock buttress is used as a belay for both the double lifeline and ladder, but although very safe is rather awkward. The pitch requires 80' ladder, belay and same length belay of courlene for the lifeline, and 175' rope. A pulley is also useful. The small rawlbolt should not be used at all for the main pitch, as its position and strength are unsuitable. This route enables the party to reach the Master Cave in wet conditions.

4. New dry Route

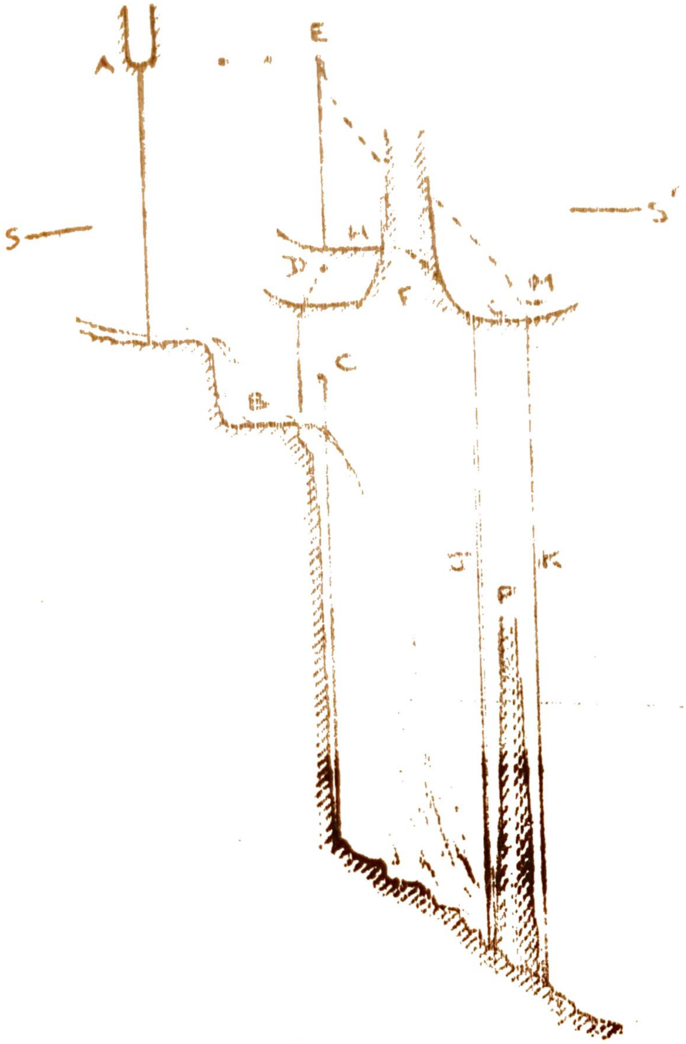
This is reached by traversing along the rift with a lifeline in a downstream direction from the head of Battleaxe, using the stemples positioned by persons unknown in Autumn '66. A 25' ladder is attached to the third (and probably last) stemple, and this lands directly on to the Dry Route upper ledge. The ladder is only a foot or two short and a longer ladder is not required. The Dry route ladder may then be attached to the bottom of this (an extra 100') or may be belayed to the buttress as in (3).

At the moment a dry descent may be made in any weather by using 125' ladder from the stemple, if this is held away from the water by a person on the edge of the lower ledge. This makes a considerable difference as normally the ladder would hang on the Old Routde side of a buttress which is not visible at the head of the pitch but which develops lower down; if the ladder is held on the other side of the buttress a completely protected descent can be made. However, to use this method, two people must be left on the ledge to hold the ladder and lifeline.

5. Prospective Belay

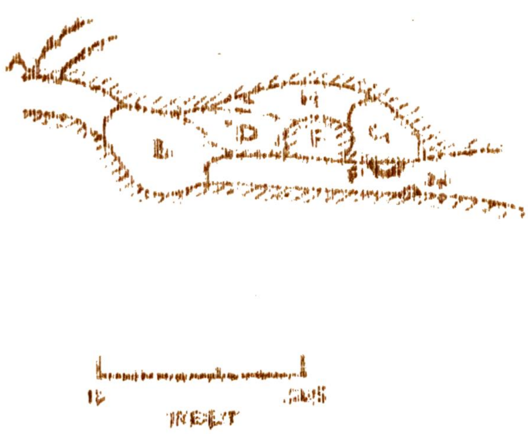
When standing on the lower ledge a vertical rift can be seen, one to two feet long, in solid rock on the extreme left-hand end of the pitch, i.e. the furthest point accessible from the old Wet Pitch. A short piton in here would form an ideal temporary belay if put in correctly.

