

BULLETIN

Number Nine

of the



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FOR THE NEXT ISSUE: Editorial changes will be announced in the columns of *The Newsletter* when these have been determined by action of the Board of Governors. In the meantime, with resignation of the Editor, publication of the *Bulletin* is temporarily suspended.

BULLETIN of the



NUMBER NINE

SEPTEMBER, 1947

CAVE MAPS AND MAPPING

By WILLIAM E. DAVIES

WITH MOST of the surface of the earth explored at least, and many areas adequately mapped, the remaining untouched field for those with pioneer inclinations is found underground. Even though caves were man's first (and may possibly be his next) dwelling place, however, relatively few of them have been thoroughly explored and still fewer mapped.

At first consideration the uninitiated may assume that cave mapping presents the same problems as ordinary surface mapping. If the average surveyor were to confine his work to a narrow canyon, working only at night, in high humidity, and on ground covered with the stickiest sort of mud, he might approach physical conditions comparable to those underground. A more difficult problem, too, is encountered in cave mapping, since the surveyor is mapping a void and not a solid, as in surface work; thus, the features to be delineated are far more complex.

Methods of Survey

Ordinary surveying methods using transit or plane table have been tried but found impractical except in large caves. Poor lighting, short lines of sight, and difficulty of carrying large instruments through caves make such methods more time-consuming; and the increase in accuracy gained is of questionable value.

Where time is available, and physical conditions of the cave are such that a transit can be used without undue inconvenience, a transit traverse to establish accurate horizontal positions and levels of selected control stations is valuable.

From each of these control stations, compass and tape traverses are executed to complete detail necessary for the map. From such a survey the highest accuracy should be expected, enabling alignment of the cave with surface features.

Ordinary stadia rods are usually too cumbersome and delicate to transport through a cave. A rod made from one-inch dowels with a total length of six feet, in two detachable segments, will serve well and is easily transported. In many places a tape used in place of the stadia rod is more expeditious, but care must be taken to eliminate sag in the tape during measurements. Laxity in such cases will defeat the purpose of a transit survey.

In using a transit it is necessary to have a steady, pin-point source of light at the station being sighted. Candle flames, in general, are too variable for such work; but carbide flames, with a flame protector or a flashlight, are satisfactory. An open flashlight bulb mounted on a dry cell can be used. If a stadia rod with illumination is used, the need for a pin-point source of light is eliminated.

Compass and tape, the instruments most commonly used for cave measurements, are suitable, except in very large caves or where engineering work is involved. Because of the short lines of sight, 50 or 100 foot cloth tapes will serve. The average life of a steel tape in cave use is short since it is rapidly corroded by cave waters and humidity. A string knotted at intervals of five feet is satisfactory for measuring where cave

conditions would ruin a standard tape. Readings on the string can be estimated to the nearest foot.¹ Clothes-pins or small stakes of wood, consecutively numbered, are ideal for establishing semi-permanent survey stations; these are valuable in coordinating the survey with work of other members of the party.

A Brunton or similar compass with sights, clinometer, and fully graduated disk makes for a most rapid survey. Whenever possible, all readings should be consistent foresights (sights progressive from an occupied station to a new station), or consistent backsights (sights progressive from a newly occupied station to a former occupied station). Combination of foresights and backsights should be avoided, as this will cause considerable confusion unless carefully identified in the records. All compass readings should be given as bearings based on a 360° circle without reference to quadrants. Since most compasses read progressively clockwise, it is necessary to subtract the reading from 360 to obtain the bearing. If bearings are given in quadrants, it is essential that the readings be compatible with the quadrant (South 30 east; not North 150 east) as this simplifies recording.

Care must be taken to keep lamps and similar magnetic attractions at least three feet away from the compass to prevent incorrect readings. In caves where the rocks are composed of sufficient magnetic minerals to cause erratic compass readings, bearings must be determined by use of a transit or plane table.

Depth or elevation of the cave floor is best obtained by use of a hand level (or transit in a transit survey) and stadia. Level work in areas of descent is carried on by a series of backsights and by foresights in ascending areas. In all cases it is easier to run the level traverse after the compass and tape survey, using the same stations. When using a hand level, the instrument man should not be changed as the "height of the instrument" should remain the same to permit simple calculation of each level.

The accuracy of altimeters or barometers in level work in caves is questionable. The reaction of barometers to cave conditions has received little study; but it is the author's experience that when barometer and stadia level runs are made concurrently, there is a marked discrepancy in the results. Barometers tend to exaggerate depths, occasionally as much as 20 feet in 100. The greatest error occurs at vertical drops, and is probably accountable to the rapid change in humidity and carbon dioxide content of the air. If an altimeter is used, an arbitrary setting (for example, the 1,000 foot mark) should be made on the dial, preferably at its mid-point to prevent negative readings, should the cave rise higher than the entrance. Barometers

should not be used in a cave until they have had time to become adjusted to the temperature of the cave. Failure to allow for this adjustment will introduce considerable error in the absolute value of all levels.

When a Brunton or a compass with a clinometer is used, the degree of slope can be determined and, from this, the change in elevation. This method is not as accurate, however, as the handlevel and stadia. In recording, care should be taken to indicate whether the slope is up or down.

To obtain sufficient data for contouring the cave floor, a series of auxiliary stations must be run to critical points from each of the primary level stations. Where contours are desired, detailed running sketches are also necessary, as a part of the notes.

Ceiling heights have always been difficult to obtain. In areas of low ceilings an extension ruler is adequate for measurements. The simplest and quickest means of obtaining ceiling heights in rooms or passages of great height is the use of an ordinary child's balloon, filled with hydrogen and attached to a string which is knotted at five foot intervals. If enough personnel is available, the height of the cave may be determined by triangulation. In such a system a prominent spot on the ceiling is selected, and the angles to that spot are measured from two stations, the distance between stations having been previously determined.

Where streams, pools, or lakes occur in caves, the depth of the water should be obtained at critical points. Shallow water causes little trouble—it can be easily measured by rulers—but deep water must be sounded. A line knotted at intervals of five feet and weighted at the end is adequate for deep-water soundings.

The use of photographs in cave mapping has, unfortunately, received little attention. It is rather common to find that photographs taken in caves reveal far more detail than the individual observes. To be of use in mapping, the point at which the photograph is taken must be tied to a survey station, and at least two other points on the photograph identified, so that the relative position of features can be determined. Photos are most useful for adding detail to the survey in large rooms; but to obtain full detail it is necessary to use flash bulbs in more than one position, thereby eliminating deep shadows that obscure many features.

Range-finders and similar instruments are well suited to cave mapping; but their initial cost, complexity, and general unavailability—as well as a lack of understanding concerning their use—usually prohibit their utilization.

Methods of recording survey data are most important, as the effectiveness of the final map is directly related to the quality of the survey notes. Two general methods of recording are in use. In one, each salient feature is established as a station and has an azimuth and distance as one of a series

¹Two knots at 10 feet, three knots at 20 feet, four knots at 30 feet, etc., add considerably to ease in reading distances from such a string.

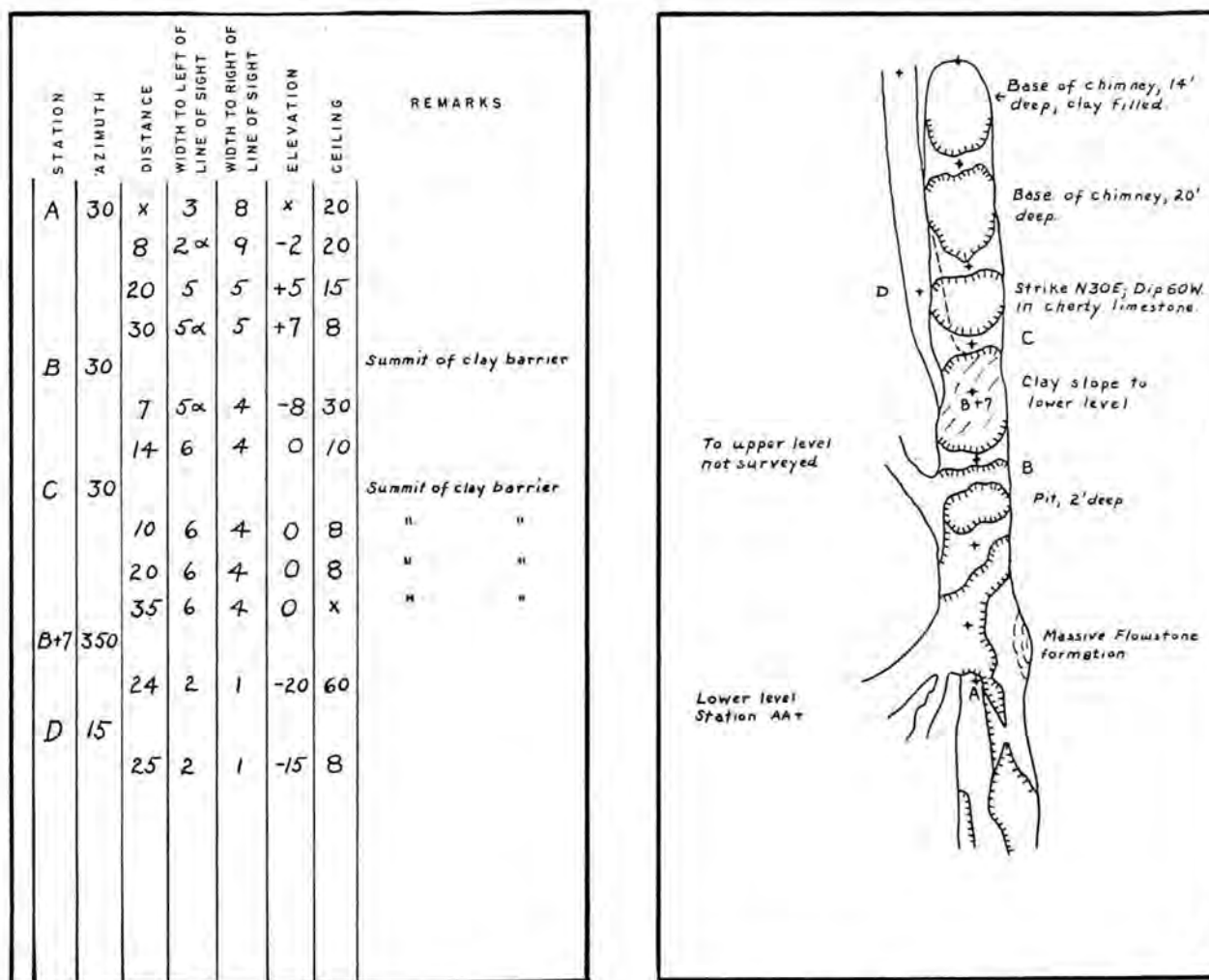


Fig. 1—Sample survey notes and sketch map illustrating a survey in which each salient feature is established as a station.

of successive stations. In the other, a series of primary stations are established, and salient features are located by distances to the right or left of secondary stations along the line of sight. In each method, elevations and slopes at all points are recorded. Figures 1 and 2 illustrate the methods.

Personnel

Experience has shown that a minimum of two persons is necessary for mapping. In such cases the lead man on the tape does all the recording, and the rear man makes all compass and tape readings. If the line of sight is downhill, the leadman handles the change in elevation; on upgrades, the rear man observes elevations. Where the party is larger, best results are obtained by relieving the tapemen of duties not attached to tape work. In these cases the person handling the compass also handles other instruments, such as barometers, and the recorder is left free of all other duties.

On all surveys the leadman is most important, for he decides the stations to be occupied. It is his duty to establish stations in order to utilize the best

possible lines of sight within the limits of the instruments. Much is to be gained from advance exploring parties, as the information brought back enables adjustment of the survey to conditions to be met.

It is the duty of the recorder to take copies and accurate notes of data furnished by the surveyors, supplemented by detailed sketches. Reliance upon memory for rounding out of detail is often very costly. The best mapper produces sketches that are maps in themselves, needing only the refinements of control furnished by the survey.

Where a plane table or transit with stadia is used, the party can be reduced to two. Three people, however, make for more speed, one remaining behind for a backsight, while the other establishes the foresight. The man on the backsight also can furnish the instrument man with light during the survey.

Construction of the Map

The type and scale of the final draft of the map depend directly upon the detail of the survey. If

survey notes are detailed and sketches complete, an accurate map at a large scale can be produced. On the other hand, an incomplete survey makes impossible the production of a large-scale map, for the detail necessary for such a scale will be lacking.

Generally, it is well to survey the smaller caves (up to 1,000 feet in length) with the detail necessary for construction of a map at a scale of 1 inch to 10 feet (1:120). For larger caves, a minimum scale of 1 inch to 40 feet (1:480) is best, as smaller scales permit showing little more than a bare outline of the cave.

If an accurate contour survey has been made of the cave, the final map should emphasize this to the fullest degree, since information revealed by contours can seldom be derived elsewhere. Only those contours derived from a detailed survey with complete lines of levels are of value. Contours derived from memory are useless and are better omitted. Where contour data are not available, the map should consist of a detailed plan accompanied by

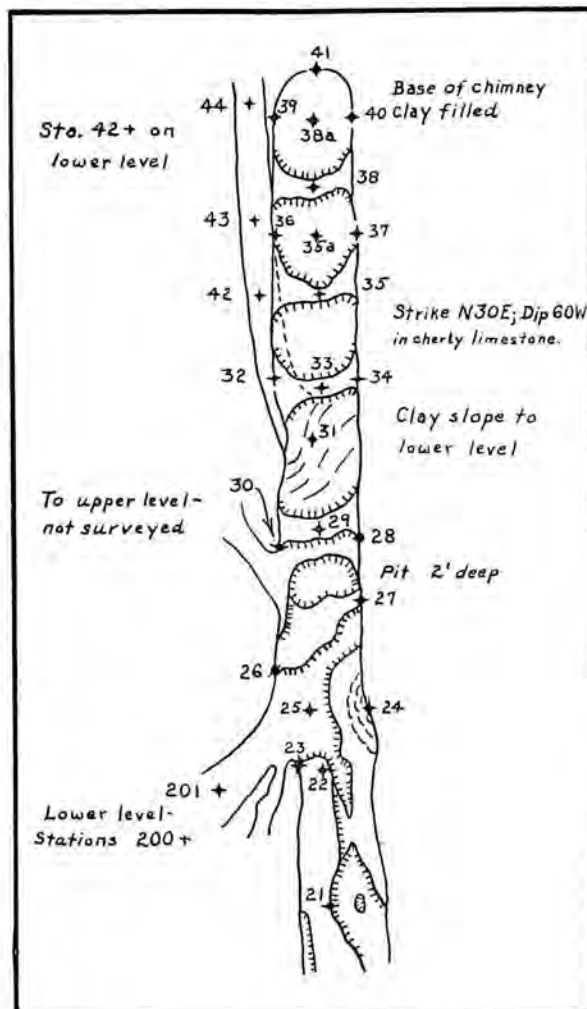
numerous cross sections and profiles. Cross sections and profiles also considerably enhance the clarity of contoured maps.

Where contours delineate the floor of the cave, they should be shown by light lines with every fifth one (or fourth, depending on the interval used) accentuated in weight, and labeled as to its value. Where contours are used the datum of the contours (zero point) should be identified by a note. The entrance to the cave is the most practical datum point. The contour interval to be used should be consistent throughout the map, and its choice depends on the detail of the survey, the scale of the map, and the general slope of the floor. In all caves an interval of five feet should be obtainable.

Since maps are scaled, two-dimensional drawings, the features shown must be symbolized. Experience in other fields of mapping has shown that a standardization of symbols is necessary if a map is to be readily and universally understood. Since most cave maps are reproduced in one color,

Fig. 2—Sample survey notes and sketch map illustrating a survey in which a series of primary stations are established with secondary stations along the line of sight at salient points.

STATION	AZIMUTH	DISTANCE	ELEVATION	CEILING	REMARKS
<i>Instrument on 21</i>					
22	30	10	-1	20	
23	360	12	-1	20	
24	60	14	+1	18	On massive flowstone formation
25	30	14	-3	20	Base for Survey Sta. 200+
26	5	18	+2	20	
27	48	24	+4	15	
28	40	30	+4	12	
29	30	30	+6	8	Summit of clay barrier
30	20	30	+5	60	
<i>Instrument on 29</i>					
31	0	8	-8	30	
32	0	15	0	8	
33	30	14	0	10	Summit of clay barrier
34	60	15	0	12	
<i>Instrument on 33</i>					
35	30	10	0	8	Summit of clay barrier
35a	x	x	-20	40	Base of Chimney
36	350	15	+1	8	
37	70	15	+1	15	
38	30	20	0	8	Summit of clay barrier
38a	x	x	-14	30	Base of chimney
39	350	27	0	8	
40	70	27	0	8	
41	30	35	0	x	End of passage. Survey continues on lower level



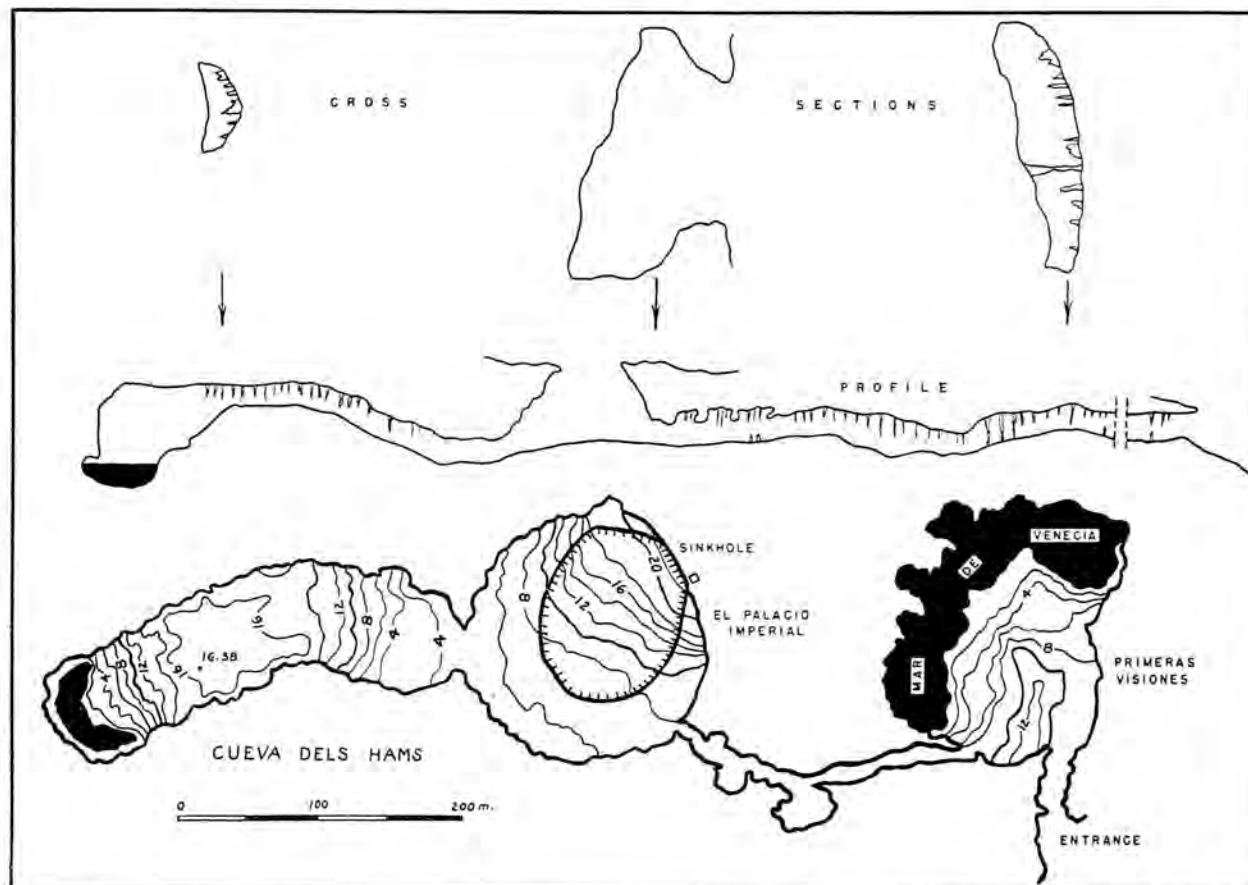


Fig. 3—Contoured cave map with profiles and cross sections. Cueva dels Hams, Isla de Mallorca. (Modified from XIV Congreso Geológico Internacional).

it is necessary that symbols be clear, simple, and designed for such reproduction. The accompanying figure contains those symbols that have been used extensively by the Society, as well as additional ones the author has found useful.

Since an infinite number and variety of conditions are met in a cave, it is neither practical nor desirable to design a symbol for each feature. The use of text should be resorted to freely, to describe special features or further to explain symbols.

Almost as important as the surveyed information shown on a map are the border data, for they contain the key by which the map is rendered useful. The border data should contain a legend to all symbols used on the map; but, where necessary, symbols may be omitted if they are well known, are universally used, or are self-explanatory. All maps should bear a title box composed of the name of the cave, its location, the credit and reliability notes. Where the map is to become a part of the Society's collection, proper identification of the Society should also be made in the box. A standard form for the box is shown in Figure 5. Wherever possible, the title box should be placed along the bottom of the map.

For the sake of appearance all maps should have a border line. This line should be continuous and form a rectangle. A single heavy line or a light inner line with a heavy outer line form pleasing borders and are easily drawn. Where a small portion of the map extends beyond the border line, it is permissible to break the border line and extend the map data.

A locality index in the form of a small map showing the location of the cave should appear on each cave map. Places of settlement, railroads, streams, and roads should be drawn in complete detail. Roads should be shown in two groups—paved and earth roads. Route numbers of federal and state highways should be indicated. The locality map should be at a scale of one inch to the mile, and cover the area immediately adjacent to the cave. It is not necessary to include a large town in the map as long as some recognizable cultural detail is shown. If necessary, the direction and distance to a prominent place can be shown by text as a part of the index. The position of the cave is best shown by an X.

The most practical medium for the final draft of the map is tracing linen, as this permits easy filing and reproduction. Reproductions can be fur-

Fig. 4—Conventional symbols for use on cave maps.

	SURVEYED PASSAGE
	UNSURVEYED OR CONJECTURAL PASSAGE
	LOWER LEVEL (WHERE LEVELS COINCIDE)
	CONTOURS
	CEILING HEIGHT
	DEPTH OF FLOOR BELOW CAVE ENTRANCE
	ELEVATION OF FLOOR ABOVE CAVE ENTRANCE
	DROP OR LEDGE
	BARRIER
	SHORT, STEEP SLOPE
	WELL OR SINK
	LADDER
	STAIRS
	DIP AND STRIKE OF ROCK STRATA
	DEGREE AND DIRECTION OF FLOOR SLOPE
	SURVEY STATION WITH NUMBER
	SAND
	ANGULAR ROCK FRAGMENTS
	CLAY OR MUD
	GRAVEL
	LARGE ROCKS
	COLUMNS (FORMATIONS)
	PROMINENT STALAGMITE
	PROMINENT STALACTITE
	FLOWSTONE
	STREAM—ARROW INDICATES FLOW
	INTERMITTENT STREAM
	CONJECTURAL STREAM COURSE
	POOL OR LAKE
	INTERMITTENT POOL

nished in the form of blue-line prints (ozalids) or as photographs, at a minimum of expense. When necessary, high-grade tracing vellum may be substituted for linen. All drawings should be made in one color, preferably black, as this permits clear facsimile reproductions. Multicolor maps should be avoided, for in reproduction all colors come up black or grey, resulting in the loss of considerable detail and clarity.

The work size of the drawing should be limited to approximately 18 by 22 inches to facilitate reproduction and filing. If additional space is needed, the map should be drawn on more than one sheet, in which case each sheet should be identified by a number and a key showing its relation to other sheets of the series.

Cave maps should show clearly the surveyors and date of survey. In cases where part of the survey is by one party, while the remainder is from older surveys or maps, the credit note should so distinguish. The credit note is best placed below the title, and at times may be combined as a part of the reliability note.

The average map-user is entirely at the mercy of the map-maker, for the latter, only, has knowledge of the materials and information intrinsic to the map. It is the duty of the cartographer to show in conventional form the critical data used in its preparation, so that users may properly evaluate it. In cave maps, where the map is a direct result of a survey and not based on compilation from existing maps, the statement of reliability is considerably simplified. For practical purposes cave surveys may be assigned to the following standard categories:

Rigid Instrument Surveys. Based on exact compass and tape, transit, or plane-table surveys commensurate with the scale of the map. If properly executed, this type of survey is satisfactory for all purposes and can be considered final.

Reconnaissance Instrument Survey. Based on rapid compass and tape surveys in which only salient features are surveyed accurately, the remaining ones being sketched. This survey will serve most map purposes, but cannot be considered final.

Sketch Survey. Based on a survey in which primary angles are measured and distances are estimated. This type of survey is not reliable and should be used with caution; for all human beings, especially when underground, estimate distances and angles with considerable error. At best, this type of survey can be considered only as a base for later and more rigid surveys.

If, as in most cave mapping, the survey is of the same quality throughout, a statement in the legend of the map is sufficient to define the reliability and type of survey. Where the planimetric detail shown on a map is of better quality than other information, such as ceiling heights and elevations, a statement of reliability should clearly

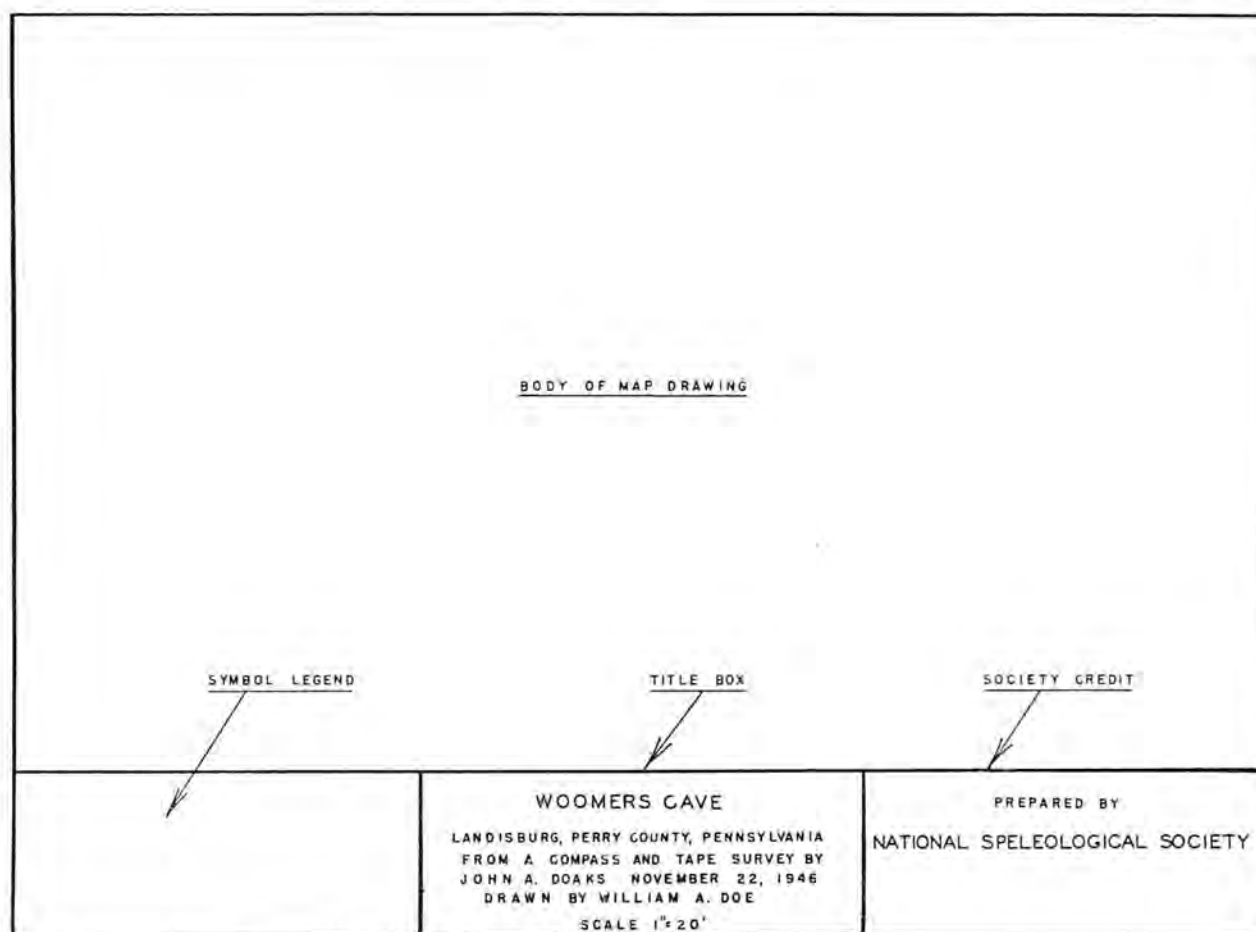


Fig. 5—Style guide for cave maps of the National Speleological Society.

distinguish between the relative accuracies of the features mapped.

When caves are mapped in successive stages, the types of surveys may vary considerably. If the variations are not complex a statement in the legend concerning the surveys will suffice. Where, however, relations between types of surveys are complex, a small diagram of the cave using forms of shading, dotting, or text to distinguish the types of survey is necessary. The diagram should be about one-tenth the scale of the map.

Mapping of Geological Information

A map of a cave alone may hardly be considered a final product. Since the primary purpose in mapping a cave is to gather data with which such points as the origin of caves, the action of underground water, and many similar questions may be solved, it follows that a complete cave map should show surface topography, a real and structural geology of the area. It is to be realized that topographic and geologic mapping are often beyond the averaged caver; but, since it is essential to any scientific approach to the geologic problems concerned with caves, it is discussed here to bring it

to the attention of all speleologists with an inclination towards mapping.

Surface mapping is considerably simplified because most caves are somewhat limited in horizontal extent. For surface mapping, ordinary plane-table work is recommended; but, in lieu of plane-table surveys, a series of connected traverses using compass, tape, and hand level are sufficient. Surface traverses should be run after the cave has been explored and mapped, as the traverses may then be limited to the area underlaid by the cave. The surface area mapped, however, should not be confined to the immediate area of the cave, but should include any surrounding area with pertinent features such as streams, springs, sinkholes, and cliffs. Geologic mapping should be thorough, both on the surface and in the cave. Dips and strikes of outcrops and faults should be accurately recorded. Dips and strikes within caves should be recorded just as accurately, but care should be taken since solution processes often form false bedding planes on the rock. All rocks should be carefully identified and classified according to their physical properties. Identification of rock merely as limestone is insufficient, for practically all caves

(Continued on Page 37)

WHAT TO DO WHEN LOST IN A CAVE

If You Ask Me . . .

By LOTYS R. JACKSON

THERE IS ALWAYS the chance of getting lost in a cave. This shadowy menace lurks before and behind every explorer and sometimes in a few other directions.

An experienced explorer can easily be recognized by the many precautions he takes against the occurrence of this tragedy. When he is going into unfamiliar territory (and how could he be exploring if he wasn't going into unfamiliar territory?) he takes along a compass and a piece of string. The compass shows him in what direction he is going and the piece of string shows him where he has been.

When he comes to the end of the string, if he be a wise and seasoned explorer, he clings to it very carefully while he turns around and backtracks. Now, he uses the piece of string to show him where he is going and the compass to show him where he could have gone if he had been the foolish type.

There was, once, a foolish explorer. I cite his case in order to bring you up to the point where I can offer advice on what to do or not to do if you ever reach the point he reached.

He was a rash, hardy soul who, saturated with routine exploration, was looking for something that would make him an heroic figure in the annals of cave history and, at the same time, give himself something to talk about when he got too old to do anything else.

Armed only with a compass, he ventured beyond the end of his string. The compass pointed North, but the cave passage didn't, and so he sat down to figure out which way it did point.

It was somewhere between North and East. It could have been North-northeast or East-east-north. The lines drawn here were too fine for him, but he got the general idea that he was somewhere in the vicinity, and proceeded.

After much travail, he came to a blank wall. Disgusted, he thought he was finished with exploring, then he found that he had a choice of going straight down or straight up, since there were holes both above and below him.

Debating with himself he reasoned that, without a rope, going straight down might be somewhat dangerous. The only way to do that would be to step out over space, pause momentarily, then let himself go. In his particular case, this seemed a little frightening, because he had flat feet, and, in his opinion, having flat feet was enough flat.

So, his choice made for him, up he went. He had not gone far, chinning himself on little pieces of rock that stuck out far enough to give him

Seriously Now . . .

By GEORGE F. JACKSON

ALTHOUGH MOST of the tales of lost persons and parties that go with some of the caves in this country are to be taken *cum grano salis*, it would be folly to doubt that it could happen.

So, one of the wisest things speleologists do before starting on any trip is to see that outsiders know to what cave they are going or, if it is a large cavern, in which part they are going to do their exploring. The safest move of all is to put some sort of time limit on the jaunt by having it understood that if the party is not out by a certain time, a "rescue" expedition should be considered. In a case of that kind, they make sure that they leave ample time for unexpected dallying, in order not to alarm those outside if they fail to show up exactly at the specified hour.

If the cave is commercially operated, all one has to remember is that none of them considers "lost" parties good publicity. The management is certain to be on the lookout for such possibility. Merely sitting down and waiting to be found is just about the best bet.

But whatever happens, in whatever kind of cave, remember that "a clear head will find itself." Loss of mental control is more serious than lack of food, water, lights, or anything else likely to be encountered underground. The person who keeps his head has the best chance to come through safely. Keep the old bean working, and the chances are that you will come out of every "new" cave on your feet, knees or stomach, depending on the height of the roof!

The writer well remembers that young man who, several years ago, on a visit to one of the big commercial caves with a large party and fancying himself somewhat of an explorer, but knowing nothing at all of caves, wandered into a side passageway while the guide was not watching. He had only a small flashlight and, for a few moments after leaving the party, was so excited over what he thought of as "exploring on his own" that he did not realize how feeble was his illumination. When he reached a sizeable room and could see neither ceiling nor further wall, he beat what he thought was a hasty retreat. However, instead of choosing the passage through which he had entered the room, all unwittingly he went in the opposite direction. Result: He was soon completely confused.

The feeling of being alone in a strange place gave him the "creeps." He became panic-stricken; and, when found a few hours later, was so dazed and mentally unbalanced that he was mumbling

LOTYS

a handhold, when the horrible thought struck him that if he persisted in this mad folly, when the time came to return he might find himself far enough up that he would be in the same situation as when he contemplated going down, and decided not to.

Beginning to be not quite so hardy, his scalp prickled, he shuddered, almost lost his grip, and in some inexplicable fashion the compass fell out of his pocket. (He could not hold it in his hand and climb, and anyway it was no good since he was going straight up.)

He heard it splinter on solid rock below. It had a tinkling sound like the peal of doom. Frantically, he back-chinned and back-handed and pretty soon he was back down to where he was when he decided to go up.

So far as he could see there was nothing to do but call it a day for there he was with a smashed compass, the trip spoiled, and no new wonders unveiled.

Wearily, he started back, and Lo!—one lone passage had divided into quadruplets. He didn't know east from north or west from south and he thought longingly of the piece of string he didn't have. He was in a quandary, with four sides to it.

He passed quickly from this stage, feeling the hair begin to rise on the back of his neck, and went rapidly to frenzy which he barely noticed because he was too close to hysteria. He hovered between this and complete mental disintegration until he remembered an article he had read by a Mr. Jackson, extolling the virtues of serenity.

He pulled himself together, sat right down and waited for someone to come after him. Patiently. So patiently that as time passed he was not even moved to action when a fissure appeared in the ceiling and water began to trickle through it and down upon his head, where each drop evaporated leaving its little deposit behind it. Perhaps, if you have been to Indiana you have seen in a certain cave the stalagmite resembling Rodin's *The Thinker*. The foolish explorer . . .

This should be enough to prove that sitting down and waiting will get you nowhere, especially if no one knows where you went when you were able. Nor will thinking.

Why should anyone in such a predicament bother to think more when what he is already thinking is enough to drive him crazy? Why should he try to figure out where he is when his exact location is too, too obvious?

There is no getting around the fact that a man who is lost in a cave has, indeed, a problem. What it needs is not further complication with absurdities, but—a solution.

The following suggestions will provide this effectively. If you ever find yourself in such a predicament here is what you **MUST** do:



GEORGE

to himself, stumbling around in the darkness. Brought to daylight, he soon recovered, none the worse for the incident, even though he swore his hair had turned white.

Had the young man kept his head he would have halted in the middle of the path when he became confused in his directions, and waited for the next party of tourists to come through that part of the cave. Had he kept his head he would also have noticed that he was walking, most of the time, along a well worn and very smooth trail that was marked very plainly every few hundred feet with huge painted arrows showing the direction to the entrance.



Left to right, top to bottom: George F. Jackson at entrance to Langdon's Cave, Indiana, 10/20/46; inside small passageway in same cave; wondering how he can get on that ledge 80 feet above the cave floor; and coming 'round the corner in a tight squeeze, high off the floor.

LOTYS

Scream. Not once, but many times. Again and again. Soon the echoes will come rolling back and you'll think that you have company. Trouble is, it may not be the kind you want or need, so do the next best thing.

Lose your head. It couldn't have been much good anyway, or you wouldn't be where you are now. Tear your hair, keep screaming, run until you can't get your breath, and then go beat violently on the walls.

Continue until the screaming and the beating vibrates sufficiently that rocks loosen and come falling down on you. From here on you need not concern yourself about being lost or in a hole. Everything will be taken care of.

Not only will you be out, in the strictest sense, but there will no longer even be a hole, since you have helped, magnificently, to fill it up.

You will be much better off than the foolish explorer who set out, selfishly, to give himself something to talk about. You will have given the world yourself to talk about for generations of explorers to come.

GEORGE

There are a number of things to be remembered in guarding against becoming lost in a cave. No one should start on an exploring trip without plenty of spare lighting material. For emergency use, candles are swell—in fact, some speleologists use them entirely for exploring. And, by all means, regardless of what sort of lights are carried, one should take some waterproof matches. A few matches, a candle, and a small piece of sandpaper well wrapped in oil paper may sometime mean the difference between one's hair turning white or remaining its natural color. A spare flashlight, or extra bulbs and batteries for it, are *not* sufficient for emergencies. If dropped too hard, stepped on, or thoroughly soaked, the flashlight may fail to function; while one may safely soak a properly waterproofed package for hours and still get plenty of light from it when it is opened. There are many well-known methods of waterproofing lighting material and matches. During the war the army devised a waterproofed match that would actually strike under water (according to reports). If these are available for civilian use, they would certainly be a boon to all speleologists.

The old method of paying out string behind one as the cave is explored is almost too foolish (in the writer's opinion) to be feasible. Consider: If the cave is a large one, it would be impossible for the average party to carry enough string. If the cave is a small one, then there is small likelihood of getting lost. So why bother with string?

In exploring in some of the country's largest caves, the best method the writer has found to mark passageways where there may be a doubt as to "which is which," is by piling up a few stones

in an unmistakable pattern, with the top one pointing in the proper direction. Chalk marks on the walls, floors or ceilings are good; but there is always the chance of missing them in a large space because the returning party may veer too far to one side or the other and a shadow, formation, or pile of rocks may hide the marks. Paper or cardboard arrows placed in the proper positions as the exploring party advances may be of some help, but there is always the possibility of some of them accidentally being turned in the wrong direction.

A splendid method is to leave a burning candle at what you think might be a confusing place when you return. If placed entirely out of drafts, a good candle should burn about an inch an hour. Numerous tests have shown that the old-time eight-inch candles made by the Standard Oil Company will burn more than eight hours. This should be sufficient time for most explorations, unless you happen to be in one of the really big caves; if that is the case, then it is to be assumed that you will be "speleologically minded" enough not to get lost.

But, supposing that you are one of those unfortunates who forgot directions, and that suddenly you find yourself facing a blank wall where you expected to find a street-sized tunnel? Suppose you turn and discover that the many openings behind you resemble the mythological labyrinth in Crete in which the Minotaur was confined? What then?

First thing: STOP. Sit down and try to figure out where you made your mistake, where you took the wrong turn. Use your head, not your legs.

Do not wander about as you mentally reconnoiter. Take stock of your lights. If you think the supply of spare material is getting low, extinguish as many lights as you can to conserve the remainder.

It is only natural that if you think yourself lost you will be inclined to get excited. But, whatever you do, do not walk aimlessly about. Do not run, yell or worry.

If it is a "civilized" cave, do nothing. Just sit down and wait, and sooner or later a guide will come after you.

Here are some suggestions to follow if you actually do feel you are lost:

Remember that you must have left footprints, or some trace of passage, on the floors as you came in. If it is a previously unexplored cave then it shouldn't be too hard to find some of these traces. Look carefully for broken matches, candle tallow, anything you may have unconsciously thrown to one side which will help to guide you in the right direction. Take your time. The character of the cave isn't going to change within the next few minutes, and if you remain level-headed you are certain to get out. If necessary you may be able to find the proper tunnel by a process of elimination, by first venturing one passageway far enough

to ascertain if it is the right one, and if not, by marking its entrance and then trying the next one, and so on. No cave is a maze of identical channels. Each passage, every room, has some characteristics that make it different from its neighbors. As you encounter these landmarks try to remember them.

Look at large rocks, formations, hills and streams from both sides. Often a pillar, cairn or stalagmite looks entirely different from one side than it does from the other. The thing that re-

sembled a huge cat as you approached it may look like a ship or a house when viewed from another angle.

Many large cave rooms have only small entryways and it is in locating these small holes on the return trip that many tyros fall down. Lacking a marked path it is easy to veer slightly to one side or the other and miss seeing a small opening. In such a case, common logic indicates a journey completely around the walls until the hole is found.

"DOWN THROUGH CHASMS AND GULFS PROFOUND"

By JOHN HOOPER

THIS QUOTATION, from Longfellow's poem "Rain in Summer," has been used before in accounts of cave exploration, and I make no apology for borrowing it again, as it describes most aptly the descent of Gaping Ghyll Hole—one of the largest and deepest of the British caves.

Gaping Ghyll lies at about 1,300 feet above sea level on the barren marshy slopes of Ingleborough, a hump-shaped mountain of limestone capped by millstone grit in the West Riding of Yorkshire. Numerous small streams rising among the bogs of the upper slopes, a few hundred feet below the summit (2,373 feet), unite into a single large stream known as the Fell Beck; this stream, after twisting slowly downhill for two miles, ends its course above ground in abrupt fashion and disappears from the light of day into the chasm of Gaping Ghyll.

The water pours down a series of rocky terraces and is then swallowed up by a dark hole, about 15 feet in diameter, at the bottom of a grass-lined, funnel-shaped depression, some 20 feet deep. Between the rock lip at the mouth of the shaft and the floor of the cavern below, there is a sheer, unbroken drop of 340 feet. The descent of this cave is thus not a matter to be undertaken lightly. Much tackle and equipment is required; and, since this has to be carried across three miles of rough track and moor, relatively few meets—sometimes only one a year—are held at the cave.

A book would be needed to do justice to a full description of Gaping Ghyll. The article which follows is, therefore, simply intended to be a plain and, I hope, unvarnished account of my own few experiences in the cave, which I visited as a sight-seer rather than as an explorer.

My first opportunity for a trip occurred during the 1938 Annual Conference of the British Speleological Association, held in the buildings of the nearby Giggleswick School, when I joined a party (Eric Hensler, Pat Cahill, Jack Sheppard, and David Pick), proposing to survey a section

of an extensive new passage system which Hensler had discovered the previous year.

We reached the cave entrance at about noon on a hot sunny day and found a flourishing camp spread out along the banks of the Fell Beck. The stream bed by the mouth of the shaft was dry save for a trickle of water, the main flow having been diverted by a wooden dam into another hole some distance upstream. A gantry structure with boarded floor and handrail had been built across one side of the pit, and this formed the taking-off point for the descent. At the far end of the gantry steel cable rose up from the depths, and passed round an overhead pulley to a petrol-driven winch which was firmly anchored on a nearby terrace of rock. The winch was clanking away merrily as we joined the waiting group about the entrance, and presently a "bosun's chair" bearing a figure wrapped in oilskins appeared in sight and came gently to rest at the level of the gantry.

The "passenger" climbed out of the chair, and his place was taken by a caver who had been waiting, ready clad in water-proofs, for his turn to descend. Then, when all was ready, the safety ratchet on the winding gear was released, and chair and occupant sank rapidly from view. The speed of descent was controlled by the winch operator who applied pressure to a long brake lever. After about one-an-a-half minutes, the motion of the cable was stopped, and we knew that the chair had reached the far distant floor.

We learned that we should have to wait about an hour before we should be able to go down, and so took the opportunity to eat our lunch. Presently, however, it came to the turn of our party, and Hensler and Pick were duly lowered. Soon, I found myself "next on the list," and was given heavy rubber oilskins and a stout belt to put on.

I stood on the gantry platform and peered over the edge for the first time, and then wished I had not done so! The shaft just seemed to go down and down into black emptiness, and the damp mist

swirling up in clouds from below made the thought of the descent a most uninviting prospect. It did not take long to decide that "Gaping" Ghyll Hole was a most appropriate name for the yawning void beneath my feet. After a short but somewhat "nervy" wait, the so-called chair reached the surface; a plank was pushed across to close the hole in the floor of the gantry, and then I gingerly balanced myself on the narrow board seat. An iron rod on each side of me curved up into a hoop overhead, this being attached to the winding cable. The plank below was then removed so that my legs dangled in space, but I was held securely against a fall by two ropes attached by karabiners to my safety belt. I was told to grip these ropes tightly. Then I started to sink downwards.