DIAGRAM SHOWING METHO[D] OF LADDERING WET PITC[H] LOST JOHN'S



A Battleaxe top passag[e]
B Thunderstorm Depot
C Rawlbolt belay
D Dry routes' rawlbolt
E Third stemple
F Buttress (belay)
G Lower ledge
H Upper ledge
J Old Dry Route
K New Dry Route
M Piton rift.
N 'Wingnut' belay
P Protecting buttress.

Section S-S'



Details of the ladders required elsewhere in Lost John's may be found in the revised tackle list of major Yorkshire potholes, obtainable from I.C. at 1/3 d.

6. "Wingnut" Belay

A superb belay point is visible on the opposite side of the rift from the Dry ledge. We gave the belay the above name after a vivid description by "Min" of the placing of a belay around the spike - 4 feet away - by a certain legendary character who held the belay and fell across the rift, placing the belay on the way. This was in an attempt to ladder the pitch dry under flood conditions; it failed as there was still no protection from the water.

In conclusion, the quickest and driest route down is the New Dry Route, and this could be greatly improved by the positioning of a rawlbolt at the end of the Dry ledge so that full use can be made of the lower buttress. The Master Cave can then be reached in any conditions.

J. Winterhalder

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CORRESPONDENCE - THE BERGER EXPEDITION

Dear Hon. Editor,

I have read the article by Julian Coward on the Berger expeditions and would be grateful if you would spare me some space in your journal to correct a few inaccuracies, and suggest another point of view.

The object of the expedition as stated by Julian was to "explore past the sumps and attempt to get through to Sassenage". This object was fully achieved. Other objects achieved fully were to take photographs depicting the size of the cave, to survey from Sassenage to the Berger entrance. The radiolocation objective was only partially successful and the survey beyond the syphon was not attempted because the objective of getting two divers through the sump was only 50% successful. Wether or not the results of the surveys are published depends on the people who took the measurements, Messrs. A.C. Waltham, P.R. Deakin and Dr. H. Lord.

In 1963 I passed the first syphon which was in fact 240' long. I did not attempt the second syphon because the support diver did not pass the first one with the necessary equipment. Julian incorrectly states the first sump to be 100' long, and the air space to be 100' long. I have roughly measured this latter at 65'.

Again in relation to the 63 expedition he quotes 20 hour days and four hours sleep. A study of my published report on this expedition would reveal that one third of the undergrownd time was spent in bed, only two nights were less than ten hours. One of these was eight and one on the surface four. This latter was followed by sleeping in turns on the way home.

The biggest misconception is the comment "Pearce appears to do the cave the hard way". This can better be evaluated by considering some of Julian's own comments and some of the facts.

Julian says he arrived a day late. Hence he missed the heavy grind carrying equipment the two miles to the camp site, six or seven journeys each for the ones who arrived early. Julian was in fact in the area before the expedition arrived. He then "felt ill" and was unable to join in the big 20 hour push when all the ladder for the cave and most of the food and equipment was sweated through the most strenuous and constricted section of the cave (the Meanders) to the River Gallerie and carried down to camp 1 and beyond. This part of the operation had to be done quickly to release this section of the cave to the Pegassus scheduled four days behind us. When camp one is reached about half theload carrying is over.

Julian then had a warming up trip, pleasant because I wasn't there he says. May I suggest that it was also pleasant because he had comparitively little to carry and was obliged to keep sitting down and transmitting to the surface with the radiolocation equipment.

On the morning of the 11th Julian went down the cave about Midday and was in camp one at 9.00 p.m. The expedition was planned for shift sleeping and Julian was in the first shift because he had inconsiderately spent longer on his pleasure trip than he was asked to and was likely to be short of sleep. The rest of us worked until he rose at 6.30 a.m.