All apprehension now vanished, and I took stock of my surroundings with interest. At first the wet rocks about me were covered with glistening ferns and mosses; then as the speed of descent increased, the brightness of the daylight slowly faded and the shaft opened out into a big rift with smoothly polished, water-worn walls of reddish-grey rock. At the far end of the rift, I could see a huge waterfall which poured from the misty blackness high above my head and crashed down in a hissing white sheet to the invisible depths below.

So far, the descent had been interesting and unexpectedly comfortable. The motion of the chair was smooth and rapid, and there was no tendency to swing or gyrate owing to the steel guide cable which carried it on a gently curving course to avoid a projecting ledge. I could now see, however, that this cable was relentlessly leading me nearer and nearer the fall; and soon the heavy spray was pattering about me in an icy, stinging showerbath. I realized then just why I had been provided with oilskins! Almost immediately I floated down past a shelving ledge where the dead body of some unfortunate sheep had fallen from above is often seen; and then the walls of the shaft just seemed to disappear into the gloom, leaving me suspended in empty space.

I was now in the roof of the great "Main Chamber" and, as I continued to sink down through the chilly mist and spray, I could see little pinpoints of light, winking fitfully in the blackness far beneath and marking the progress of the explorers who had already descended. A few seconds later, I was able to distinguish the rocks on the floor itself. These rocks, which gleamed faintly in the soft light penetrating the shaft, grew larger and larger, and then, almost before I was ready for it, hit my feet with a bump as the chair came neatly to rest. A figure, at first little more than a dimly recognizable shadow, helped me from the chair and undid my safety belt; and then, as my eyes grew more accustomed to the gloom, I took off my oilskins and gazed around the colossal hall.

Immediately overhead, the slender guide wire

curled up into the main shaft and was lost to sight behind the overhanging rocks. The chair, now ascending once more with a fresh passenger, made its slow journey up towards a tiny oval of sky far above, and was silhouetted against the shimmering whiteness of the waterfall. A surprising amount of light pervaded the chamber and, in fact, it was not at all necessary to use a torch to find one's way about the sandbanks and pebble strands that composed the central portion of the floor. The chamber was comparable both in shape and size with the interior of a great church or cathedral, and the walls on either side curved up into a narrow vaulted "nave," 150 feet above. The main shaft rose like a mighty tower from the center of the roof, and reached up to the surface, 200 feet higher still. This fine underground hall is 480 feet long by 80 feet wide—small perhaps by American standards, but the largest natural chamber in Great Britain.

The scene owed much of its grandeur to the restless, pulsating column of spray formed by the big waterfall. This seemed to change in shape and movement unceasingly as one watched it and, when seen from a distance, appeared as a blue-grey, iridescent curtain against which the dark profile of the roofs and walls stood out in striking contrast. The myriads of droplets, pulverized into mist during their long descent, crashed into a shallow pool which overflowed into a wide stream and was then miraculously swallowed up amongst the sand and gravel of the floor. This water actually disappears here from the sight of man, and follows an unknown course until it wells up into the daylight as a powerful spring near the mouth of Clapham Cave, fully two miles away. Twenty yards from the main waterfall, a second great torrent hurtled down with a deafening roar from some invisible hole in the roof, its noise and turbulence adding still more to the awe-inspiring, slightly unreal atmosphere of this magnificent cavern.

The Main Chamber lies at the northwest corner of the cave system and is the starting point for a number of intricate passages totaling in length some 3,000 yards. Our object on the present trip was to visit one particular section which, as already mentioned, had been discovered by Eric Hensler a year previously. So, when we had all assembled, Hensler led us upwards over a great heap of boulders at the eastern end of the chamber and then into a tunnel in the solid rock of the wall itself. This tunnel, which was comparatively spacious, was known as South Passage. Hensler's passage branched off on the left a short distance along, the entrance being an archway barely 12 inches high. The roof remained at this depressingly low height beyond the archway, and so we had to flounder clumsily along on our stomachs.

Now this method of progress, while doubtless novel and interesting for a short while, becomes



1. The Fell Beck
above Gaping
Ghyll entrance.
A typical
camp scene.
Windlass and
cave entrance
in foreground.



2. Gaping Ghyll
Hole. Entrance
as it normally
is, except that
no water is
going over the
edge due to a
long spell of
dry weather.

3. Entrance
to the Hole,
showing
winch and
"gantry."
Those who
have been
to the Hell



Hole, near
Petersburg,
W. Va., will
note the
resemblance
to its
entrance.



4. "Mud Hall,"
in Gaping Ghyll.
Note rope
ladder which
indicates
size of this
cave.

5. Lowering
into the Hole
in a bosun's
chair, 340 feet
straight down.



tedious, not to say painful when prolonged for several hundred yards; and to make matters more difficult, the floor, which was of uncompromisingly hard rock, had been carved by water action into the sharp furrows and facets sometimes described as "fluting," and thus was hardly conducive either to comfort or speed. The roof height varied between nine and 15 inches, and it seemed to me that the lowest sections inevitably coincided with long unavoidable pools of water. One pool was fully six inches deep and probably 30 feet long, and so we were soon soaked through and very cold in spite of the "heated" nature of our comments concerning the passage, its discoverer, and cave-crawling in general. At the beginning of the trip we had felt it an honor to be personally conducted by the discoverer of the passage, but now we considered that anyone who was rash enough to find such an unwholesome place was surely welcome to keep the pleasure of its exploration all to himself!

After about 100 yards, Pat Cahill decided that this form of potholing was a grossly overrated pastime and wisely turned back. The rest of us struggled on and, after a further 150 yards, came to a junction. The right branch led into the main portion of Hensler's Passage, while the left fork was unsurveyed. Accordingly we turned left, and were glad to find that we had now reached a section where it was possible to travel on hands and knees. This was a pleasant change, even though the floor was thickly coated with a glutinous layer of mud. Straws and pieces of stick adhering to the roof served as a gentle reminder that this tunnel was sometimes flooded; and I, for one, fervently hoped that no prolonged cloudburst would occur during the next few hours.

Presently the roof descended again and elbows, stomach muscles, and toes once more became our chief propulsive units. Fifty yards further on, the passage ended abruptly in an uninviting siphon pool. Hensler and Sheppard now got busy with measuring line and compass, but the space was too limited to allow Pick and myself to assist, so we were advised to go back to the junction and to carry on towards the final and very much more spacious sections of Hensler's Passage. Before we reached the junction, I noticed a low bedding plane leading off to the left. David Pick started to wriggle along it, but I had had enough of that method of progress for the moment and continued alone down the passage by which we had entered.

Reaching the junction, I crawled along a stream, mostly on hands and knees, for about 100 yards. In common with all cave streams, the water was far from warm, and since it was often nine inches deep I did not "linger by the wayside!" Then I came to a place where several low creeks branched off; but since I did not know which was the main tunnel and had not the energy to find out, I

scouted around for only a short while before making my way back to the surveying party.

They asked me to go in search of Pick, as he had not returned and they were afraid his torch might have given out. So I did some more wriggling, this time along the branch passage where I had last seen Pick. The tunnel was again only a foot high, but the floor was dry for a change and covered with soft sand. After some 70 yards, I heard a noise like a sack of coal being dragged along in the far distance, and guessed that Pick was on his way back. Actually, he was still a long way from me, and it was many minutes before we were within intelligible shouting range.

Most readers of this article will probably be familiar with the tricks that sounds can play in such low passages, and with the curious acoustic effects that can sometimes be produced. In this instance, every time I stopped to wait, I could hear a loud thudding noise like a booming drum, and this was really the sound of my own heart beating, apparently amplified so that it seemed to me to echo down the tunnel in a most eerie fashion. Fortunately I had been warned about this beforehand, otherwise I might have been very puzzled, if not well and truly scared!

In due course, Pick joined me and then we crawled back to the others, where he related that his route took him to a high rift and a waterfall. Hensler realized from his description that this waterfall was one which had already been reached from the main passage, and so he and Pick set off to complete the circuit and gain a rough idea of the dimensions of Pick's new passage. Meanwhile Sheppard and I started on our quarter-mile crawl back to the Main Chamber.

The "going" on the return journey was far harder than on the way in, owing to the fact that we were traveling "against the barb" of the furrows and facets on the floor. The sharp-edged, steep sides of the water-worn flutes now faced us all the time so that we felt as if we were crawling over a carpet of fish-hooks! They were certainly just as destructive, catching in everything they could, so that they soon played havoc with our clothing. I was wearing a nice, thick pair of woollen stockings to protect my knees, but after that trip they were more holes than stockings! I doubt if I have ever felt quite so miserable in a cave as I did during that crawl, and certainly the jagged rocks, the cold water and the icy wind which whistled along the passage did little to add to our sense of comfort. We dragged ourselves along as far as we could and then rested until violent shivering fits made it a relief to start moving again. My hands soon became so numb that I could hardly grasp my camera tripod which I had most unwisely brought in with me. To add to our difficulties, Sheppard's torch kept going out at frequent intervals.

And so we went on and on until finally we began to think that we had lost our way and unwittingly crawled into the wrong passage. However, there was little we could do except advance, and we were eventually rewarded by the sight of the roof getting higher and higher—a welcome sign that we had reached the end of the passage. We had been crawling for about four hours without a break and, when I stood up, I found that my legs had almost forgotten how to walk!

We staggered back to the Main Chamber using the sound of the waterfall as a guide; then, while Sheppard went to see about getting up to the surface, I remembered that I had a camera with me and set about trying to photograph the big underground hall. I was still inclined to shiver and this caused me a lot of trouble and delay in erecting my tripod. However, I took a couple of photographs, or—to be strictly accurate—opened the shutter twice, as I did not use enough flash powder, and I discovered later that both pictures were failures.

Then I wandered back to the foot of the shaft and was glad to find that Hensler and Pick had returned. They were both soaked through, cold and exhausted, and were sent up to the surface without delay. I followed after them and found that the ascent, although slower than the descent, was equally impressive. Being now fully accustomed to the dark, one could appreciate more readily the great size of the chamber that, in fact, the floor was easily visible from roof level. From this lofty point of vantage, dangling from a thin cable in airy space, the aptness of one writer's simile—"like a spider in a huge cathedral"—was forcibly brought home to me. Then I floated noiselessly up into the shaft itself, through the cold spray of the waterfall, and up towards an ever-expanding piece of sky above. As I finally scraped past the rocks and ferns below the mouth of the pot and came to rest at the level of the gantry, I was greeted by the spectators with ironical cheers, "Here comes another that can't get any wetter"—and I was certainly inclined to agree with them!

And so ended my first trip in Gaping Ghyll—a trip in which thrills alternated with spells of intense discomfort. The latter were duly paid for in kind by pronounced muscular stiffness the next day. Frankly, I had the utmost difficulty in persuading my reluctant and audibly creaking limbs to carry me downstairs to breakfast! This stiffness, however, was effectively if drastically cured by a trip down the 300 foot deep cave known as Alum Pot, and then on the day following, I paid another visit to Gaping Ghyll.

This time, the descent held no terrors. It was a thrill to be looked forward to. At the bottom, I spent some minutes at the unloading point, and each time the chair descended, helped the heavily-wrapped passenger to disengage himself from his safety-belt, before giving the whistle signal to tell

the winch operator that the chair could be hauled up again.

On this trip, I joined a large party paying a straight-forward, "sight-seeing" visit to one of the most beautiful sections of the cave—a half-mile series of chambers and corridors known as East Passage. Our guide led us up the boulder slope we had ascended on the previous visit, but this time we climbed right to the top of the pile and then up a short wooden ladder into a low tunnel. After about 50 yards of progress on hands and knees, or "at the stoop," we emerged into a spacious passage where we were able to walk along at our leisure past a magnificent array of stalactite formations. These grew from the roof and walls in almost unbelievable profusion, and there were many particularly lovely, translucent clusters reminiscent of gleaming icicles or ornamental wax candles. Names, perhaps slightly hackneyed, such as "the Canopy," the Pillar," "the Organ Pipes," and "the Curtain," do nevertheless give some idea as to their variety. Needless to say, the photographers in the party were soon busy, and before long we had made ourselves unpopular by filling the passage with dense clouds of smoke from our flash-powder.

Presently the roof ascended almost out of sight and the floor on our left dropped away into velvety blackness. This was the entrance to a vast chamber known as Mud Hall. A scramble, much aided by a fixed rope, down a steep bank of clay took us onto a narrow ridge which roughly divided the chamber into two parts. From here we slid down a precipitous mud slope for about 50 feet, using a hand line to keep our speed of descent under control. The slope then terminated in a vertical cliff, 30 feet deep, which we descended by rope ladder. The ladder rested against a wall which was plastered with sticky, yellow mud, and this mud was a gentle foretaste of things to come. No sooner had we descended to the broken, rock-strewn floor than we started to climb again—this time up a slope of debris, 80 feet high.

From the big passage which opened out at the top of this slope, we had a fine view back into Mud Hall. This chamber is about half the size of the Main Chamber, but is equally impressive in its own fashion. The general atmosphere of savage grandeur, the enormous scattered boulders, the empty blackness of the unlit corners, the drab colors of mud and rock, and the sheer, smooth walls vanishing in the shadows high above all left a vivid picture in my memory.

The passage leading on created another memorable impression—physical rather than mental, since the floor was covered with an apparently bottomless swamp of tenacious, treacly mud which threatened to remove my boots at every step. By now I consider myself a connoisseur as regards the different types of cave mud, and this was definitely in an "A-1" class of its own. After a while

we had a better opportunity still to appreciate its properties of viscous adhesiveness, since it unfortunately became necessary to start crawling. However, we passed many superb groups of glittering stalactites and fragile, dainty "straws" and these more than compensated for the shortcomings of the floor. A brief splash through a dirty pool, and then we entered a rather larger grotto, beautifully furnished with a succession of brilliantly white pendants and draperies whose very whiteness was perhaps emphasized by contrast with the murky brown of the all-pervading mud.

We continued along a passage, reminiscent, both in shape and size, of a large drain pipe, but which was thickly lined with delicate incrustations and many specimens of the curiously distorted, so-called "anaemolites." In due course we came to a lofty rift carrying a stream and we were able to follow the water downstream for about 100 yards before it disappeared through a hole in the right-hand wall. Our guide placed a lighted candle in this hole and then led us further along the passage which twisted sharply round to the right and down a rocky slope into a small terminal chamber. Overhead we could see the candle-light shining through a small window or "eyehole" in the ceiling, and the stream flowing through it splashed down a 20-foot waterfall and then disappeared for good amongst the rocks on the floor.

This chamber marked the end of East Passage. So, after the assembled group had been duly photographed, we started on our half-mile return journey. When we reached the Main Chamber again, we found it completely deserted. The chair was at the surface, so our leader tried to telephone the camp above to ask for it to be lowered. Unfortunately, the telephone, like most field telephones, was inclined to be temperamental, and we were unable to get any response from above. At first we began to wonder how long we should be stranded, but one of the party, apparently blessed with powerful lungs, put his fingers in his mouth and emitted a penetrating whistle which, although sounding comparatively thin in the empty space of the big chamber, was nevertheless heard at the surface. Still more important to us, its meaning was correctly interpreted and the chair came floating down. While all this was going on, I attempted yet again to photograph the Main Chamber; but although I fired a large charge of flash powder, the picture was once more a failure.

Three of the party ascended without incident. When the fourth man was halfway up, however, and dangling helplessly under the waterfall, the chair stopped, owing (as we learned later) to a breakdown of the motor. After a short, but probably very damp wait in the thick of the heavy spray, the luckless passenger was lowered rapidly down to the floor again. As the telephone was out of action, we could not tell what was happening at the surface and so just had to wait in pa-

tience. After five minutes, the chair started to ascend very slowly and from the jerkiness of its motion we guessed that it was being wound up by hand. The full journey to the top took from ten to fifteen minutes instead of the usual five, and must have given the unfortunate occupant of the chair ample time to reflect on the beauty, volume, and height of the waterfall.

After a further ten minutes, the chair came down again empty, but on the subsequent upward journey was raised at its accustomed speed, so we knew that the motor was running once more. I was the next to go up, and when I was nearly 100 feet above the floor, someone below lit a few lengths of magnesium ribbon. The fierce white blaze illuminated the whole chamber with dazzling brilliance and banished the gloom and shadows so that the walls just seemed to recede into limitless distance. The effect, as seen from my unique aerial viewpoint, was almost terrifying, but I was truly sorry when this wonderful sight was left behind as I traveled up through the roof and into the cold twilight of the main shaft.

I paid two more visits to Gaping Ghyll during the British Speleological Association "Meet" at Whitsun, 1939. This time, I arrived before the preparations for the descent were complete, and was able to assist in the lowering of the steel guide wire and the telephone cables. As mentioned earlier, a fixed cable guides the "Bosun's Chair" on a curved course to carry it clear of a projecting ledge. The first man down therefore always has to make an "unguided" descent and carries a pole to fend himself and his freely-swinging seat from the walls and ledges. When he reaches the bottom, the long, stranded guide cable is carefully lowered so that he can anchor it to a bolt in the floor of the Main Chamber. This was duly carried out on the present occasion, but the second man to descend then reported that the cable was too slack; and so, after some discussion, I was selected as the next "victim" and sent down to give my opinion. As I started the descent, I was sped on my way with the cheering statement "If anything goes wrong, you'll get your name in the papers!" However, the trip down seemed normal; and when I reached the bottom, I telephoned to the surface to say that the cable was satisfactory.

This particular visit to the cave was a brief one, and was largely taken up with the task of carrying ropes and tackle along East Passage to be fixed in Mud Hall. The next day, I made another descent, and this time managed to take a successful photograph of the Main Chamber. It necessitated a ten-minute time exposure to record the effect of the daylight coming down the main shaft, followed by the explosion of four ounces of flash powder. This made an impressive, reverberating bang which caused birds (dippers) nesting in the shaft to rocket up to the daylight and which also startled many of the people gathered about the entrance.

Then I joined a large party which was being shown the Southwest Passage, and later I took a party of my own along East Passage. One of the members of this latter group was wearing spotlessly clean, white overalls and was soon christened "Snow White." Needless to say, by the end of the trip, he was the same muddy color as the rest of us, so that his appearance did much to belie the nickname!

Southwest Passage branches off from South Passage, the beginning of which I had already seen on my way to Hensler's Passage. We made rapid progress for about 100 yards along a clean-washed rocky tunnel until we came to a place with the self-explanatory name of "T-Junction." Here we turned to the right and crawled on hands and knees along a sandy floor for about 40 yards. We emerged into a big chamber known as Sand Cavern, which was 250 feet long and in places 40 feet wide and high. As might be expected, its main feature was sand—tons and tons of it—and big soft slopes rose up on either side like desert dunes. A slippery climb up a clay bank at the far end took us up into "Stalactite Chamber." This was only a few feet high, but had a large floor area (200 square yards) while the flat roof was closely packed with innumerable stalactites, of all possible shapes and sizes. A short distance further on, we came to the adjacent "Stalagmite Chamber" where we followed a devious course through a forest of stumpy pillars, and then we entered a truly impressive corridor known as the "Stream Chamber." This was a long, straight canyon, 40 to 50 feet wide. Great mud slopes alternated with piles of boulders and debris beneath high walls of bare rock, so that the general nature of the scene was in dramatic contrast to the two richly decorated chambers we had just left.

After skirting cautiously round the black mouth of a 30-foot deep pothole, we came to a gigantic boulder of fallen limestone, measuring approximately 30 by 20 by 10 feet. Just beyond this, our guides led us into an active stream passage which branched away from the main canyon. We followed the water upstream for some distance, and eventually came to a high fissure where we discovered an energetic potholer trying to enter an "oven" or chimney some 40 feet up in the roof.

We stopped to watch his fly-like antics on the smooth and apparently ledgeless wall far above our heads, and held our breath anxiously on several occasions before he safely "abseiled" down to the floor again.

Then we turned back, and all went well until our so-called guides lost themselves in the miniature labyrinth of passages round "Stalactite Chamber." For a time the party seemed to travel round in small circles, each member in turn finding a fresh tunnel in which to go astray. Eventually, however, the right way on was discovered; so, in due course, we returned to the Main Chamber and to the daylight once more.

There are still many sections of Gaping Ghyll which I have yet to visit, but which can only be listed briefly here. In particular, I am looking forward to a trip along "Southeast Passage," which extends for roughly 250 yards from T-Junction, and which includes a sensational traverse round the side of the 100-foot deep Southeast Pot. Above this traverse the walls rise sheer for a further 100 feet; and, at the top, a confined and torturous climb leads to the surface at "Flood Entrance"—so-called because it provides a "backdoor" into the cave which might prove a possible escape route should rain and a swollen stream render the Main Shaft impassable.

Also, in case I have failed to give a fair impression of Hensler's Passage, I should mention that I have never penetrated to the real inner sections (beyond the 400-foot entrance crawl) where many lofty and extensive corridors and chambers are to be found. Again, I have yet to make acquaintance with the big "West Chamber," with the low bedding plane known as "Booth-Parsons Crawl," with the ominously named "Rat Hole" and perhaps many others, still to be discovered. I hope, however, that I have said enough to convey perhaps a faint impression of the magnificent and widely-varied underground scenery to be found in this fine cave.

First descended in 1895 by the great French speleologist, Edward Martel, it still challenges all ardent cave-explorers to penetrate even deeper into its innermost recesses and to persevere on their sometimes weary journeys "down through chasms and gulfs profound."

CAVE DIVING AS I SAW IT

By D. W. JENKINS*

IT HAS BEEN suggested that it might be interesting to know what the ordinary caver saw, felt, and thought while watching the Cave Diving Group at work. The description of such a scene is rather a difficult task as, fortunately, we are not all blessed with the same ideas; but, for what it

is worth, here is an account of what I witnessed while watching Bill Weaver and his men attack the terminal sump of Ogof-yr-Frynnon Ddu.

This occasion was the first time that I had come in contact with the Cave Diving Group and although I had been warned that there would be a great deal of equipment to carry up the cave I was surprised to see just how much lay ready in

*Through our friend, Gerard S. Platten, we are sent this interesting article on a newly-developed aspect of the science—Cave Diving.

a nearby barn. Then I was told that even more lay ready half-way up the cave—that really shook me.

Now, I had two objects in view on this trip. The first was to watch these divers at work, while the second was to take some photographs of the proceedings. I mention this because, while my head was still full of such pleasant thoughts as falling down a pot loaded down with Divers weights, Peter Harvey arrived and, noticing the camera, told me that the water was higher than usual, so that the chances of keeping it dry were few. After a conference with John Davies, who was going to carry the precious flash bulbs, we decided to risk it, and the camera was tied as high up my body as could be conveniently managed without strangling me.

The journey up the cave was not as bad as I had expected. One victim thought that the fourth pot was not as deep as it is—but he now knows better! Nevertheless, the water was higher than I had ever seen it before, and it would have been most uncomfortable had it been much higher.

Eventually we reached the rising and near it were situated two rocky platforms, one of which the Divers used as their "dressing-room," while in the other we set up the "cookhouse." Enough candles had been lit to make it look as though we were going to celebrate somebody's hundredth birthday, but they were soon put to shame when Arthur Hill got his flood lamp going. Little did we realize how useful that lamp was going to be in keeping us warm, as well as providing illumination.

While all this was going on the divers were getting undressed—or should I say dressed? Both, I suppose; whichever it was, it was a performance. By the time they had finished trussing themselves up I began to wonder if we were expected to carry them to the sump, but they seemed to manage very well. During these proceedings it was getting so cold that I began to wonder where I had lost my feet, so off I went to find a good spot for taking the photographs—and in doing so increased the circulation.

The first diver to go down was Bill Weaver, who as he said, "was going to have a look round." After I had taken a photograph of the three divers in their glory, Weaver set off. I did not go up the rising the first time so all I saw was the back view of several people and a length of cable disappearing into the water.

I had expected Weaver to be down quite a time but it was not many minutes before he was up again with the news that the water came through a rift, and that he did not think it was possible to get through. This was disappointing news for us as we had had great hopes of finding a new series, and I felt sorry for the Divers, too, who had come such a distance with all their equipment. The Divers now held a conference, so while this was

taking place I went to see what was going on in the cookhouse.

Great activity was taking place up here for Jack Riggs had got the primus going while Arthur Hill had great fun trying to fill a kettle with water from a torrent which went everywhere except where he wanted it. I wish I could have recorded for my readers the very amusing sight which then presented itself to me, of a certain person of fair dimensions lying on his side attempting to cut a new loaf into slices in a spot where Nature had provided no kitchen facilities whatsoever. Having gathered up a few crumbs I returned to watch Valcombe and Coase, who were going down, and then John Davies and I decided to take the remaining photographs before we became any colder.



Following these two olive-green figures—who looked like creatures from another world—to the end of the passage, I was fascinated to see them disappear and to watch their lights glimmer under the water. To me it was a most impressive sight. We took our photographs as best we could and cleared off out of the way back to the cookhouse, where we remained for what seemed an eternity.

By now hot drinks were ready, and during the rest of the period there was a constant supply. If ever a man deserved praise it was Jack Riggs who kept that kettle going. We sat on that ledge and perished with cold. Some performed physical jerks to try and keep warm while the rest of us went up the old river passage to get some of the frozen blocks of blood in our bodies moving. If this should give the impression that any of us were bored, it is unintentional. Far from this being so, I, for one, was most interested, but all of us were cold—very cold.

In spite of repeated efforts, and a great deal of perseverance, the divers were forced to give up.

This gave rise to a scene which I should like to see on the stage—that of them undressing.

Various frozen spectators, seeing a chance of getting warm, seized hold of various parts of the divers' outfits and proceeded, with malicious delight, to tug with all their strength, while the poor victims inside were slowly being suffocated or strangled.

Between eight-thirty and nine we started back, and were our troubles over! No—they were not, I stumbled and left a bit of my hand behind, another victim decided to fall over the waterfall instead

of climbing around it, while yet another (one of the divers) landed with great grace into the pool near the entrance. However, by ten we were clear of the cave, and we soon changed back into warm clothes.

From what I saw, and I am sure that all the other spectators will agree with me—the Cave Diving Group has won my undying admiration. Finally, a word to all cavers who have not seen these divers in operation: if you should get the chance of seeing them at work, do not miss it. It is certainly a sight worth seeing.

GEOPHYSICS AND ITS APPLICATIONS TO SPELEOLOGY

By E. L. KRINITZSKY

A FEW REFERENCES to the possibility of cave spotting through geophysics have recently appeared in the *Bulletin*. The writer does not believe that geophysical methods, in their present state of development, can be of any more than very limited value to speleologists.

For those persons who are not acquainted with this subject, the author would like to present a rough outline of the common methods of geophysical prospecting along with their shortcomings along speleological lines. One method, the electric probe, does stand above the rest by having speleological possibilities and so is discussed at somewhat greater length.

It should be stated in advance that the use of radar devices involves the detection of waves reflected from surfaces and that the present instruments do not have penetrating powers. Consequently they are of no use in exploring beneath the surface of the earth and, likewise, cannot be considered as geophysical instruments. However, future developments may change the present limitations of radar.

Geophysics in general is a highly specialized scientific activity and it is essential that workers in that field have a thorough foundation in physics and chemistry along with training in geology. Most of the equipment is intricate, limited in its usage, and extremely expensive. Also, data obtained by most of the methods may lend themselves to varying interpretations, so that an amateur would be almost incapable of producing results of any reliability.

GEOPHYSICAL METHODS

Geophysics is a study of the physics of the earth and includes such fields as Meteorology, Oceanography, Hydrology, and Vulcanology. When geophysical information combined with detector instruments are used in the search for minerals or rock structures, the procedures belong in the field of Applied Geophysics. The systems of explora-

tion are divided into five groupings that have wide usage: 1. Gravitational, 2. Magnetic, 3. Seismic, 4. Electrical, and 5. Electro-magnetic methods. In addition there are several minor means of collecting geophysical data which include Sound Reflection, Radioactivity, and Geothermics.

1. Gravitation

If all of the earth's crust were made up of a homogeneous material, there would be a constant gravitational attraction. But the materials of the earth vary widely in their densities and consequently in their gravitational pull. Such differences in the density of rock masses cause recordable changes (termed anomalies) on instruments designed to detect variations in the earth's pull. If a portion of the earth's crust has a greater density than surrounding areas, it will exert a greater gravitational attraction. Likewise, if the local density is lower, a decrease in gravitational attraction will result. Pools of oil have relatively low densities, and gravimetric surveys are made primarily in connection with petroleum work.

The instruments used for gravitational surveys are called gravimeters, and are built on the principle of sensitive spring balances. A few of the devices in common use are the Humble and Frost, Tomaschek-Schaffernicht, Wright, Boliden (an European electric device), and the Haalk (suitable for work at sea) types. All the instruments have a heavy mass that is attracted by the earth's pull. Connected with the heavy mass is a support that has the effect of a spring, and which is sensitive to changes in the earth's attraction for the heavy mass. Elaborate enlarging devices then magnify changes in the extension of the spring so that they can be easily observable. The unit of measurement is the milligal, which is a thousandth of a force which would give a mass of one gram an acceleration of one centimeter per second per second.

A large room within a cavern system that is at

a shallow depth might be detected by gravimeters; but, in general, those instruments are not sensitive enough to locate small subterranean channels or even large rooms when they are at a moderate depth. The instruments are most effective in indicating changes of density in extensive rock masses, and are not reliable enough to spot tiny local changes that would be caused by medium-sized caverns.

2. Magnetism

There are several devices, particularly dip needles and magnetometers, which are designed to detect changes in the intensity of the earth's magnetic field. Metallic ore bodies, particularly those containing iron, chromium, or cobalt, exert a magnetism of their own which is added to that of the earth's field and result in localized anomalies. However, caverns cause no magnetic disturbances and cannot be detected by instruments sensitive only to magnetism.

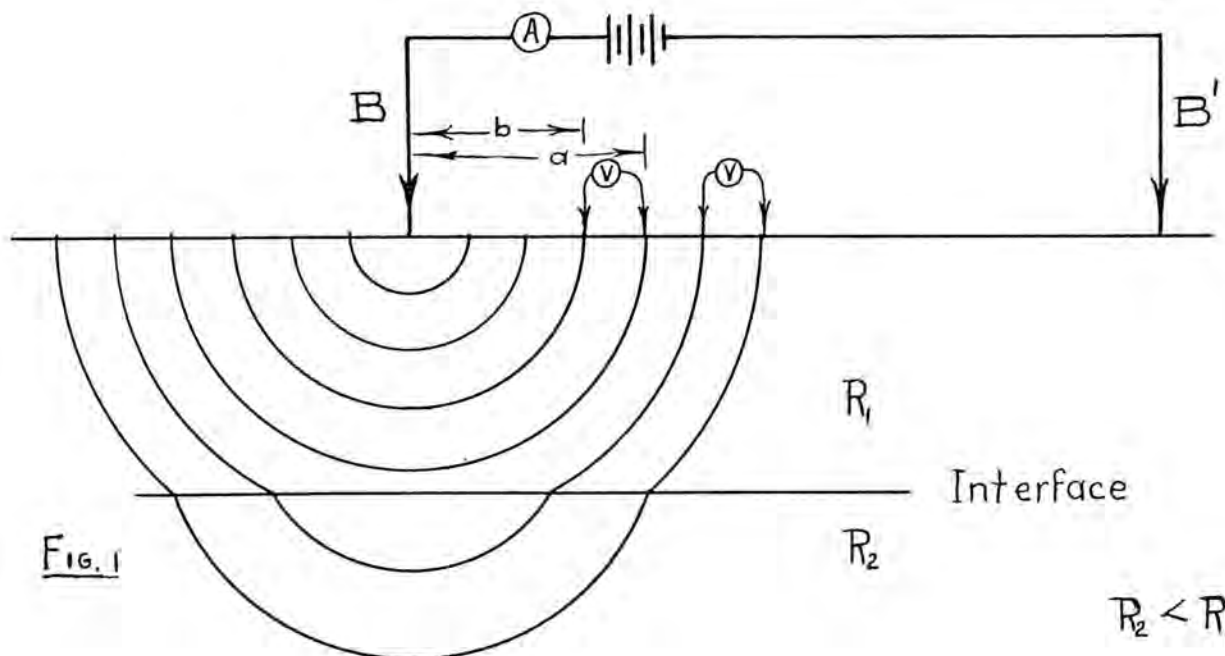
3. Seismic Methods

Concussion waves behave similarly to sound waves and so conform to the general laws of optics. Thus, changes in the materials through which concussion waves pass, will cause those waves to suffer possible reflection, refraction, and diffraction. The basic method of obtaining seismological data is the use of instruments to detect and measure the waves generated by dynamite detonations and the reflections and refractions resulting from their passage through horizons of varying lithology. Seismology is used primarily in the search for favorable geological structures in connection with petroleum work and is most effective in indicating the layout of rock-bedding below the surface. About 90 percent of all seismic surveys

utilize methods of recording reflected waves. In special work, where strata have over-steep dips or where there is no clear-cut reflection, refraction data may be used but with some difficulty. Were concussion waves to be intercepted by a cavern, they most likely would be scattered in a confusing manner, so that an exact location of the disturbance would be difficult or impossible.

4. Electrical Methods

Everywhere in the earth's crust there are weak electrical currents wandering about. They are caused, in general, by electrochemical reactions that result from the oxidation of ore bodies or disseminated oxidizable materials. All electrical currents conform to Ohm's Law which equates the voltage with resistivity multiplied by amperage ($E=RI$). And since the resistivity of strata may vary or at least become more effective, due to greater thicknesses as one gets further away from the source of an earth current, it is possible to locate the center or origin of an earth current by probing an area for related voltage changes. Such probing is accomplished by sinking metal electrodes into the earth at fixed distances apart. The electrodes, when connected with a conductive wire, will then transmit a part of the earth's current into the wire where it may then be measured by a sensitive galvanometer. The unit of measurement is the millivolt, which is one-thousandth of a volt. By plotting the voltage changes over a sufficiently large area, it is possible to track down the source of an earth current which, if generated by an ore body, will of course locate the position of the ore body. In the case of caverns, there would be no currents generated and the influence of cavities on natural earth currents would be too negligible to have interpretative value. Consequently,

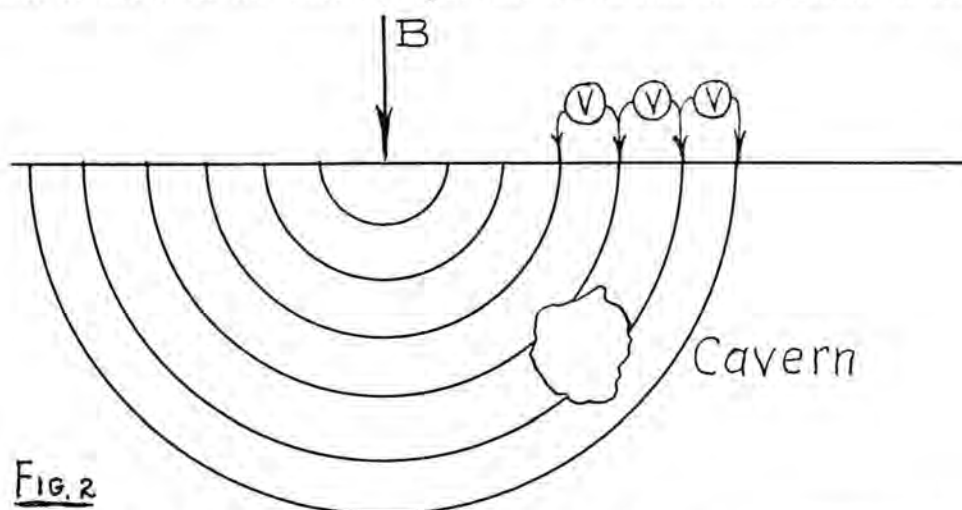


it would not be possible to use such currents in the search for caves.

But where natural earth currents are insufficient, it is frequently possible to introduce artificial earth currents and to observe their behavior. Such methods are used generally to determine depths at which rock strata change in composition by measuring the related change in their electrical conductivity. Figure 1 shows a schematic diagram of such a set up. Two electrodes (BB') are sunk into the ground and wired to each other. A battery is attached as a source of current and an ammeter is connected into the circuit to measure the current. The electrodes BB' should be apart at a distance of five times the effective depth that is

lower horizon should have a greater resistivity than the upper, a reversed condition will exist. By measuring the radii of the shells, it is possible to determine the depth of the interface marking the stratum causing the disturbance.

By similar analysis (see Figure 2) it would be possible to locate a cavern through careful observation of voltage drops. A cavern, of sufficient size, would have the effect of a small volume of exceptional high resistance to the current. Consequently there would be an increase in the surge of current in the remainder of the shell and such could be observed on the surface. However, there are difficulties encountered in determining the exact location of the cavern. It would be necessary to



to be explored. In an ideal homogeneous rock mass, the current would flow radially outward (shown by concentric lines) and the equipotential front would have a hemispherical shape. By measuring the voltage drops, as indicated in the figure, it is possible to determine the resistivity (R) of the individual hemispherical shells through the formula:

$$R_{(\text{of a shell})} = 2\pi \frac{E}{I} \left(\frac{ab}{a-b} \right)$$

where 'E' is the voltage, 'I' is the current, 'a' is the radius of the outer equipotential front, and 'b' is the radius of the inner equipotential front.

When a uniform rock mass is probed, there will be a consistent and regular drop in the voltages of the succeeding shells. But, when such a shell penetrates into a rock horizon in which the resistivity is different, a distortion of the shell will take place. In Figure 1 the two outer shells have penetrated into a horizon which has a lowered resistance, and consequently permits a great surge of the current into the lower horizon and has a short circuiting effect on the parts of the shell nearest the surface. Consequently, the voltage drop at the surface will suddenly be greatly increased. If the

make several shiftings of electrode B in order to make an accurate location.

It is doubtful if this method could be of much use in spotting normal-sized caverns at depths of greater than 50 feet, but it is of decided value in locating those cavern passages that are always associated with clogged sink holes and to which access might be feasible. It may be of interest to mention that such a survey, when made by a geophysical service company, entails an expense of from \$3,000 to \$5,000 per month.

5. Electro-magnetic Methods

The electro-magnetic methods represent special adaptations of electrical devices in order to determine magnetic influences which are either natural or induced. As has already been stated, caverns have no magnetic influences themselves, and consequently cannot be located by such analysis.

Conclusions

The electric probe is about the only geophysical method of exploration that can be of some usefulness to a speleologist. However, expert handling is required and equipment is apt to be expensive. This system of exploration is of the greatest value for the location of blocked cave entrances located near or in sink holes, and consequently has possible practical applications.

ANCIENT CAVE LORE

By BENTON P. STEBBINS*

CAVES HAVE EXCITED the awe and wonder of mankind in all ages, and thus figured largely in legend and superstition. In the Roman mythology, they were the abode of the Sybils and Nymphs; and in Greece they were the places where Pan, Bacchus, Pluto, and the moon were worshipped, and where the oracles were delivered, as at Delphi, Corinth, and Mt. Cytheron; in Persia they were connected with the obscure worship of Mithras.

Their names in many cases are survivals of the superstitious ideas of antiquity. In France and Germany they are frequently termed "Fairy Dragons," or "Devil's Caves" and, according to M. Desnoyers, a French writer, they are mentioned in the invocation of certain canonized anchorites, who dwelt in them after having dispossessed and destroyed the dragons and serpents which they were supposed to contain; thus making the pagan superstition appear in a Christian dress.

In the Middle Ages they were looked upon as the dwellings of evil spirits, into the unfathomable abysses of which the intruder was lured to his own destruction. Long after the fairies and little men had forsaken the forests and glens of Northern Germany, they dwelt in their palaces deep in the hearts of the mountains, in "dwarf holes," as they were called, whence they came, from time to time, into the upper air.

Near Elbingrade, for example, in the Hartz Mountains, the legend was current in the middle of the last century, that when a wedding-dinner was being prepared, the near relations of the bride and bridegroom went to the caves and asked the dwarfs for copper and brass kettles, pewter dishes and plates, and other kitchen utensils. They then retired a little, and when they came back, found everything they desired set ready for them at the mouth of the cave. When the wedding was over they returned what they had borrowed and, in token of gratitude, offered some meat to their benefactors. Allusion, such as this, to dwarfs, according to Prof. Nilson, points back to the remote time when a small primeval race, inhabiting northern Germany, was driven by invaders to take refuge in caverns—a view that derives support from the fact that in Scandinavia the tall Northmen were accustomed to consider the smaller Lapps and Finns as dwarfs and invest them with magic power, just as in Palestine the smaller invading peoples considered their tall enemies giants.

*In 1879, Benton P. Stebbins prepared for publication, the manuscript for a booklet intended, primarily, to describe the beauties of Luray Caverns, which he had discovered. The booklet was never published; but we here-with present excerpts from the original manuscript, as sent us by his son, C. A. Stebbins, now a member of the NSS.

The cave called Bauman's Hole, in the Hartz district, was said in the middle of the last century to have been haunted by divers apparitions, and to contain a treasure guarded by black mastiffs; and at Burrington Combe, in Somersetshire, England, some 35 years ago, a cave was dug out by a working man under the impression that it contained gold. The hills of Granada, in Spain, are still believed by the Moorish children to contain the great Boabdil and his sleeping host, who will awake when an adventurous mortal invades their repose, and will issue forth to restore the glory of the Moorish Kings.

It is, indeed, no wonder that legends and poetical fancies such as these should cluster around caves, for the gloom of their recesses, and the shrill drip of the water from the roof, or the roar of the subterranean waterfalls echoing through the passages, and the white bosses of stalagmite looming like statues through the darkness, offer ample materials for the use of a vivid imagination.

The fact that often their length was unknown, naturally led to the inference that they were passages into another world. And this is equally true of the story of Boabdil; of that of the Purgatory of St. Patrick, in the north of Ireland; and of the course of the river Styx, which sinks into the rocks and flows through a series of caverns that are the dark entrance-halls of Hades. The same idea is evident in the remarkable story, related by Aelian, an ancient author (in Liber XVI - 16). He says, "Among the Indians of Areia there is an abyss sacred to Pluto, and beneath it are vast galleries, and hidden passages and depths, that have never been fathomed. How these are formed the Indians tell not, nor shall I attempt to relate. The Indians drive thither (every year) more than 3,000 different animals, sheep, goats, oxen, and horses—and each acting from dread or of the dreadful abyss, or to avert an evil omen in proportion to his means, seeks his own and his family's safety by causing the animals to tumble in; and these, neither bound with chains nor driven, of their own accord finish their journey as if led on by some charm; and after they have come to the mouth of the abyss, they willingly leap down, and are never more seen by mortal eyes. The lowing of the cattle, the bleating of the sheep and of the goats, and the neighing of the horses are heard above ground, and if anyone listens at the mouth, he will hear sounds of this kind lasting for a long time. Nor do they ever cease, because beasts are driven thither every day. But whether the sound is made by those recently driven in, or by some of those driven in sometime before, I do not express an opinion."

At the time of the Reformation it was believed that a cave at Bishofferode would prove the death of some person in the course of the year, unless a public yearly atonement were made.

"Accordingly, a priest came, on a certain day to the chapel on the hill opposite, whence he passed in solemn procession to the cave, and let down a crucifix, which he pulled up again, and took this occasion to remind them of hell, and to avoid the punishment due to their sins."

The beauty of the interiors of some of the caves could not fail to give rise to more graceful fancies than these.

The fantastic shapes of the formations with which they are adorned, now resembling Gothic Pillars supporting a crystalline arcade, or jutting out in little spires and minarets, and in some instances covering the floor with a marble-like pavement, and lining the pools of water with a fretwork of crystals that shine like the facets of a diamond, were fitting ornaments for the houses of unearthly beings, such as fairies.

Caverns and the Geologist

It is by no means the intention of the writer of this little book to give a history of legends, such as these, however interesting they may be to the readers; but to give a very faint, and perhaps imperfect description of the wonderful, newly discovered Luray Caverns in Page County, Virginia. Not that this is the only cave in the world of note, or that they are of no interest or value, except for the pleasure of seeing their vast aisles, immense chambers, and beautiful rock formations; for the scientist and geologist, they offer far more than this.

They give an insight into the wonderful chemistry by which changes are being wrought, at the present time, in the solid rock. They enable us to understand how some of the most beautiful scenery in the world has been formed, and to realize the mode by which all precipices and gorges have been carved, out of the calcareous rock.

Caves have been used by man and the domestic animals under his protection, from the very earliest times recorded in history, down to the present day. Those penetrating the rugged hills and precipices of Palestine, we read in the Old Testament, served both for habitation and for burial; and from the notices which are scattered through the early Greek writers, we conclude that those of Greece were used for dwelling places also. The caves of Africa have been places of retreat from the remotest antiquity down to the French conquest of Algeria; and in 1845 several hundred Arabs were suffocated in those of Dahra by the smoke of a fire kindled at the entrance by Marshal (then colonel) Pelissier. Dr. Livingstone alludes in his writings to the vast caves in Central Africa, which offer refuge to whole tribes with their cattle and household stuff. In France, according to one writer, there is at the present time a

whole village, including the church, to be found in the rock, which are merely caves modified, extended, and altered by the hand of men.

There are indications in all limestone regions of numerous caves yet undiscovered, though very likely but few of them would be worth anything to the finder to exhibit. Prof. Shuler estimates that in Kentucky alone "there are at least 100,000 miles of open cavern beneath the surface of the acarboiferous limestone," and Prof. Hovey says that his observations have led him to the conclusions that there are thousands of miles of such subterranean avenues beneath the same formations in the state of Indiana. So also in the Shenandoah Valley of Virginia wherever limestone exists, the indications are that there are numerous caverns unexplored and more than likely never will be.

All caves of any size are found in calcareous rocks; that is, in carboniferous, or more properly sub-carboniferous and cretaceous limestones; mostly in the sub-carboniferous, less in the cretaceous; and very few in rocks composed of gypsum; so if your hills are composed of limestone, there may be caves in them; but if they are sandstone, granite or slate, you will find it useless to look for caves.

Why are they found in limestone and not in other kinds of rocks? Simply from the very reason that water does not dissolve sandstone, or granite, while it does more or less all kinds of limestone.