During this day little was done as it became obvious that the loss of members wouldforce a retreat and the expedition would have to be reshaped. The following day surplus equipment was only moved out as far as Aldos and because of the floods the rest of the ascent had to be made empty handed.

Julian was not in the party which manhandled all this surplus equipment up the 750 foot of pitches and few hundred yards of traverses to the surface nor present when it was carried the odd mile back up to camp.

Whilst this work was going on Julian did two radio fixes and the rest of his party sorted gear at Aldos. The rest of his party also carried gear back to Camp 1. Similarly, when he went down to Camp II, the Pegassus had laddered that section of cave before he entered it.

It may have seemed rough not saying what had happened through the sump but this was necessary in order to negotiate with the press to try and relieve some of the financial burden which had fallen on shoulders other than Julian's.

Finally, although Julian "craftily set off from camp II to avoid deladdering" (Pete Watkinson and I had planned this) Barney and two others went back down the cave to Gaches to retrieve the rest of the sub camp II tackle. In fact, the eleven men on our team carried out the third of the total tackle used below camp II plus some spare. Pete's 20 men carried out the rest, $\frac{1}{3}$ between camp I and II and $\frac{1}{3}$ on the entrance pitches.

With respect to the 63 expedition in which thirteen men took twelve days to ladder and deladder the cave and carry six cylinders, diving gear for four men and lead weights to the bottom. Less than this was achieved by over forty men on Julian's easy trip.

May I close by saying that I think Julian is hard working, competant, and worthy of a place on any expedition. He was specifically allocated the task of radiolocation and did it very successfully. I have no reason to believe that he would have complained or shirked whatever lot had fallen to him and he was not in general responsible for the desirable circumstances in which he found himself. But I wonder: if he had been running with the donkeys would be still have said I do it the hard way.

Ken Pearce

Dear Editor,

I appreciate the interest shown by Dr. Pearce in my article in No. 4 Journal and would like to add a few comments.

The article was intended to be fairly light-hearted and some remarks (such as "craftily leaving a few hours before Pagassus so that they had to deladder!) were not intended to be taken too seriously, and so could I apogise for any misinterpretation of such remarks. I would also like to apologise for the factual mistakes I made in the article, as brought out in Ken's letter.

I realise that there is not sufficient space here to fully answer Ken's letter and so I will not attempt to defend the article over some of Ken's critisisms, although I don't agree with all the points in the letter. I do however realise that I did have an easy trip mainly due to the concienciousness of most of the team members. Also we had help from Pegassus and the weather was generally good.

Ken Pearce is undoubtedly an excellent caver and the article was in no way meant to critisise his caving ability. It is only due to his enthusiasm for the Berger that the sumps have been dived and the bottom of the cave has continued to be explored.

Could I take the opportunity here of thanking members of our team including Ken Pearce himself, for a very memorable and enjoyable trip.

J. Coward

A NOTE ON THE DEPTH OF THE GOUFFRE BERGER

The original French survey of the Berger gave a depth to sump 1 of 3,680' but the validity of this result has been doubted for some time. However, last summer's expeditions at last gave some new light on the cave's depth. Most siginficant was Paul Deakin's surface survey which gave the difference in height between the entrances of the Berger and the resurgence at Vats de Sassenage as 3,615'. This survey was considerably more accurate than any underground survey.

Also the French (see Cadoux's book) have explored up the Berger inlet of the Vats to a point where the water surface is 145' above the entrance. It should be noted that their major recent explorations in the Vats, to a height of about 1,300', were up the St. Nizier inlet which is unrelated to the Berger. This does give a total maximum depth of the Berger as 3,470', until the through trip is made. The actual depth at present is probably much less than this as Ken Pearce's discoveries have shown the cave is still steadily descending and there is still a considerable horizontal gap between the Berger and Vats sumps.

Consequently the depth to sump 1 cannot possibly be more than about 3,370', allowing for the 1967 explorations in Berger 3 (see LUCC Journal no 4). Furthermore it is very probably that this depth to sump 1 is even less than 3,280' - the mystical figure of 1000 meters down, which made the cave so famous - and the original survey was between 300' and 500' out. And, sadly, the Berger can never be deeper than Pierre St. Martin - 3,779' at present.