Nearly everyone knows what hard water is; that it is water impregnated with lime, and that a tea-kettle becomes coated on the inside with a crust of lime in a short time after using hard water. Caves then are formed by the dissolving and wearing away of the softest parts of the rock, in the immense ages of the past, forming long avenues, narrow passages, large irregular shaped rooms, and deep ravines which in some instances are almost unfathomable. In some cases rivers are found in caves, as in the Mammoth Cave of Kentucky. Also rivers and streams, in limestone countries, run many miles under ground. Near Hanover, Indiana, a stream flows out of the hills, which has been followed a mile and a half towards its source underground. Lost River, in the same state, after becoming a large stream, flows into a cavernous opening, and continues for miles along a subterranean channel, alternately rising to the surface and sinking again several times before it finally emerges a mile below Orangeville, Indiana. Also there is Lost Creek, in Virginia.

When space enough is formed in the limestone rocks underneath, then stalactites and stalagmites commence to form. The mould of the soil above, being acted upon by moisture and air, evolves carbonic acid, which is taken up by the rain. The rain water thus impregnated, penetrating or permeating the calcareous strata, has the power of taking up a portion of the lime; that is, dissolves a portion

of the rock, which it retains in a liquid condition, until from evaporation the excess of carbonic acid is parted with, when the lime precipitates and returns to the solid state again; that is, after the water has percolated through the rock and hangs in drops on the surface beneath, the carbonic acid evaporates the lime deposits and forms the incrustations, stalactites, stalagmites, etc.

Where the water drops slowly the lime all deposits before reaching the floor, the result being a stalactite; that is, a formation hanging from the roof, without a corresponding stalagmite below; whereas if the water drops a little faster, not giving time for the lime to all deposit, then a stalagmite is found directly under the stalactite, varying in size and height, according to the rapidity of the dripping. Consequently, where the dripping of the water is fast, the result is a stalagmite with no stalactite above, and vice versa; but where they form equally fast at each point, they finally meet midway in the room, and form a column. If earthy

matter is retained, then the formations look dirty and muddy, taking the color of the soil it retains. But if the filtration is perfect, the formations are as white as the driven snow. It is, in fact, pure alabaster. Some of the rocks are black, and white running over the black makes slate color. A great many of them look like rusty iron. Some are blue, and in a few instances we find a beautiful green color; in fact, nearly all the colors of the rainbow are seen with the aid of a brilliant light.

The formations are found in all stages of growth, from the smallest pipe stem of a few inches in length, to the massive columns, 30 or 40 feet in diameter, and 25 to 50 feet in height. So, too, they are of all ages, from the tiny new ones to those that are crumbling and falling to pieces returning back to their native elements.

[There follows a fine description of the principal features of Luray Caverns, which may sometime appear in the pages of the *Bulletin*.]

NOTES ON PHOTOGRAPHY AS APPLIED TO SPELEOLOGY

By JOHN MEENEHAN and HOWARD WATKINS

WHY TAKE PICTURES in caves? No reason is really needed because any picture-taking is fun. Photography is a universally popular hobby, and it acquires a new savor when the photographer applies his skill to the difficulties of cave picturization. Of course, if pressed for reasons, the photographer can supply any number—the desirability of making a permanent record of each cave studied; the illustration of changes in a given cave by comparative photographs over a period of time; arousal of interest in the work of the National Speleological Society and picturization of its activities; and in connection with the development of caves for purposes of national defense. The fact remains, however, that picture-taking is fun, and all other reasons while sufficient in themselves, are usually subordinated to this very human one.

In the Society we have a number of very excellent photographers, but unfortunately their art is viewed by relatively few people. To relieve this situation it is suggested that each grotto have a photographic committee which would make arrangements to exchange pictures at intervals. This applies particularly to collections of color slides. In these exchanges duplicates of the best shots should be used, as the originals are often irreplaceable. Such exchanges would have the effect of stimulating interest in cave photography and would allow members to view caves they have not had the opportunity of visiting personally.

Kodachrome transparencies are the simplest method of seeing the true beauty of cave interiors, since most artificial lights are of such low color temperature that the most colorful formation looks more or less drab. The photographers in each grotto should be encouraged to give exhibitions, but their shows should be planned and edited and not presented as a haphazard collection of slides.

Those who would take pictures in caves face certain difficulties inherent to speleology. The one of prime importance is the difficulty of transporting enough supplies to take pictures and still have freedom of movement in restricted passages. This can be overcome in several ways. Willing assistants can be found on almost any trip, and the excess load distributed among them. The materials can be placed in a gadget bag of the type usually sold in photographic stores and carried over the shoulder by a strap, leaving both hands free for climbing. These bags are of sufficient size to hold a camera, battery case, and reflector, extra film and filters, and a large supply of flash-bulbs. A .30 or .50 caliber cartridge box can be padded and used in the same manner.

The authors visited a war surplus store and obtained vests which were designed for crash survivors in out of the way places. Each vest has seventeen pockets of various sizes fastened by snaps, including two large inside pockets which can each hold comfortably twelve to fifteen GE

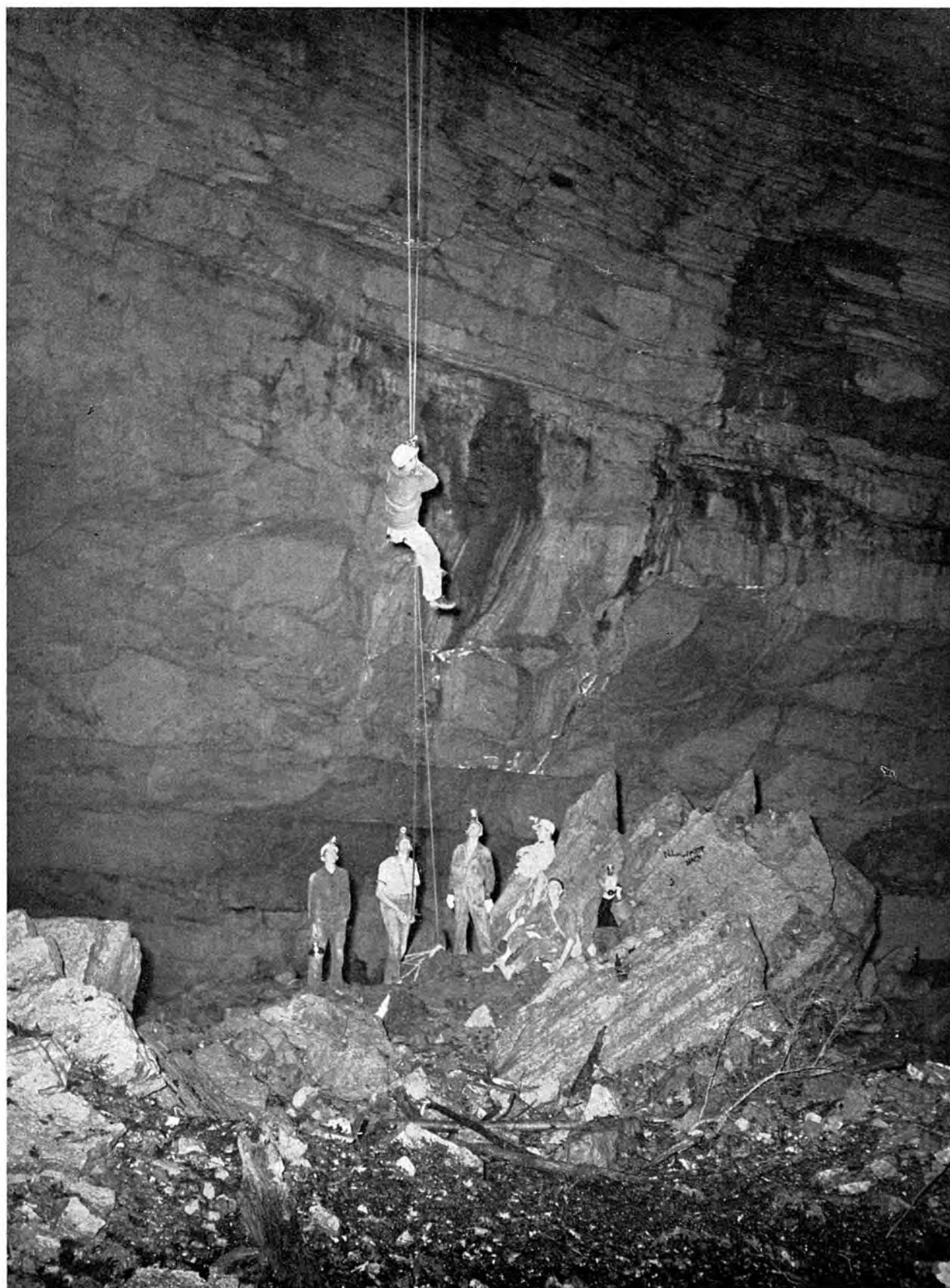


Fig. 1—HELL HOLE, near Petersburg, W. Va., July, 1946. Taken with the aid of a focusing reflector with one Wabash No. 25 bulb on a fast panchromatic film. Notice tremendous areas covered by the light. Pix by Howard Watkins.

No. 5 or Wabash No. 25 flashbulbs. As flashbulbs are one of the hardest articles to transport safely, this is an important consideration. In the fifteen smaller pockets there is room for a compact miniature camera, lens shade, filters, lens tissue, small tripod, plastic bag for protecting the camera against dust and moisture, battery case and reflector, extra film, and a few other gadgets.

In taking pictures underground, all the regular precautions of proper focusing, lens opening, and shutter setting, must be taken, and in addition there are other special conditions to be met. In caves where the humidity is high, the breath exhaled by the photographer can hang like a cloud between camera and subject and ruin an otherwise good picture. The breath should be exhaled from a corner of the mouth and the area in front of the camera examined for vapor before the picture is taken. Smoke from a cigarette has a similar effect. Also, moisture has a tendency to condense on the lens or filter and pictures taken under these conditions are invariably blurred. Both lens and filter should be examined after entering the cave, before the first picture is taken, and periodically thereafter.

There is a tendency to underexpose cave pictures. This is due to the absorption of light by dark walls, large open expanses, and the scattering of light by dust and moisture in the air. Treat pictures in any large room exactly the same as pictures taken outdoors at night, i.e., by opening the diaphragm one extra stop. With color film and midget bulbs the effective maximum working distance is about thirty feet, but this limitation can be side-stepped under certain circumstances which will be explained later. Midget bulbs are the most practical light source for use in caves, as they always give a uniform amount of light and since transportation limitations rule out the carrying of many larger size bulbs. Also, the size and shape of the midget bulb allows it to stand a lot of abuse and punishment without breaking. With a focusing reflector and a fast panchromatic film, the effective maximum working distance is seventy-five to one hundred feet (Figure 1). Black and white film offers considerably more latitude than this, and exposure need not be so accurate as for color film, which must be exposed correctly to within one-half stop.

The equipment for taking pictures can be divided into two classes: the essential and the desirable. Under the former heading are camera, light source, and film. Anything in addition to these items is merely desirable. Therefore, equipment may be as elaborate as the personal taste and purse of the operator allows.

In the opinion of the authors, the best camera for cave color work is the E. K. Bantam Special. It has a fast, wide-angle, lens; is of sturdy construction; and closes into a small, rounded shape that slips easily into a pocket. Another very de-

sirable camera is the E. K. Bantam 4.5. This has many of the features of the Special, and costs but a fraction as much. The lens was designed for Kodachrome and is highly color corrected. The E. K. Retina, Models I and II, is also a camera that lends itself to cave work, although this camera can now be obtained only on the used market, having been manufactured in Germany for Eastman Kodak.

The battery case and reflector are a matter of choice. The reflector should be strongly constructed to resist denting and bending. Otherwise the light will be spread unevenly and the picture will have "hot spots." The Heiland Co. makes a focusing reflector for miniature bulbs which allows changing from a field light of 60 degrees to a beam light of 36 degrees. We have tried this reflector on numerous trips, and are well satisfied with its performance, the only objection being its size. The results obtained, however, are considered worth the trouble of carrying it.

There are five types of miniature bulbs. The GE No. 5 and the Wabash No. 25 are general purpose; the Wabash No. 25 used in conjunction with a Wratten 2A filter being our choice for color. With a synchronizer there is little choice between them, but with the open flash technique the No. 25 gives somewhat more light and pictures can be taken at a greater distance. The GE No. 6 is designed for use with cameras having focal plane shutters and burns for approximately 1/15th of a second. It has about the same total light output as the No. 5 bulb. The S.M. (Speed Midget) burns at a speed of 1/200th of a second, but has only one-half the light output of the No. 5. These two bulbs may be used as substitutes for the No. 5 or the No. 25 but are not as suitable for general use. The No. 5B is coated with a blue lacquer and is color balanced for use with daylight Kodachrome. It gives about 2/3 the light output of the No. 5, and may be used for black and white films and for special effects with Types A and B Kodachrome.

At first glance a tripod seems like excess baggage on a cave trip, but the definition of pictures taken from a tripod is far superior to those taken by hand only. The tripod should be sturdy enough to hold the camera steady and large enough to resist being knocked over. A small miniature tripod of the auto-top variety takes up little room and may be used occasionally with miniature cameras.

For black and white flash pictures no filter is necessary; but for correct color rendition, the GE No. 5, should have an E.K. color correction filter No. 15, and the Wabash No. 25 should have the Wratten 2A filter used with it. The effect of both these filters is to eliminate excessive blue from the flash. A lens shade serves to hold the filters and protects the lens from moisture and dust. It also serves to keep "wild" light from striking the lens and fogging the picture. When the camera is not

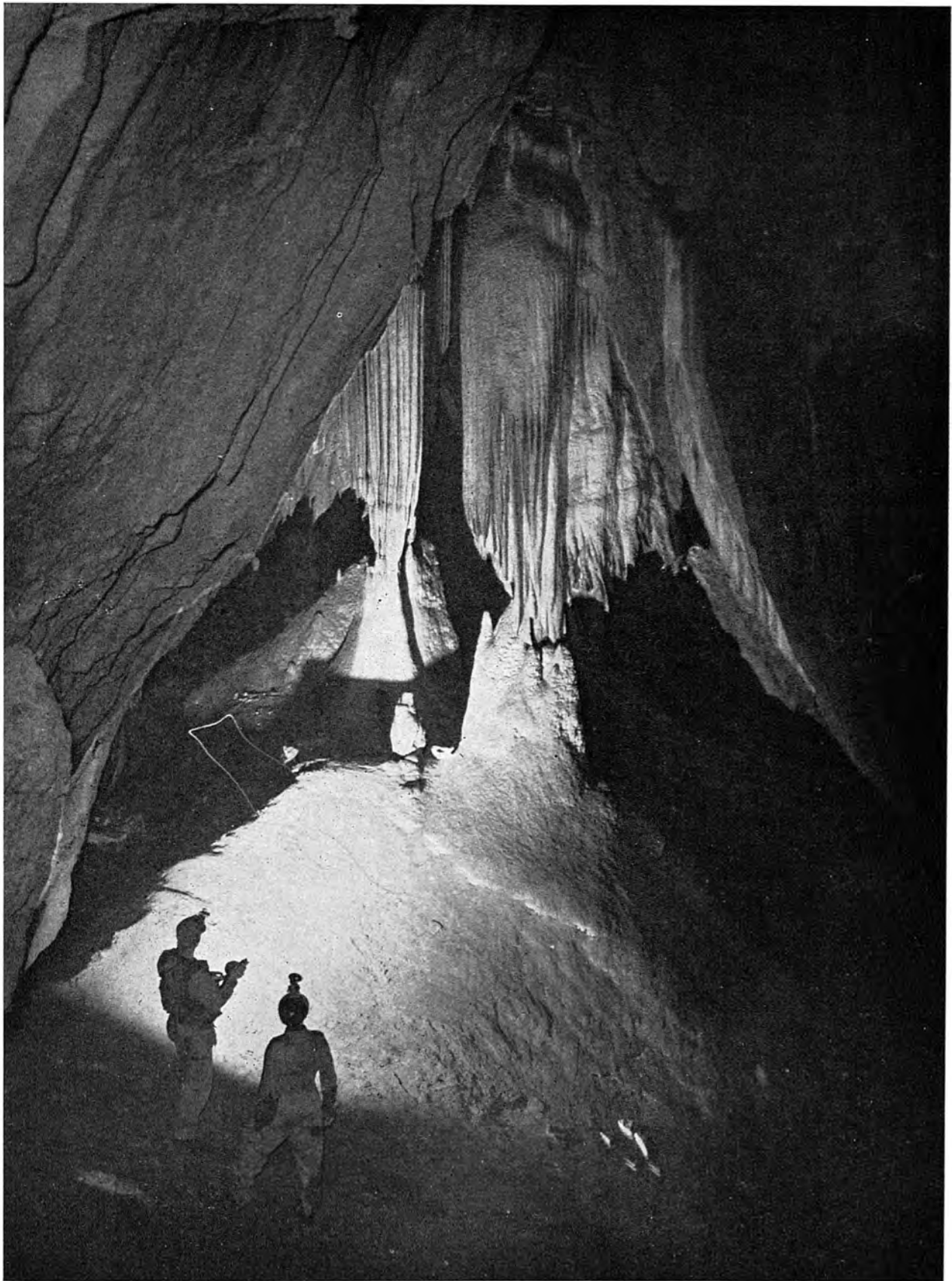


Fig. 2—ELKHORN MT. CAVE, Petersburg, W. Va. Meenehan and Tanner in the foreground looking like Supermen in an eerie out-of-this-world setting. Pix by Howard Watkins.

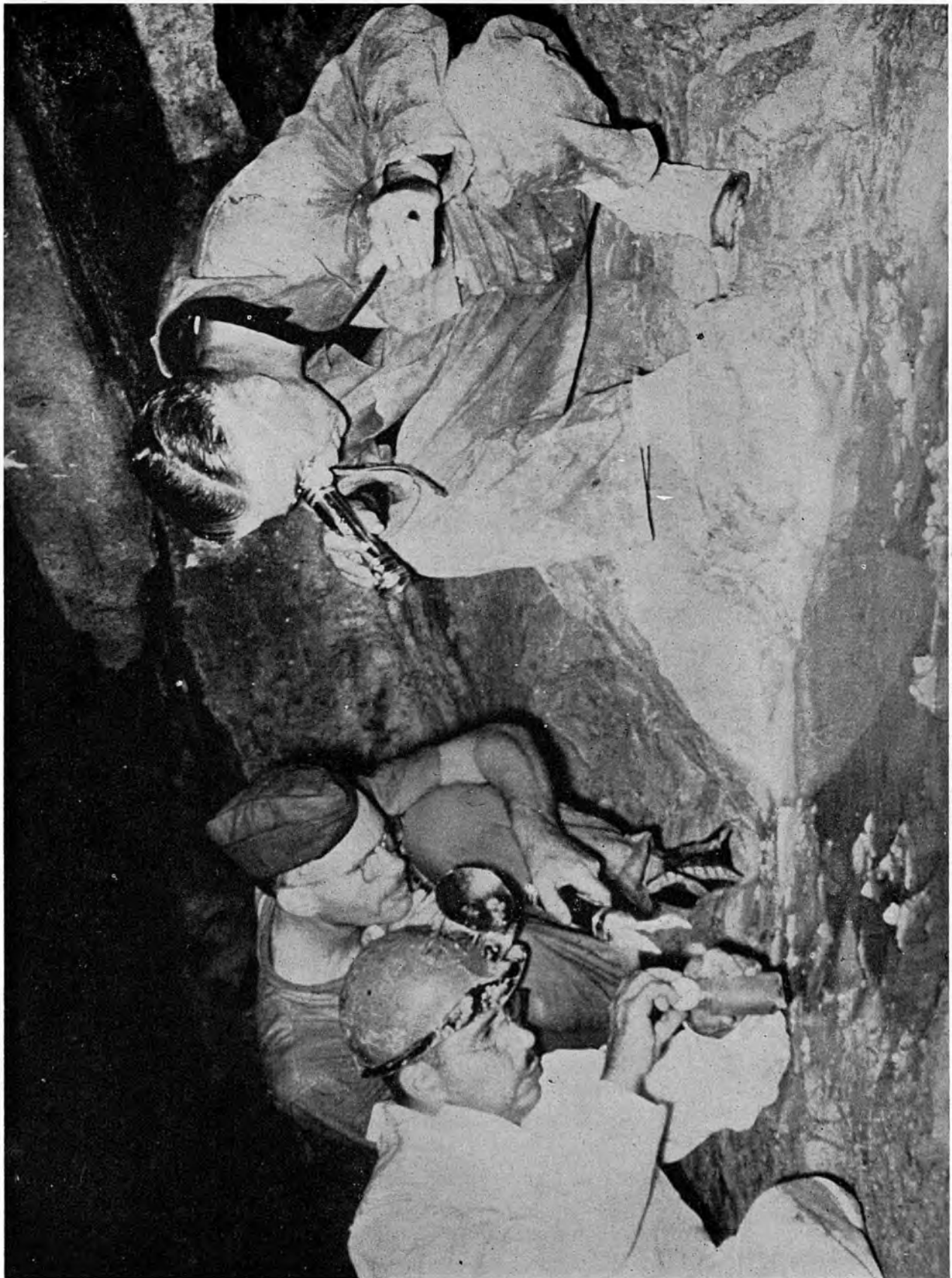


Fig. 3—Left to right: W. J. Stephenson, N.S.S. President; J. S. Petrie, Corresponding Secretary of the Society, and "longest underground" of any of its 700-odd members; Al Lewis, member No. 23, all collecting snails (probably for Dr. Joe Morrison) in WYANDOTTE CAVE in Indiana. Pix from BULLETIN NINE, N.S.S. [28]

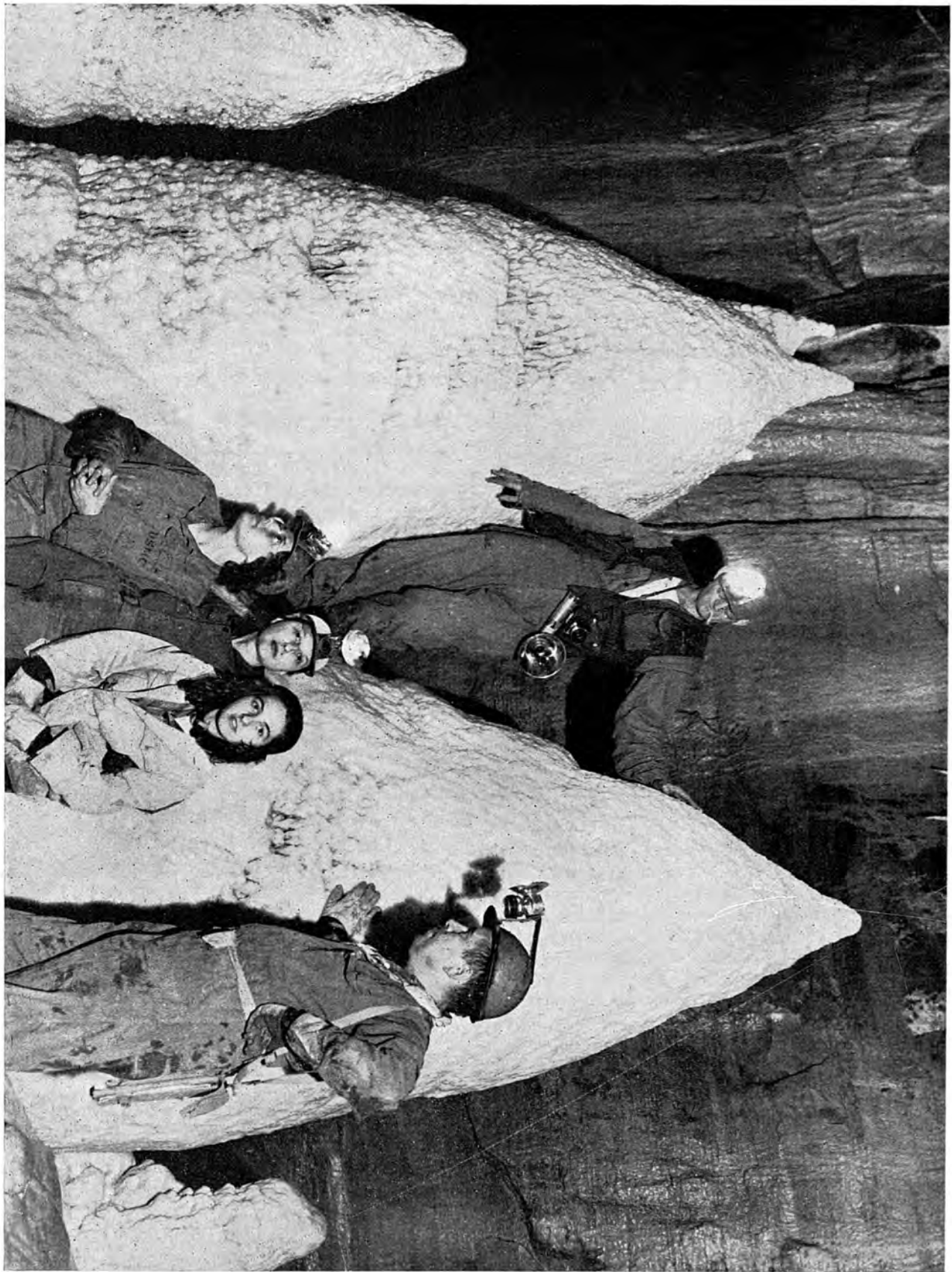


Fig. 4—Straight single flash shot to illustrate the size of the stalagmites in GRAPEVINE CAVE near Lewisburg, W. Va. Clara "Dutch" Scholtz, Gwen Wilson, and Marion Mitchell look pretty; Bill Stephenson looks bored; and Meenehan looks cynical. Note vest on latter—the type mentioned in article. One Wabash No. 25 on pan film. Pix by Howard Watkins.

in use it should be kept in a case to protect it from water and dust.

The difficulty of estimating distance in caves is common knowledge and, because of this, a camera with a range-finder attached or a separate range-finder should be used to determine the correct focus. If the subject is a person, his light is the easiest thing on which to focus. The range-finder on the Bantam Special is one of the best as it has a magnification of 3.1X.

Comparatively speaking, the art of speleological photography is in its infancy. There is need of experimentation to determine the best ways of picturing the netherworld. In order for the experiments to mean anything, records must be kept showing the number of the picture, the distance from light to subject, the lens opening, and all other pertinent information. The resultant picture can then be properly evaluated. Only in this way can definite rapid progress be made.

We have found that two photographers working together can achieve much better results than one photographer with a party. For instance, there is no limit to the number of pictures that can be exposed on one bulb by "riding the flash." This conserves one of the photographer's most vital supplies and allows more extensive trips to be properly photographed. Then, too, photographers working together are not prone to skimp on the time necessary to make a good picture in order to explore the cave.

Formations record beautifully in pictures; but without something of known size in the picture, much of its effect is lost. Anything from a human figure to a pack of cigarettes may be used to show the scale.

Earlier in this article we mentioned that the distance limitation of flash pictures might be avoided. Our method is this. The photographer selects his subject and gives his assistant or assistants hand flash equipment. The shutter is set on time, and the assistants are stationed so that when they flash their bulbs their bodies will be silhouetted against a rock or wall. If the camera is on an elevation the subjects may be silhouetted against the floor. The photographer sets off his flash and immediately the assistants flash their bulbs, lighting up the area in front of them and at the same time giving scale to the picture (Figure 2). In our opinion this is one of the greatest single steps in cave photography. So far, the greatest number of assistants employed has been three, but experiments are still continuing.

It has been said that one picture is worth 10,000 words, but this is true only if the picture has something to say. Few things can be duller than a group of people staring aimlessly into a lens. Try to have the models doing something to give an excuse for the picture (Figure 3). The partial exception to this rule is that record shots should be made of personnel on the trip, the entrance to the

cave, distinctive features of the cave, the activities of the NSS in the cave, unusual formation, and anything else that is peculiar to the cave.

There is a wide choice among the flash techniques that may be employed, the most common being a straight flash shot with the light source near the camera axis (Figure 4). This gives a flat lighting which is suitable for color, but which washes out detail in monochrome prints. By using multiple flash this bad effect of flat lighting can be overcome (Figure 5). The main or "key" light is placed very close to the camera and a fill-in light is placed at the apex of an imaginary isosceles triangle, of which the subject and camera limit the base. It is recommended that the reflectors used be of the same type, but this is not absolutely necessary.

The authors like cross lighting even for color film. (Figure 6). The exposure for the film is calculated from the distance between the key light and the subject, the light from the fill-in being ignored. Pictures taken with the use of flash back-lighting, reflected light, and with a combination of flash powder and flash bulbs will be reported on at a later date, being still in the experimental stage.

The flash may be synchronized to the shutter or pictures may be taken by the open flash method. The main disadvantage of the latter method is that models may move their lights while the shutter is open and make streaks on the film. This effect can be minimized by carefully placing the models and getting them to lower their lights. In our opinion the advantages and flexibility of the open flash more than counterbalance its bad features.

Proper exposure for each shot resolves itself into a problem of simple mathematics. Each type of film is assigned a guide number by the manufacturer of the flash bulb used. To arrive at the exposure, using open flash, the guide number is divided by the distance in feet from light to subject and the quotient is the nearest lens opening for that distance. In large caves where we take most of our pictures, we have found that, using Kodachrome Type A and No. 5 or No. 25 flash bulbs, the guide number should be about 75. Now, if you wish to take a picture at fifteen feet, then $75/15$ equals 5, or f.5.6. In large caves or those with dark walls you should use the next larger opening of f.4.5.

The blue flash bulb may be used to enhance the clear beauty of a pool by flashing it down into the pool as a supplemental light. When taking pictures at less than six feet it is advisable to place a diffuser over the lamp to soften and reduce the amount of light. A clean handkerchief or plastic bag may be used; then it becomes necessary to give twice the normal exposure.

Since there is danger of damaging or losing

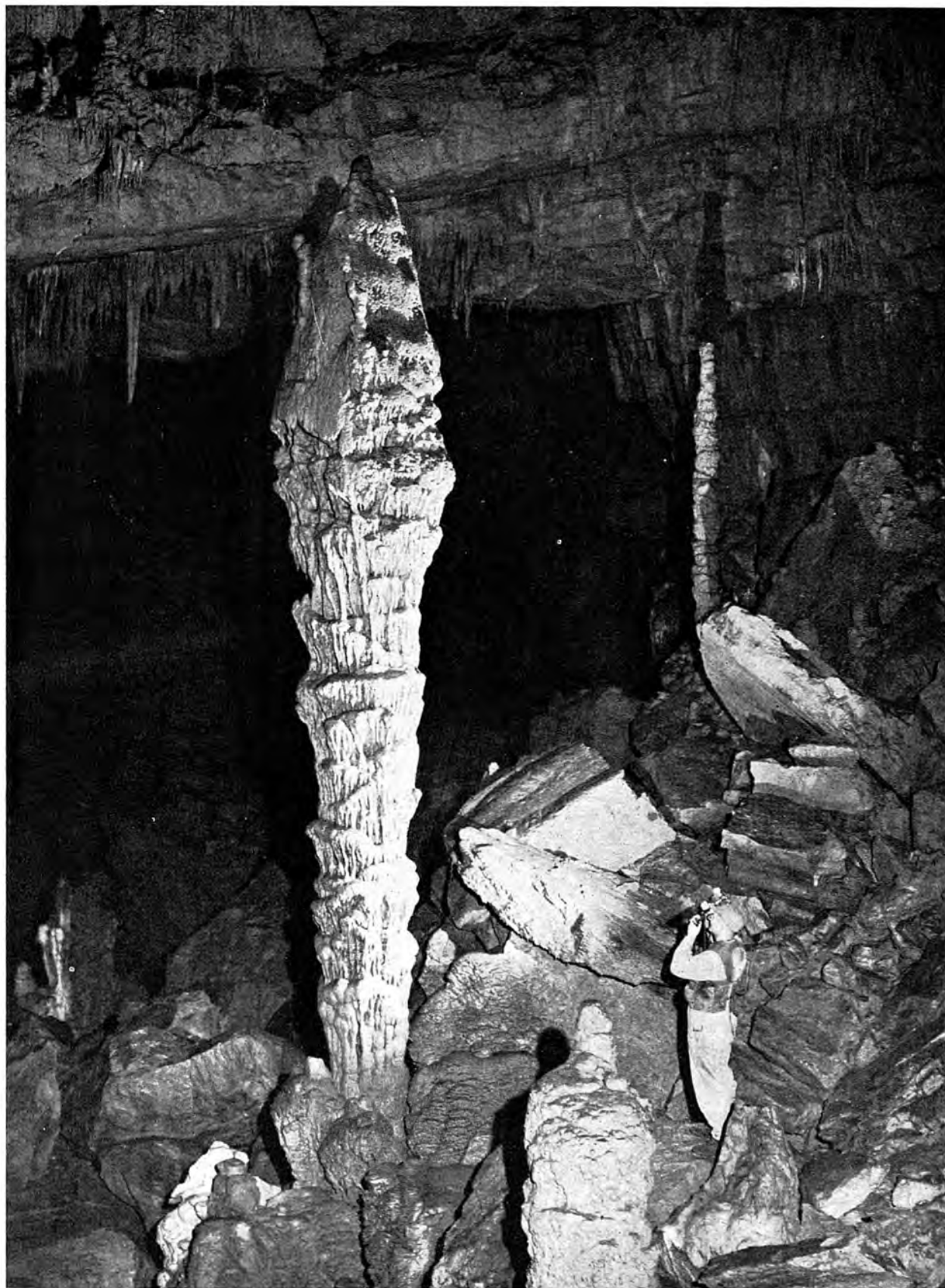


Fig. 5—Multiple flash shot taken in GRAPEVINE CAVE. Main light is Wabash No. 25, used by Watkins at camera, and cross-light supplied by Meenehan. Note great improvement in detail over Fig. 4 picture.

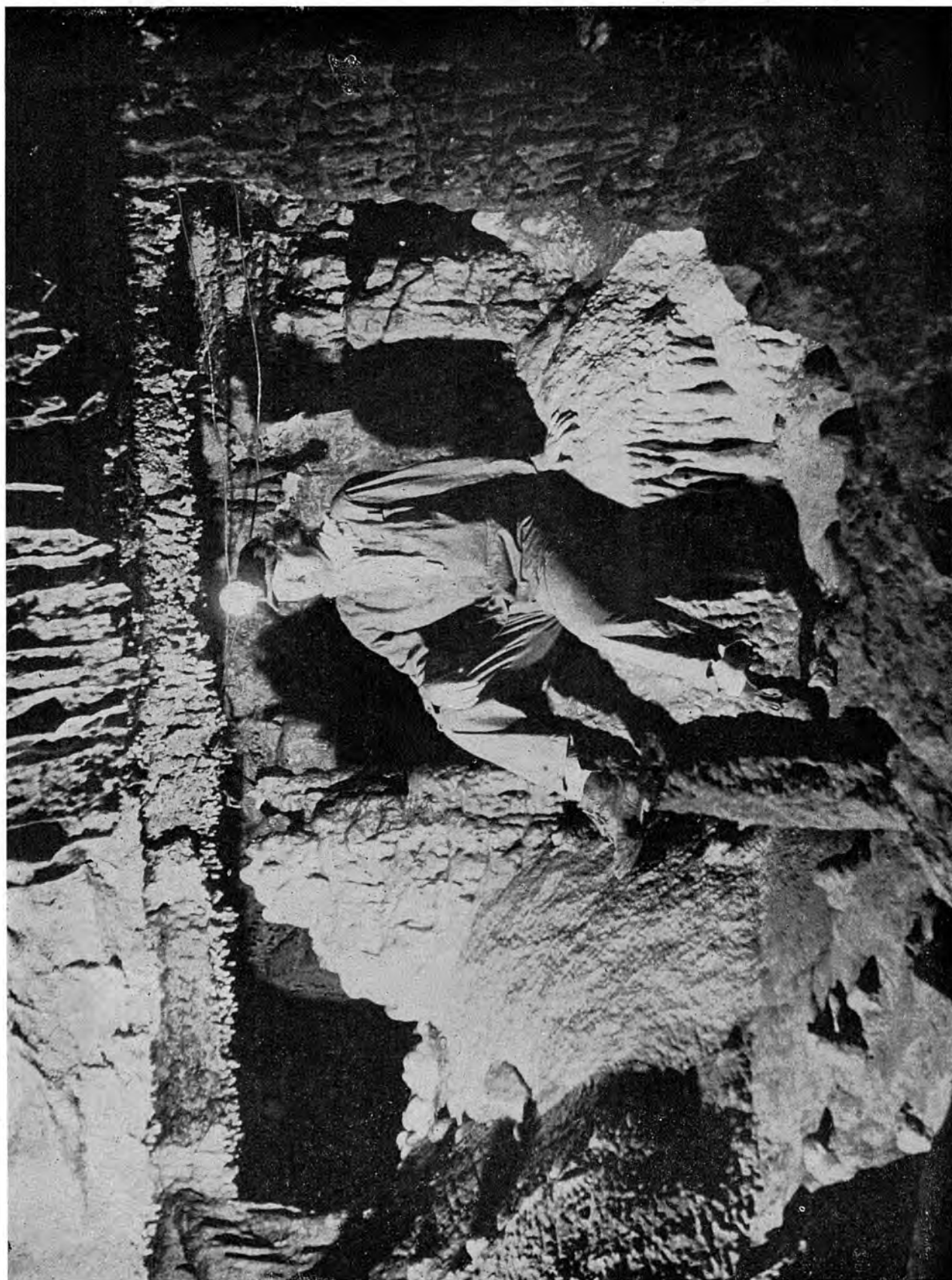


Fig. 6—Clara Scholtz in ORGAN CAVE, near Lewisburg, W. Va. This picture shows the use of cross-lighting to bring out detail. Original submitted to Editor in sepia. Pix by Howard Watkins.

your equipment in caves, it is advisable to insure your outfit for its full value. The usual annual premium is 2 per cent of the valuation. Naturally, all precautions should be taken against accidents as good cameras are still hard to obtain.

Discard any bulb that appears to be cracked or otherwise defective, as it may explode when used, scattering fragments of glass towards the subject. Such bulbs rarely give the full amount of light, and it is cheaper to discard them than to run the risk of ruining a picture. The most common danger to the camera is that of water or dust getting into it. The camera should be cleaned after each trip, and inspected and cleaned by competent repairmen at regular intervals.

The photographers working with each grotto should have 8x10 glossy prints made of their best monochrome pictures and duplicates made of their best color slides. An integrated collection of slides should then be assembled for exchange with other grottos and for lectures. Each slide in the collection should be accompanied by a statement showing complete data so the lecturer can know his facts. Included should be: where and when the picture was taken, who is in it and what they are doing, who took it, and any other pertinent information.

Black and white prints may be desired from your transparencies and with a little trouble negatives can be made. The easiest method is to project a needle-sharp transparency onto a suitable panchromatic film such as Isopan or Panatomic X. It gives a little better definition in the negative to place a gelatin filter, such as a Wratten X2 (green), between the light source and the transparency. With such a filter the average exposure is 12 to 20 seconds at f.8. The negative is developed in the usual way and prints up to 11x14 inches are possible. By sepia toning the resultant print, a pleasing product is obtained and the print itself made more permanent as the metallic silver is changed to silver sulphide.

The authors are willing to supply duplicates of their color slides and 8x10 or 11x14 prints of their black and white pictures for approximately their cost. It would be of general aid to the society if its other photographers would do likewise. Naturally such exchanges do not confer reproduction rights.

We would also like to hear from those who are taking cave pictures, with a view toward exchanging information and improving the techniques used in this type of photography.

THE USE OF AMERICAN CAVERNS FOR WORSHIP

By ELLIS LOUIS KRINITZSKY

*I*N EUROPE and the Near East, the former use of caverns for religious purposes has been so widespread as to attach very little distinction to the grottoes so used. On the other hand, in America, caverns have been so rarely used for worship that the writer feels that it may be worthwhile to note the few that he has happened to run across. No doubt there are probably many others that should be considered and it is hoped that they may eventually come to the attention of the Society.

To the author's knowledge, the earliest use of a cavern room for worship in America was in Mammoth Cave, Kentucky, during the period of the War of 1812. At that time, the peter mining in Mammoth Cave was a large scale project that furnished a great part of the niter needed in the war with the English. The cave itself was fitted with roads in which ox carts were operated; the salt was refined at the cave and was then sent by pack mule and ox cart as far as Philadelphia. These huge workings were started around 1809 by a Mr. Archibald Miller who worked a large number of negro miners. With the coming of the War, an immense expansion took place and white miners began to outnumber the negroes. At about this time, itinerant ministers began to visit

the men in the cave and sought their welfare through preaching to them. For this purpose, a room in the cavern having a diameter of 80 feet, a height of 40 feet, and a fairly level floor, along with a conveniently-located stalagmite that served as a pulpit, was equipped with logs for benches, and there the miners congregated for religious services. With the coming of peace in 1814, the cave workings closed down completely and the use of the room ceased.

Very little is known concerning the early services, but later in the nineteenth century, when the cave was utilized for exhibition, the manager sponsored weekly sermons in the same room which then came to be called the "Methodist Church." Hovey¹ mentions attending such a service deep in the cavern in which the hotel band, guests, guides, and servants listened to a lecture based on John XIV:5, "How can we know the way?"

The Goodwins Ferry Cave in Giles County, Virginia, was also worked for saltpeter, mostly by local boys, during the Civil War period. Perhaps as a result of the work of these boys, a zig-zag trail was developed to the entrance of the cave which is majestically perched at a height of 235

¹Hovey, Celebrated American Caverns, Cincinnati: (1882), p. 77.

feet up the side of a steep gorge. In recent times this trail has deteriorated greatly.

At some time during the 1860's or 1870's, one of the inner rooms was fitted out by the local people and used for church services until 1882. The Church Room was the third moderately-sized room away from the entrance and completely cut off from outside light. It is roughly elongate, being about 40 feet in length, 15 feet wide, and around 15 feet high. In order to obtain access to the room, it is necessary to traverse a hump in the passageway, which has been rendered less difficult by the placement of slabs of rock to form rude steps. It cannot be determined whether this was done by the churchgoers or by the earlier miners, but most likely it was done by the miners. Remnants of the Church Room's furniture are said to have been in the cave until very recently but nothing remains at present. The room is believed to have been equipped with a pulpit, hewn log benches, and candle chandeliers for illumination. In recent times, rock falls from the roof have given an irregular appearance to the floor which probably was fairly level at the time that it was used. The services, in this grotto also, were apparently intermittent and presided over by visiting ministers of no one particular sect.

About 25 miles from the Goodwin's Ferry Cave is the Warren Miller's Cave on Miller's Knob in Montgomery County. Miller's Cave consists of only one room that is entered from the surface by a steeply sloping tunnel that had at one time been provided with wooden steps. The shape is roughly that of an ellipse, with a little eccentricity, having a length of 30 feet, width of 20 feet, and a height of 10 feet. The cave was equipped with hewn log furniture by the Rev. Alby Jones who then held regular services there for the local people. Apparently Jones held a weekly Sunday School and Sunday service for a Baptist congregation, and supported himself by farming. The grotto is said to have been used as a church for a number of years prior to and until 1885.

The nearness of Miller's Cave to the Goodwin's Ferry Cave and their use at similar dates may indicate that one was copied from the other.

No other caves in the Giles-Montgomery County vicinity have been so used, but, with the multitude of caverns in the Appalachians and in the Interior Lowlands, it is entirely possible that many other caves have served religious purposes and whose peculiar use has become hidden in the local folklore.

Possible Explanations for Cavern Worship

When the early Christians first ceased to be persecuted, and were able to assemble for worship without fear, two distinct types of church contested for supremacy—the Basilican and the Catacumbal.² The first above ground churches were

made over from the basilicas of the rich Romans which had been used as stately reception halls and later became the pattern for most cathedrals and churches.

However, at first, the Catacombs were the most numerous and were in the greatest favor. The devout had become accustomed in times of danger to resort to these artificial caverns, and the cult of the martyrs had grown so that it was the custom to commemorate the anniversaries of the saints' deaths at their tombs in the Catacombs. It was near the bones of the saints that it was believed special sanctity dwelt and that prayers were most effectually answered.

But, when the whole population became Christian, the resort to underground chapels became so great as to cause inconvenience and the Bishops, in trying to remedy matters, began to "elevate" the bones of the saints to the basilicas above ground.

As a result, underground worship lost its attraction so that it eventually ceased and the Catacombs were forgotten. It is important to note that even the remembrance of the use of grottoes during the days of persecution was lost and so it is highly unlikely that any such association prompted the few subsequent reverts to underground worship.

Thus the only purely religious factor in later times that could have connected caverns with worship would have been the biblical associations of a much earlier period. Stanley³ mentions the following New Testament grottoes. They are the grotto of Bethlehem, regarded as the scene of the Nativity (although there is nothing in the Gospel to indicate that it was a grotto); the grotto on Mount Olivet, the scene of the Lord's last conversation before the Ascension; and the sacred cave of the Sepulchre. Shortly afterwards were rapidly added the cave of the Invention of the Cross, the Cave of the Annunciation at Nazareth, the cave of the Agony at Gethsemane (which has been patiently rebuilt out of two caverns into an underground church⁴), the cave of the Baptism in the Wilderness of St. John, the cave of the Shepherds of Bethlehem, and a host of concentrated hermit caves.

These Biblical associations of caverns with worship, along with the ruggedness and loveliness of most caverns, may have prompted the simple and earnest-minded children of the American wilderness to seek a closer communion with Nature and their Creator.

Less sacred is the thought that a well-located

²Baring-Gould, *Cliff Castles and Cave Dwellings of Europe*, London: (1911), p. 173.

³Stanley, *Sinai and Palestine*, London: (1856), p. 150.