(Acknowledgements to Paul Deakin of Eldon P. C. for kind permission to use his results.)

A. C. Waltham

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REVIEW - C.P.C. JOURNAL

Vol 4 No 1 1967 8Cpp, 2 surveys, 8 photos. 10/6d

Always one of the best produced club publications in Britain, this year's Craven Pothole Club Journal is excellent. Professionally printed it contains well reproduced surveys and photographs and the material does the production justice.

The only original exploration at home is the Aille River Cave in Ireland which revealed $\frac{3}{4}$ mile of mostly wet passage. As usual Gaping Gill is well covered - this time by three articles - and in one the writer makes the incredible suggestion that the ICCC Hon. Pres. can climb ladders three rungs at a time ! There is also a fine historical article on Juniper Gulf, a description of Notts Pot with an unusual tackle list to say the least, and an article on Dan yr Ogof. Foreign caves described include those in New Zealand, Italy, Africa and Turkey, and local news and climbing articles further broaden the scope of the journal. Altogether a most readable, interesting and informative journal which provides an example to the cavers of this country.

A.C.W.

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NOTES AND NEWS

Langstroth Cave - During the summer a new entrance was opened near the sink giving on to a long crawl, to the top of the pitches explored by diving and maypoling. Now over 300' deep.

Mexico - The Texan cavers, A.M.C.S., explored a new system to a depth of about 2000' and were stopped by a wet pitch after some long horizontal passages. The rising is 6000' below the entrance and they will probably camp down next summer. Best of luck to them.

Agen Allwedd - The main downstream sump was dived by P. Kingston (B.E.C.) for 150' and he was stopped by the same submerged pot as stopped the divers two years ago.

A Symposium - on Cave Hydrology and Water Tracing is being held at Leicester University (Vaughan College) on Saturday 3rd February. Five lectures and discussion cover a variety of aspects and the cost is 10/- (6/3 for students).

Dan yr Ogof - Led by A. Coase of SWCC a party including members of ICCC and UCLSS visited Far North series in November. They were only the second party in the remotest parts, but had no success in finding a route towards the surface.

Hull Pott- Little Jim (IC) wandered up the streamway entering the open pot, in flood conditions in November, and climbed over the waterfall into a muddy bedding plane on the right. Destroying a dead stalagmite barrier he went 25' in the direction of a loud roaring of water !

Rumania, 1968 - An expedition by the newly formed Queen Mary College Caving Club hopes to spend a month exploring caves here next summer. Members of all LUCCs are welcome. Contact John Dolman (QMC).

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MEETS LIST

Oct.	14	Swildons
	15	Swildons, Stoke Lane
	21	Swildons (Black Hole)
	22	Swildons
	26	Cuthberts
	28	Ogof Ffynnon Ddu 1 and 2
	29	Ogof Ffynnon Ddu 2 (exchange trip)
Nov.	4	Ogof Ffynnon Ddu 2
	5	Cwm Dwr Quarry Cave
	11	Simpsons, Hunt, Bull, Sell Gill, Barbon, Swildons 4
	12	Tatham Wife, Bull Pot O.T.W., Alum, Juniper, Rift, Simpsons
	25	Dan yr Ogof 3, Cwm Dwr Quarry Cave
	26	Ogof Ffynnon Ddu 2

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WINTER LECTURE PROGRAMME 1968

The Association of the
William Pengelly Cave Research Centre
with Imperial College Caving Club

Feb	7	Dr. A. J. Sutcliffe	Caving in East African Volcanoes and Coral Reefs.
Feb	14	Dr. A. F. Pitty	Karst Water Studies in Peak Cavern, Derbyshire.
Feb	21	Mr. P. J. Boylan	The strange beasts of Kirkdale Caves and their (Stranger) discoverers.
Feb	28	Dr. J. Lotz	Caving in New South Wales
March	6	Dr. M. Sweeting	Karst Relief and Caves

All lectures will be held at the Department of Physics, Imperial College, Prince Consort Road, (Queens Gate end), London S.W.7 at 7.30 p.m.

Nearest Underground stations are South Kensington and Gloucester Road

Admission free without ticket

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