⁴Geikie, *The Holy Land and the Bible*, London: (1887), p. 8.

cavern would be much cheaper than a church building, and that convenience combined with economy may have prompted the utilization of grottoes. It is certain that this reason explains the miners' church in Mammoth Cave.

And then again, perhaps these few reversions to grottoes were simply novelties that had the popularity of an unusual fad, and so had little or no connection with the past.

CAVE REFERENCES IN THE BIBLE

By C. A. STEBBINS*

PALESTINE and Syria are limestone countries and full of caverns which have always been used for temples, for storage, dwellings, and burial places. These holes, or caves, gave names to the towns. There are many underground streams which feed the Sea of Galilee and the Jordan River. Writer Shabo says there is a cavern near Damascus which holds 4,000 men. Also there is a large cave near Sidon and 200 different rooms on the seacoast near Joppa. There are caves between Bethlehem and Hebron. In the mountains they united the caves by digging tunnels and made cisterns in them.

Professor Lyn H. Wood, archeologist in the S.D.A. Seminary, Takoma Park, D. C., says he believes that the Ark of the Covenant and other articles of the old Sanctuary are hid in a cave under the old foundation of Solomon's Temple in Jerusalem. It is known that there are extensive caves there, but the Moslems in control will not allow anyone to enter any of the lower hills and rooms below their present Mosque which stands on the floor of Solomon's Temple.

Genesis 14, recounting the battles of the kings, mentions in v. 6 (Authorized and Revised Version) "and the Horites in their mount Seir, unto El-paran, which is by the wilderness . . . v. 10, and the vale of Siddim was full of slimepits; and the kings of Sodom and Gomorrah fled, and (they) fell there; and they that remained fled to the mountain." The foregoing, in Smith's O.T. American translation (Univ. of Chicago Press) reads: "and the Horites in the highlands of Seir, penetrating as far as Elparan, which is close to the desert . . . The valley of Siddim was so full of bitumen wells that on the flight of the kings of Sodom and Gomorrah some fell into them, but the survivors fled to the hills." The same passages in Moffat's translation read: "and the troglodytes in their highlands of Seir, driving them as far as El-paran which lies close to the desert . . . The valley of Siddim was all petroleum wells, and, when the kings of Sodom and Gomorrah fled, some people fell in, while the survivors fled to the hills."

Genesis 36:20, 21 (Moffat), "Here are the

sons of Seir, the troglodyte, the natives of the country: . . . there were the troglodyte chieftains, the Seirites in the land of Edom." Edom was a land of canyons and caves in cliffs. Its people were cliff dwellers for fear of bands of robbers, and because of the extreme heat of the region.

Gen. 19:30 (Auth.). "And Lot went up out of Zoar, and dwelt in the mountain, and his two daughters with him; for he feared to dwell in Zoar: and he dwelt in a cave . . ." There follows the interesting story of the origin of the Moabites and Ammonites.

Gen. 23. Sarah, the wife of Abraham, had died in Hebron. Abraham asked the sons of Heth for a burying place. In v. 6 is their reply: "thou art a mighty prince among us: in the choice of our sepulchres bury thy dead; none of us shall withhold from thee his sepulchre, but that thou mayest bury thy dead." And Abraham said (v. 8, 9) "intreat for me to Ephron the son of Zohar, that he may give me the cave of Machpelah, which he hath, which is in the end of his field; for as much money as it is worth he shall give it me for a possession of a burying place amongst you." Ephron the Hittite offered to give it to Abraham but he insisted on paying for it, and paid four hundred shekels of silver. The sale included the (v. 17) "field of Ephron, which was in Machpelah, which was before Mamre, the field, and the cave which was therein, and all the trees that were in the field, that were in all the borders round about, were made sure . . . (v. 20) "unto Abraham for a possession of a burying place by the sons of Heth." (v. 19) "And after this Abraham buried Sarah his wife in the cave of the field of Machpelah before Mamre: the same is Hebron in the land of Canaan."

Gen. 25:8-10. "Abraham . . . died . . . and his sons Isaac and Ishmael buried him in the cave of Machpelah, in the field of Ephron the son of Zohar the Hittite, which is before Mamre; the field which Abraham purchased of the sons of Heth: there was Abraham buried, and Sarah his wife." (See Robinson's *Researches*, Vol. II, pages 433-440.) A Mohammedan Mosque is built over the cave of Machpelah. It is surrounded by a high wall. No one, not even Moslems, are allowed to descend into the cavern.

Exodus 20:4 (part of one of the Ten Commandments), "Thou shalt not make unto thee any graven image, or any likeness of any thing that is in heaven above, or that is in the earth beneath, or that is in the water under the earth . . ."

Ex. 33. When Moses asked to be shown the Lord's glory he was told (v. 20-23 R. V.) "Thou canst not see my face; for man shall not see me and live. And Jehovah said, Behold there is a place by me, and thou shalt stand upon the rock: and it shall come to pass, while my glory passeth

*N.S.S. Member No. 35, son of one of the two discoverers of the famous Caverns of Luray (in 1878), probably, all things considered, the finest known cave in the world.

by, that I will put thee in a cleft of the rock, and will cover thee with my hand until I have passed by: and I will take away my hand, and thou shalt see my back: but my face shall not be seen."

Deut. 2:10-12 (Moffat). "Long ago the Enim used to live there, a strong and numerous race, as tall as giants; like the giants they are generally called Titans, but the Moabites call them 'Enim.' Long ago also troglodytes used to live in Seir, but the sons of Esau dislodged them and killed them off, taking possession of their country just as the Israelites did with the land which the Eternal had assigned as their possession."

Josh. 10:16-27. Israel was at war with their enemies and "five kings fled and hid themselves in a cave at Makkedah . . . And Joshua said, 'Roll great stones upon the mouth of the cave, and set men by it for to keep them: and stay ye not, but pursue after your enemies . . . Open the mouth of the cave, and bring out those five kings unto me out of the cave' . . . the king of Jerusalem, the king of Hebron, the king of Jarmuth, the king of Lachish, and the king of Eglon . . . and afterward Joshua smote them and slew them, and hanged them on five trees . . . and they took them down off the trees and cast them into the cave wherein they had been hid, and laid great stones in the cave's mouth, which remain until this very day." The place of this cave is not known.

Judges 6:2. "and because of the Midianites the children of Israel made them the dens which are in the mountains, and caves, and strongholds."

I Sam. 13. The Philistines warred against Israel, and (v. 6) "when the men of Israel saw that they were in a strait (for the people were distressed) then the people did hide themselves in caves, and in thickets, and in rocks, and in high places, and in pits."

I Sam. 14:22. "Likewise all the men of Israel which had hid themselves in mount Ephraim . . ." So there must be caves in this mountain of Ephraim.

Saul came out with his army toward the Philistines but he was afraid of them. But his son Jonathan and his armorbearer went and hid in the rocks above the enemy, then suddenly came out of the holes to slay the Philistines (who at first mocked saying, [Moffat, v. 11] "look at the mice creeping out of their hiding-holes.") The Lord helped by causing an earthquake.

I Sam. 22:1, 2. King Saul was jealous of David, a popular hero, and pursued him to kill him. "David therefore departed thence, and escaped to the cave Adullam: and when his brethren and all his father's house heard it, they went down thither to him. And every one that was in distress, and every one that was in debt, and every one that was discontented, gathered themselves unto him; and he became a captain over them: and there were with him about four hundred men." Tradition says that Adullam is a large cavern at Wady Khureitun

which passes below Frank Mountain. See Josephus VI:12,3.

I Sam. 23:14-24:22. "And David abode in the wilderness in strongholds, and remained in a mountain in the wilderness of Ziph. And Saul sought him every day, but God delivered him not into his hand . . . David and his men were in the wilderness of Maon . . . Saul also and his men went to seek him. And they told David: wherefore he came down into a rock, and abode in the wilderness of Maon. And when Saul heard that, he pursued after David in the wilderness of Maon. And Saul went on this side of the mountain, and David and his men on that side of the mountain: And David went up from thence, and dwelt in strongholds at Engedi . . . in the wilderness of Engedi. Then Saul took three thousand chosen men out of all Israel, and went to seek David and his men upon the rocks of the wild goats. And he came to the sheep-cotes by the way, where was a cave: and Saul went in to cover his feet: and David and his men remained in the sides of the cave . . . Then David arose and cut off the skirt of Saul's robe privily . . . But Saul rose up out of the cave, and went on his way, David also arose afterward, and went out of the cave, and . . . said to Saul . . . Behold, this day thine eyes have seen how that the Lord had delivered thee today into mine hand in the cave . . . And Saul went home; but David and his men gat them up into the hold." Engedi is clearly identified. It is called now Ain Tidy by the Arabs, which means the same as the Hebrew, "The Fountain of the Kids."

Rev. William Buckland, in *Reliquiae Diluvianae* (1824) describes the Wady El Mughara: Valley of the Caves. The valley starts from the hills east of Mt. Carmel, going north and west to the sea. It is so-called from a conspicuous group of caves which lie at a point where it joins the coastal plain. The valley contains dolomitic limestone. Pottery and bones were found packed together indicating result of one single action of a violent flood. In every cave he found only one crust over the deposits. Mr. Buckland calls them "ante-diluvian caves," and in them he could identify human bones and those of animals and birds.

II Sam. 23:13-17. David was again in the cave Adullam. This time the Philistines were after him. "Now three of the Thirty went down to the rock to David to the cave of Adullam, while the camp of the Philistines was pitched in the Valley of Rephaim. David was then in the stronghold, and the garrison of the Philistines was at the same time in Bethlehem."

I Kings 18:4. "For it was so, when Jezebel cut off the prophets of the Lord, that Obadiah took an hundred prophets, and hid them by fifty in a cave, and fed them with bread and water." Repeated in v. 13.

I. Kings 19:13. Elijah the prophet, fleeing from Queen Jezebel, "went a day's journey into the

wilderness (of Beersheba) . . . and he arose, and did eat and drink, and went in the strength of that meat forty days and forty nights unto Horeb the mount of God. And he came thither unto a cave, and lodged there; . . . and a great and strong wind rent the mountains, and brake in pieces the rocks before the Lord . . . and after the wind an earthquake . . . and . . . a fire . . . and . . . a still small voice. And it was so, when Elijah heard it, that he wrapped his face in his mantle, and went out, and stood in the entering in of the cave. And, behold, there came a voice unto him, and said, What doest thou here, Elijah? . . . And the Lord said unto him, Go, return on thy way to the wilderness of Damascus."

Job was a wealthy prince who supposedly lived in eastern Arabia. He became diseased with boils. Young men, whose fathers were vagabonds and who dwelt in the desert eating mallows and juniper roots, made fun of his misfortune. Job says of them (30:5, 6) "They were driven forth from among men (they cried after them as after a thief) to dwell in the cliffs of the valleys, in caves of the earth, and in the rocks. Among the bushes they brayed; under the nettles they were gathered together."

Psalm 57, sung by David in the cave, when he fled from Saul. "Be merciful unto me, O God, be merciful unto me: for my soul trusteth in thee; yea, in the shadow of thy wings I make my refuge, until these calamities be overpast . . ."

Psalm 142, a prayer of David when he was in the cave. ". . . when my spirit was overwhelmed within me, then thou knewest my path . . . refuge failed me; no man cared for my soul. I cried unto thee, O Lord; I said, Thou art my refuge and my portion in the land of the living . . ."

Isaiah 2:19. "And they shall go into the holes of the rocks, and into the caves of the earth, for fear of the Lord, and for the glory of his majesty, when he ariseth to shake terribly the earth. In that day a man shall cast his idols of silver, and his idols of gold, which they made each one for himself to worship, to the moles and to the bats; to go into the clefts of the rocks, and into the tops of the ragged rocks."

Ezekiel 33:27. "Thus saith the Lord God; As I live, surely they that are in the wastes shall fall by the sword, and him that is in the open field will I give to the beasts to be devoured, and they that be in the forts and in the caves shall die of the pestilence."

Nahum 2:12 (R. V.). "The lion did tear in pieces enough for his whelps, and strangled for his lionesses, and filled his caves with prey, and his dens with ravin."

II Macabees 2:1-8. Descriptions of Jeremiah the

prophet of things commanded when carried into captivity. The prophet, "being warned of God, commanded that the tabernacle and the Ark should accompany him, till he came forth to the mountain, where Moses went up, and saw the inheritance of God. (Mt. Nebo. See 3 Kings 8:11. Douay version). And when Jeremias came thither, he found a hollow cave: and he carried in thither the tabernacle and the Ark, and the altar of incense, and so stopped the door. Then some of them that followed him, came up to mark the place; but they could not find it. Jeremias said, the place shall be unknown, till God gather together the congregation of the people, and receive them to mercy. And then the Lord will show these things, and the majesty of the Lord shall appear, and there shall be a cloud as it was also showed to Moses."

Asher. The same reference regarding taking the Ark to Mount Nebo is mentioned in the ancient book of Asher. These books (Apocryphal), however, are not considered reliable references. We know this is true of other texts of these books.

John 11:38. When Lazarus his friend died, Jesus came and they showed him the grave. "Jesus therefore again groaning in himself cometh to the tomb. Now it was a cave (spelaion) and a stone lay against it. Jesus saith, Take ye away the stone . . . And when he had thus spoken, he cried with a loud voice, Lazarus, come forth. He that was dead came forth, bound hand and foot with grave clothes; and his face was bound about with a napkin. Jesus saith unto them, Loose him, and let him go."

After Jesus' own death, as recorded in all four gospels, his body was laid in a tomb "hewn out in the rock" (Matt. 27:60). His sepulchre was apparently not a natural cave.

Heb. 11:38. By faith the martyrs overcame suffering and persecution "(Of whom the world was not worthy;) they wandered in deserts, and in mountains, and in dens and caves of the earth."

Cave Mapping

(Continued From Page 7)

are in limestone areas. Variations in color, in content of clay, chert, or sand, and type of weathering as well as paleontological evidence, should form a basis for differentiating the rock in mapping.

At the best these notes can serve only as a guide to cave surveys and the standardization of cave maps. The author is aware that many questions will arise that are not covered in these notes. If, however, the mapper keeps in mind that surveying is primarily a job of observation and recording, and approaches all problems with simplicity and common sense, he will experience little difficulty.

Editorial

NSS Membership as of June 1, 1947

The Number 8 *Bulletin* report over a year ago showed memberships through No. 372, with 98 losses, leaving 274 active members, including 31 Life Members and two Honorary Members not included in the annual and Life Membership ranks.

The Board of Governors elected Dr. Robert de Joly, Presidente Societe Speleologique de France (already an annual member of the NSS), as its 1946 Honorary Member.

A little over a year ago, Life Member Larry Wilson passed on, and the Board later transferred his membership to his widow, Gwen Wilson. Seven new Life Members bring this total to 38. Eleven annual members resigned or have been dropped for non-payment of dues. One previously dropped member paid up back dues, thus reinstating himself with his original number. This makes the total net losses now 109.

As of June 1, 1947, the current membership number is 710, thus showing 601 actual present members (more than doubling in number between the last two February Annual Meeting dates), who are located as follows:

Virginia	153	Alabama	3
Pennsylvania	56	Florida	3
West Virginia	43	North Carolina	3
Dist. of Columbia ..	41	Oregon	2
Ohio	36	Nebraska	2
Maryland	36	New Mexico	2
New York	28	Arizona	1
California	22	Colorado	1
Texas	17	Idaho	1
Connecticut	16	Iowa	1
Georgia	15	Louisiana	1
Missouri	13	New Hampshire	1
Indiana	9	North Dakota	1
Illinois	8	South Carolina	1
Massachusetts	8	Vermont	1
Kentucky	7	Address unknown ..	5
New Jersey	7	England	13
South Dakota	6	France	7
Tennessee	6	Mexico	4
Michigan	5	Venezuela	2
Oklahoma	4	Greece	1
Washington	4	Germany	1
Wisconsin	4		

This table shows 37 states (a gain of 7), the District of Columbia, and six foreign countries (a gain of 3) represented—a decided increase in the expanding national and international character of our Society. The women membership almost tripled, increasing from 34 to 93. Forty-six doctors are noted, and an increased number of commercial cave representatives.

Commercial caves to a total of nine have

joined as Institutional Members which, with the Alabama Geological Survey, makes our present total of such memberships, 10. Non-member subscribers to our publications have increased from four to seven. The V.P.I. Student Grotto has dropped its reduced-rate student status and become a regular grotto with about 30 members.

Our Grottoes have increased to include, in addition to the V.P.I. Grotto (Blacksburg, Va.), and the Richmond, Cleveland and District of Columbia Grottoes of a year ago, Grottoes in Charleston, New England, Lexington (Va.), Charlottesville, Philadelphia, Salem (Va.), North-eastern Virginia, and Elkins—a total of 12. Numerous other localities having growing lists of members should multiply their effectiveness and enjoyment by grotto organization, achievable extremely simply.

Again the obvious is pointed out: that if each of our members gets just one new member this year, we'll again double our membership. Since this result was achieved last year by the work of a comparatively few of our members (who will, of course, continue their activity) it would seem that we could and should easily reach the thousand mark this year. Treasurer Foote suggests that each member take along a new prospect on every trip and give him a brochure. Anyway, from getting that new member, what's stopping you?

J. S. Petrie,
Secretary.

Death of Honorary Member

Dr. Roy Jay Holden, 75-year-old professor of Geology at Virginia Polytechnic Institute and Honorary Member N.S.S., died in his campus home on December 16, 1945. Although he underwent hospital treatment earlier, in August, he had been active up to the time of his death.

Dr. Holden was born in Sheboygan Falls, Wisconsin, in 1870 and received his B.S. from the University of Wisconsin in 1900. Prior to that time he had taught country school in Wisconsin for a decade. He joined the V.P.I. faculty in 1905, and in 1915 was awarded the Ph.D. degree by his alma mater. His continuous association with V.P.I. lasted for 40 years.

In 1915 he married Miss Elizabeth Virginia Evans of Lynchburg, Virginia, who, with their two daughters, Mrs. Robert B. Hummel and Mrs. J. G. Rocovich, their son, Roy J. Holden, Jr., and three grandchildren, survives him.

Dr. Holden was primarily a teacher, and followed the examples of the great teacher-naturalist, Louis Agassiz, in encouraging his students to learn how to learn for themselves. He was at all times extremely exacting and saw to it that pupils under him obtained a meticulously detailed knowledge of their subject.

He did considerable work on geological problems in the folded Appalachians of his district, and is credited with greatly extending the known area of the valley coal field of Virginia. Perhaps his greatest accomplishment was the location of the first natural gas well in Virginia. His last major effort concerned a study of the "Punch" Jones diamond found near Peterstown, W. Va., which proved to be the largest alluvial diamond ever reported found in the United States. At the time of his death he was working on the problem of the origin of Mountain Lake in Virginia. In spite of his great industry, he was an extremely careful scientist who would not risk making possible errors and consequently he wrote very little.

In addition to being an honorary member of the NSS, he was chairman of the Committee on Formations and Mineralogy and gave unstintingly of his time and knowledge.

Besides the National Speleological Society, Dr. Holden held membership in the Geological Society of America, the American Institute of Mining and Metallurgical Engineers, the American Association of Petroleum Geologists, the Society of Economic Geologists, Phi Kappa Phi, and Sigma Xi.

Funeral services were conducted at the home, December 19, with Rev. William S. Hicks, pastor of the Blacksburg Baptist Church, officiating. Interment was in West View Cemetery, Blacksburg.

New England Grotto Merger

At the Annual Meeting of the Society in February, 1946, Clay Perry suggested to me that plans be made to reorganize the New England Grotto and merge the Massachusetts and Connecticut caving groups.

Since the organization of the New England Grotto, Mr. Perry and Roger Johnson had led the New England Spelunkers and almost all of them were from Massachusetts. In 1941 I was leading caving parties in Connecticut and of necessity those attending were from Connecticut in the Waterbury area and these cavers had all the earmarks of potential members. When interest had lagged in Massachusetts it had now developed among residents in Connecticut. Because of conditions that restricted travel, New England members had not been able to keep their Grotto operating and the charter had been suspended.

To build up local interest, a trip was planned for April 19th to explore the underground river at Clarksville, N. Y., locate the two highwaymen's caves on top of the Helderberg escarpment at Altamont, N. Y., and visit the beautiful Howe Caverns at Cobleskill. Twenty-three persons made up the party—mostly prospective members. It was an interesting trip and was featured in Albany papers.

Plans were made immediately for the reorganization of the New England Grotto set for July

14th and the place selected for the meeting was the abandoned feldspar and mica quarry at Portland, Connecticut, known as the Strickland Quarry. Mr. Perry and I felt that this quarry, widely known as "a mineralogist's paradise," afforded all the possibilities of a cave man's meeting place. In making up the program especial care was taken to include in the day's events as wide a variety of interests as possible. The "Master of Ceremonies" job was assigned to me because of my comparative nearness to the quarry; and, with the welcome suggestions and help of Perry, Johnson, Ned Anderson and Frank Wilson, a program was worked out and events were held as planned.

Jack Wilson and John Meenehan of the Washington, D. C., Grotto were on hand to demonstrate rappelling on the 100-foot walls of the quarry. Lydia Neubuck from Natural Stone Bridge at Pottersville, N. Y., and Ackerly and mother from Georgia were on hand as out of state guests. The outing was covered by the International News Service which it featured in leading newspapers in Springfield, Mass., Albany, Buffalo, and New York City, giving much publicity to the Society.

Roger Johnson, with his submersible suit, gave demonstrations of how to explore caves filled with water. The 150-foot canal covering part of the quarry floor afforded excellent opportunities for this method, demonstrated for the first time at this meeting. Roger also inflated his 5-man rubber boat on the canal to explore the numerous tunnels accessible only by water and to show the possibilities of another method of cave exploration.

The biggest feature of the day was the rappel stunt by Meenehan from the top of the quarry to the rubber boat in the canal. Professor Richard Logan, an authority on New England geology, gave a talk on prehistoric Connecticut at the Meshomasic State Forest where lunch was held near the old Cobalt Mine. Frank Wilson displayed his collection of minerals, many of which were found in the quarry in Portland and he gave an interesting talk about them.

Kodachrome slides were shown by Meenehan of caves in United States and Italy. The reorganization meeting was held in a large tunnel room in the quarry overlooking the blue-green water of the canal and this location afforded delightful air-conditioning on a hot July day. Thirty-seven were present and the occasion was termed the most unique of its kind ever held in New England. Since the meeting the membership in the New England area has more than doubled. Mr. Logan, elected Chairman of the new Executive Committee of the reorganized Grotto, plans a full schedule for the Grotto this year with another annual event equal if not better than this "Cave Man's Field Day."

LeRoy W. Foote,
Middlebury, Conn. (3/13/47)

Editor Resigns

In the few years we have existed as a group with a common denominator—an active, articulate interest in caves and cavern lore—growth of our membership has been a most impressive thing. We have expanded not only in numbers; our stature can be measured, too, by the variety of interests and reputation of many of the men composing the present NSS.

All of our activities, however, must keep parallel with this personnel attainment factor. We must have adequate funds to explore all the potentials of our organization; we must have permanent offices and staff to carry out the functions of such offices; we must have adequate library facilities for our growing collection of books, manuscripts, and clippings on the speleological subject; we must have proper storage for our photographs and moving picture films.

These things will come . . .

We must have a magazine, also, worthy of our attainments. We must be articulate—as a society of international membership; as a society of individuals representative of scores of interests, not all social or purely recreational, not all scientific.

I have carried, with some pride, the burden of this latter aspect of our growing, for several years. Those who have assisted me in this task—as contributing editors in whatever capacity—have here my thanks in a sometimes thankless job. They have also my apologies in having had, perhaps unwittingly or unwillingly, to share the blame for omissions and commissions which, in the main, have been my own.

Some of the members of an earlier Board of Governors who read this will recall that I have tried for four years, without palpable success, to be relieved of the responsibilities of Editor. The confidence in my poor abilities inherent to this gesture of refusal to let me go has been, in gross understatement, most gratifying to my heart.

Geographically, I am now too far removed from the centers of active interest in caving properly to feel the pulse of things. My pleasures in speleology have latterly all been by proxy—not a good thing for me, nor for an editor of the *Bulletin*.

I have explained these and kindred matters in recent correspondence read to the Board of Governors. My request to be relieved of my position has been acceded to. This, therefore, is the last *Bulletin* under my hand.

Don Bloch, Editor.

Concerning Committee Reports

There are no reports to be met with throughout the whole issue. (With apologies to Horrebow, via Sam: Johnson, for the opportunity to pull this parody, the significance of which I fervently hope shall not be lost upon those most immediately concerned. Ed. Note.)

Honorary Member—R. de Joly (1946)

Although born in Paris (in 1887), where he pursued his studies, Mons. R. de Joly, elected Honorary Member N.S.S. for 1946, lived during his vacations in the province of Causses where he possesses property. Consequently, he has always seen grottoes and potholes. At any rate, it was in 1926 that his career of speleology was fixed; and, encouraged by the savant E. A. Martel, he has since devoted himself to the science.

Since he had countless times explored the caverns, both in France and abroad, de Joly especially endeavored to find the end of those caves and fissures which Martel was never able to achieve—Padirac, St. Marcel d'Ardeche, Chourum-Martin, Jean Noveau, Marzal, etc.—that is, grottoes of several kilometers in length, or fissures of 200 meters or more in depth.



Mons. de Joly owes his success in achievements to a technique and equipment of his own invention. In 1935 he discovered and later essayed, at the request of the State, the vast Fissure d'Orgnac in lower Ardeche, a cavern famous for its unique decorations. He continues always to record his observations for the enrichment of scientific knowledge. For traversing the entire length of the Grand Canyon of Verdon, and the explorations listed above, he has received many citations from scientific societies.

He has always been very active in the field as President of the Societe Speleologique which he founded in 1930, and which now has over 1,200 members. He is a genuine enthusiast, an example of good sportmanship to those about him, and runs all the risks of the game with his companion speleologists.

American Cave Series

The American Cave Series, which was really launched at the annual meeting of the NSS in February, 1946, is well on its way. By the time this is in print, perhaps the second volume of the Series which is being done by Clay Perry with the promised assistance of other NSS members, may be also in print. It is hoped by both author and publisher that no such delays and obstacles will be encountered for *Underground Empire—Wonders and Tales of New York State Caves*, as was suffered in getting out *New England's Buried Treasure*, the first volume.

Underground Empire will be done in letterpress, from an original manuscript. It is planned as a large book, some 100,000 words, and up to 32 illustrations, to retail at \$3.50 as did *New England's Buried Treasure*.

Delivery of the entire manuscript was set for March 15 of this year and Perry had to do some scrambling to meet the deadline, for he did not start work on this book until January, 1946, although he had collected considerable material ever since 1935, when he began his "muscular literary research," as he calls it, for his New England books.

Clay found that nothing had been done about the Empire State's underground in the form of a book and, in fact, nothing comprehensive even in geological surveys. He found that New York State was quite a territory to survey, and only was able to do the job by enlisting the aid of many persons who provided him with material. He was given able assistance, also, by such institutions as the State Educational Department, University of the State of New York, Conservation Department, Department of Commerce, New York Historical Society, American Museum of Natural History, and numerous individuals.

As with his early books, Clay was helped much by the "premier caveman" of New England, Roger Johnson of Springfield, Mass., a Life Member of the NSS and a spelunker of untiring energy and topnotch curiosity. Johnson turned over to Perry for a second time, a suitcase full of material, scrapbooks, index card files, photos, and much correspondence about New York State caves which Johnson had personally explored to an astonishing extent. Clay went on from there; and the first person he asked about caves was a cave-

man extraordinary, A. T. Shorey, of the Lands and Forests Division, New York State Conservation Department.

Underground Empire has eighteen chapters and a sizable appendix, an index of caves and other subjects mentioned in the text, and is even more of a guide book than *New England's Buried Treasure*. It deals with caves, some old, abandoned mines and quarries of the Empire State by a classification indicated by the chapter headings: In an Indian Oven, Horse Thief Caves, Bears' and Other Dens, Museum Pieces, Natural Stone Bridges and Caves, Curious Caverns, Atrocity in Austerlitz (a gold-mine murder story), Some Shawangunk (Mountain) Caves, Sinks of Schoharie, They Bored a Hole in a Hill (the story of Home Caverns Development), Lost Caves, High and Low in the Helderbergs, Indian and Indian Fighters' Caves, Bandits' Roosts and Hermits' Holes, The Catskill Manlius, Some Mighty Man-Made Caverns, Salt of the Earth, Deeper If Not Better Holes.

The NSS is given special mention in the book; and, in fact, some members from Washington, New York City, and other points accompanied Perry on some of his field trips in New York State. President William J. Stephenson and Elton Brown, for instance, went on a combined New England-New York spelunking trip in July, 1946, to an ancient, abandoned iron mine in West Fort Ann where they demonstrated rappel work, and signed up some new members from the ranks of the Albany Chapter, Adirondack Mountain Club, and the Mohawk Valley Hiking Club of Schenectady. Frank Solari of New York City also joined with Perry on expeditions—one of the most exciting, to some Catskill Mountain Caves.

Departing from the formal artist's drawing which was used on the jacket or dust cover for *New England's Buried Treasure*, the publishers are using a photograph of some beautiful cave formations for the illustration on the jacket of the new book, and will also use a sketch made by Member Frank Wilson of West Cheshire, Conn., for the frontispiece. Frank made his first rough sketch in the Clarksville, N. Y., cave, with its underground stream and lake on a New England Grotto trip in April, 1946.

Clay Perry writes us that he has reserved a limited number of copies of both books at his home, to be autographed to anyone who wishes to order them from him. Otherwise, copies can easily be obtained through any bookstore or direct from the publisher, Stephen Daye Press, 105 E. 24th St., New York 10.

For his third volume of the Series, Perry has decided to take up the caves of West Virginia and the Blue Ridge country. He is there now, gathering materials.

CAVERSE CORNER

Through NSS member G. Platten, we are sent this poem by one "Lucio," a regular contributor to the *Manchester Guardian*. For title, the poem has only the inspirational line, "Caving and pot-holing are getting into their stride again . . ."

*How diverse man's choice in pleasure
as applied to hours of leisure!
There are those who only treasure
seaside joys as ones of worth;
Some are all for mountaineering,
others find the plains more cheering,
While some plump for disappearing
in the bowels of the earth.
That's a choice which strikes the critic
as distinctly troglodytic,
Harking back to days mephitic
when the blitzes buzzed around;
When so many, helter-skelter,
had to seek the air raid shelter
Where they learnt to sit and swelter
in a refuge underground.
So we gaze with awe and wonder
on the folk who dive down under,
When the guns no longer thunder
and the warning sirens cease.
Not for them mere surface strolling;
they find darkness more consoling
And prefer to go pot-holing
in these piping times of peace.
Don't denounce their taste as dreary;
they regard it as most cheery.
But it does suggest the query:
can you find a quainter soul,
Search from Knaresborough to the Dneister,
than the underground beanfeaster
Who prepares to spend his Easter
down a damp and devious hole?*

FROM LIFE'S CAVERN

By JAY ESPY

*When I consider how my light is spent
Ere half my way out this dark cave and wide,
Save one lone candle which 'twere death untried
Lodged with me erstwhile, though its use were
meant
To light my frugal meal with fragrant scent,
On no account my path, with woe astride,
That I must traverse quickly else I died.
So, dimly groping, stumbling, outward bent,
While fiercely curbing thoughts wherein would
breed
Wild panic, frenzy, imagery undressed,
O'er progress that for exit be too late,
And, trusting promises my soul that feed,
Emerge at last with Him who guideth best,
Who leaveth no one to an unjust fate.*

Adapted from Milton (1/5/45).

POTHOLE

Read "Bottomless Pit," chapter 7, in *Danny Doffer*, by Marie Halun Bloch (Harper & Brothers, 1946), for hilarious cave story. Rest of the book is good, too. (Wouldn't the ED. know?)
☞ See "The Cave Business Man," by Boyden Sparkes (*Sat. Eve. Post*, Oct. '29) on aspects of commercial development of caverns. ☞ "A Major Cave Discovery in Devonshire: The Shimmering Labyrinth of Reed's Cave," by J. H. D. Hooper (NSS), in *The London Illustrated News*, 1/18/47. Excellent illus. article: Hooper, one of four, "first ever to set foot in the remarkable cavern" described, near Buckfastleigh, 25m. from Exeter. Formations shown in dozen photographs by Hooper indicate it rivals many of our most spectacular caves. ☞ "Cave Paintings—20,000 year-old Stone Age Art is found in a French Cave," in *Life*, 2/24/47. Dozen fine b&w and color pix, plus text, describe Cro-Magnon artists' animals and men in "one of the world's oldest and most remarkable art galleries . . . Archeologists . . . call it the most important cache of cave art ever unearthed. "A 1940 find by two French schoolboys, out hunting rabbits on a hill near Mantignac, in south central France ☞ Acknowledging Report of Meetings of newly-formed Cave Association of Wales (via G. Platten, NSS) ☞ *The Black Hills Engineer*, for December 1938 (pub'd by the S.D. State School of Mines, Rapid City, S. D.) is all on "Black Hills Caves"—44pp. of text and illustrations, maps, and bibliography ☞ Meyer's Rum adv. carries a pix of "Carlsbad Caverns, the world's greatest." ☞ Acknowledging new application blank: "Bulletin D'Adhesion a la Societe Spéléologique de France"—active membership, 60 francs; life membership, 600 francs; "1,000 francs pour les Membres Bienfateurs." ☞ "Pot-Holing in the Mendips," by Hooper, also (in *Picture Post* [London], 6/15/46). In 9 marvelous pictures, and text, we get the idea that our English member is a good caver, good writer, good photographer—and that Swildon's Hole is a good spot for caving! ☞ Gravure Section of *The Sunday Star* (Wash., D. C.) for 9/8/46, carries cover pix and five inside, plus text, on the trip into Elkhorn Mt. cavern in W. Va.: "Adventure Inside the Earth," by John W. Stepp. ☞ "Lost: Irrigation Water. Quest for Lost Storage May Bring Discovery of More Caverns in Carlsbad, N. M., Area," by Harold W. Mutch, in *Reclamation Era*, August 1946. Any follow-up by anybody on this? ☞ "Underland Wonderland," 4 pix feature in *Denver Post* Roto section, 5/12/46—all about Meramec caverns, Stanton, Mo., "where local legend says the Jesse James gang had a hideout." ☞ Acknowledging membership blank: "The Cave Diving Group Incorporating The Wookey Hole Divers" (via Platten) ☞ Doc

Stone scribbles "See a story in magazine *Holiday*, Vol. 1, No. 1, March 1946, about 5 days in an Arizona cave." ☞ "No Other Man," by Alfred Noyes (*N. Y. Her. Trib.*, 3/17/40(6?))—a story, part of it taking place in famous Blue Grotto. Illus. rather unusual ☞ Psychological short story, "The Cave"—in which the notion of a cave as a grave is used to "break" a man's determination to suicide, by Warwick Deeping, in his *Stories of Love, Courage, and Compassion*, Alfred A. Knopf: New York, 1930. ☞ "The Cave of Loltun," with its "moss-covered chamber walls on which man, in times long past, had carved strange figures and mystic symbols," is a *fascinating* chapter in Edward Herbert Thompson's *People of the Serpent, Life and Adventures Among the Mayas* (in Yucatan). [See, for details of this cave, Thompson's *Cave of Loltun*, Yucatan. Memoirs of the Peabody Museum, Harvard University, Vol. 1, No. 2, 1897.] ☞ *Science News Letter* (1/4/47): Skull fragments of Neanderthal man were found in the Caves of Hercules near Tangiers (Africa) in 1939 by Dr. Carleton S. Coon, of the Peabody Museum. Research in these caves, curtailed by the war, was resumed in a Harvard University expedition this spring headed by Dr. Hugh O'Neill Hencken, curator of European Archeology at Peabody. ☞ *My Cave Life in Vicksburg*. With letters of trial and travel. 12 mo. Original cloth. New York, 1864. Any info. as to author and what it's all about? ☞ *Ecology*, Vol. 27, No. 3 (July, 1946), p. 257: "Notes on Chelonethida from the Duke Forest [at Durham, N. C.], by A. S. Pearse. "The Chelonethida are of interest as predacious arachnids. They are part of the microfauna that is characteristic of forest floors and the barks of trees. Some species have become established in caves." ☞ "Five Days in Death Cave," by Elijah H. Norby. In *True*, for (issue?) 1946, p. 57. ☞ *Treasure Cave*, story and pictures by Sanford Tousey. Juvenile, pub'd. Sept. '46, by Alfred Whiteman & Co. ☞ Acknowledging *Cave Research Group*, News Letter No. 3 (April, 1947), an English organization—very interesting, containing data on glossary of speleology, Survey Symbols, list of commercial caves in Germany and Austria, Additions to Members' Lending Library, etc. ☞ "Scintilla's Cave Hunters," by Bill Lewis. Illus. article in *The Scintillator*, March 1947, house organ for part of Bendix Aviation Corp. ☞ "Supervisor Roswell Leavitt, accompanied by Fred Varney and John C. Hunt of his staff, and Harvey Arbuckle, Trinity County Undersheriff, recently explored the passages of Del Loma Cave on Highway 299. The party spent five hours examining the limestone cave which penetrates the mountain about 300 feet with about 150 feet of side passages. The oldest of numerous initials found in the legendary cave were dated 1849." (Admin. Digest, May 7, 1947. San Francisco, Cal., U. S. Forest Service.) ☞ "Mission to Trout," by Daniel

Lang (*New Yorker*, 5/17/47—thanks to John F. Meenehan) in A Reporter at Large department. Account of trip to Trout Cave, in W. Va., by Jack Wilson, W. J. Stephenson, Dr. W. Brierly, W. E. Davies, Joseph Rush, and Meenehan. ☞ *Under the Southern Cross*, by M. M. Ballou, Ch. V on Fish River Caves at Taraua, near Sydney, Australia; "of vast extent . . . filled with many intricate windings, galleries, and irregular passages in which one would inevitably be lost without an experienced and faithful guide." ☞ *The Weak and The Strong*, by Gerald Kersh, Simon & Schuster, N. Y., 1947. Earthquake closes the entrance to a cave, trapping a group of oddly-assorted people. ☞ *American Notes and Queries*, November 1946, p. 125; tells of a Dr. Bettersworth, first of the south, then Carlinville, Ill., about 1861, whose whole life was mysterious, who wrote one book, *John Smith, Democrat*, and "there was another book . . . a fantastic tale about a group that visited Mammoth Cave." Any clues? ☞ *Living Wilderness*, for December, 1946, contains "Mammoth Cave's Underground Wilderness," by Henry W. Lix (N.S.S. No. 686), a splendid seven-pix article, on New Discovery. ☞ *Ecology*, for January, 1847: "The spring run and cave habitats of *Erimystax harperi* (Fowler)," by Nelson Marshall. A study "made in the vicinity of Gainesville, Fla., where there are many caves and sinks which are of such depth that the subterranean water forms permanent pools within them." ☞ "Exploring Unknown Britain," by Arthur Turner, in *London Calling*, Weekly Letter department, 5/16/46, a 7-pix article: "From remains found in caves, now deep in the heart of Britain, it is known that the grizzly bear, the rhinoceros, and even the tiger once roamed the country. These finds were made by speleologists — exponents of the science of cave exploration . . ." ☞ *Notes on Caves of Missouri: Bibliography*, by Alfred W. Burrill when Curator of Mo. State Resources Museum). Newspaper and magazine "popular science" stories—wealth of fugitive items—for records, and key to scrapbooks of NSS. ☞ *The Pennsylvania Hermit*. A narrative of the Extraordinary Life of Amos Wilson, who expired in a cave (near) Harrisburg, Penn. Phila., 1839; 2nd ed. 1840. ☞ Note from J. D. Kaufman, Pres. of Crystal Cave Co., Inc., Reading Pa., says "The Commonwealth of Pennsylvania, Dept. of H'ways, now have under construction a new regulation-width, hard surface State H'way beginning at U. S. Route No. 222, 1 mi. west of Kutztown leading direct to Crystal Cave. ☞ Order it from G. Platten, *The Caver's Calendar*, first of its kind—pix and linecuts, etc., plus text of humorous speleological nature for every month in the year. Good fun! ☞ "From 576" (A. D. Therrien, Hammond, Ind.) two cartoons, from Collier's, one by Bill King, of group of "outlanders" shivering in cave, facing hard-boiled guide who says: Now let's all stick

together. I'd like to make just one trip without losing somebody." "Black Dragon Canyon," by John P. Simonson, in *Utah* magazine, January '47; "a cave high upon the (canyon) walls . . . There is slight evidence that the cave has been looked over for Indian relics . . . There are a number of smaller caves in the canyons, and they, too, may have been inhabited." Many beautiful and undeciphered petroglyphs. "Riata and Spurs," by Charles A. Siringo (1927), p. 90 f.: "Arriving at Las Portales—near where the thriving county-seat town of Portales, N. M., is now located—we pitched camp at Billy the Kid's 'cave.' It was here at a large freshwater spring—the lake being salty—that the Kid and gang made their headquarters while stealing LX steers. This 'cave' was not a cave—just an overhanging rock cliff, with a stone corral around it, on three sides." "Answers to Questions About Caves and Speleology"—a neat little broadside issued by the V.P.I. Grotto gives neat replies to what are probably seven most-asked questions. "Editor hoped at least one (1) member of NSS might take advantage of 3 pages at end of *Bulletin* 8, to jot down some 'Notes, Comments, and Criticisms,' and send them in to him. Nobody did, however. Ed F. Moore wrote in: "On p. 61 of *Bulletin* 6, a letter signed 'Tony' should read 'Tommy' Watts." Thank you, Ed. "Wish we could have had the fine Culverwell drawings now copyrighted by *Appalachia*. (He's finally joining us.)" "Ohio Development News," for October, 1946: an excellent, 8-page illus. booklet issued by Ohio Development and Publicity Commission, this one on "Ohio's Hidden Wonderlands," (and of course these are caves)—the whole issue on 'em! "Our new Cave Agreement articles by Sipkin, No. 416 (get a copy from Petrie and study) are excellent NSS job! "Acknowledging Forty-Second Scratch of V.P.I. Grotto Grapevine—last received; and illustrated folder (via Platten) on "Czechoslovakia's Moravian Karst Stalagmite and Stalactite Caverns, and Gigantic Abyss MACH-OCHA one of the Wonders of the World." "Illus. story on exploration of Marble Cave, in Colo., on p. 10 of *Denver Post*, 8/11/29. "The 'Rustler of Silver Cliff' describes Yeoman's Cave, in the Sangre de Cristo Mts., Colo., p. 1, in the *Central City Register-Call*, 3/5/88. "Journal of Mammalogy, for May 1947: "Report on a Collection of Mammal Bones from Archeologic Cave-Sites in Coahuila, Mexico," by Raymond M. Gilmore, pp. 147-65. Illust. and extensive bibliography. "Ex-GI tourists who scrawled 'Kilroy' mementos overseas will feel frustrated in a cavern in New Mexico. Some 17th century Conquistador scratched 'I passed this way' on the rocks with his sword. "A whole family of ape-men and women have been dug out of the stony floor of the cave at Sterkfontein, South Africa, reports Dr. Robert Broom of the Transvaal Museum, in 5/17 *Nature*. The most precious discovery is the

skull of a toothless, elderly female, lacking only the lower jaw-bone. . . the skull has many resemblances to that of man," says Broom. "N. Y. Times, 6/10/47: "Secretary of the Interior Julius A. Krug today opposed construction of a dam on Green river in Kentucky, on the grounds that it would flood and otherwise damage the famous Mammoth Cave and its surrounding national park." "Hobbies, January, 1947, p. 161, in Natural History section: "Speleology." An article containing, briefly, an account of the life and activities of Martel, saying, "The founding of this science is credited to one Professor Edouard Alfred Martel of France, who spent more than 50 years of his life exploring more than 1,000 caves." "Further Evidence of Stellar Cult" (p. 382, in *Origin and Evolution of the Human Race*, by Dr. Albert Churchwarden), contains interesting material on hieroglyphics found in an African cave, and their decipherment. "Architectural Forum, for June, 1947, p. 16: "Cities—Underground Future . . . Army engineers had already located several hundred million sq. ft. of 'usable underground sites' in mines. Caves were no longer being considered, the Army said—they were too damp and remote." Well, is this true, Steve?

For some time a hermit made his home in a cave overlooking the gorge of the Niagara River, not far from Horseshoe Falls, on the Canadian side. He took up these quarters to save rent, in the depression years of the '30s. With a dog as companion and guard when he is absent, this modern hermit made a living at odd jobs until war-time brought him steady employment. He cooked on a rude fireplace, kept his eatables in a natural refrigerator deep back in the cave, but kept warm with his little fireplace, at all times.

G. A. "Al" Raiche of Springfield, Mass., is completing a brand new series of cave movies of New England, in color, for lecture work. One of his takes is of a "hermit" in a cave reading one of Clay Perry's cave books! Al wrote a chapter on cave photography for Perry's *New England's Buried Treasure* and Perry guided him to some of the local white marble caves for some picture work.

Probably the highest cave in New York State is John Burrough's little grotto or shelter cave atop Slide Mountain in the Catskills—altitude 4,200 feet. Who can report the lowest cave in the United States? It must be in Death Valley.

Near York Furnace Station, on the east bank of the Susquehanna River, is the "Wind Cave." It is several hundred feet deep and "blows a strong, continuous current of air." As far as known, it was unexplored up to 1899.

Commercial Caves

ENDLESS CAVERNS OF NEW MARKET, VIRGINIA

By WILLIAM GARRARD

THE WONDERFUL and spectacular Endless Caverns, visited by more than 100,000 people annually, are on U. S. 11, three miles south of New Market, Virginia, and 112 miles southwest of Washington, D. C. They lie in the center of the beautiful and historic Shenandoah Valley, a region of high adventure which for more than 200 years has set a stirring pace in America's march of history and progress.

The entrance of these world-famous caverns is

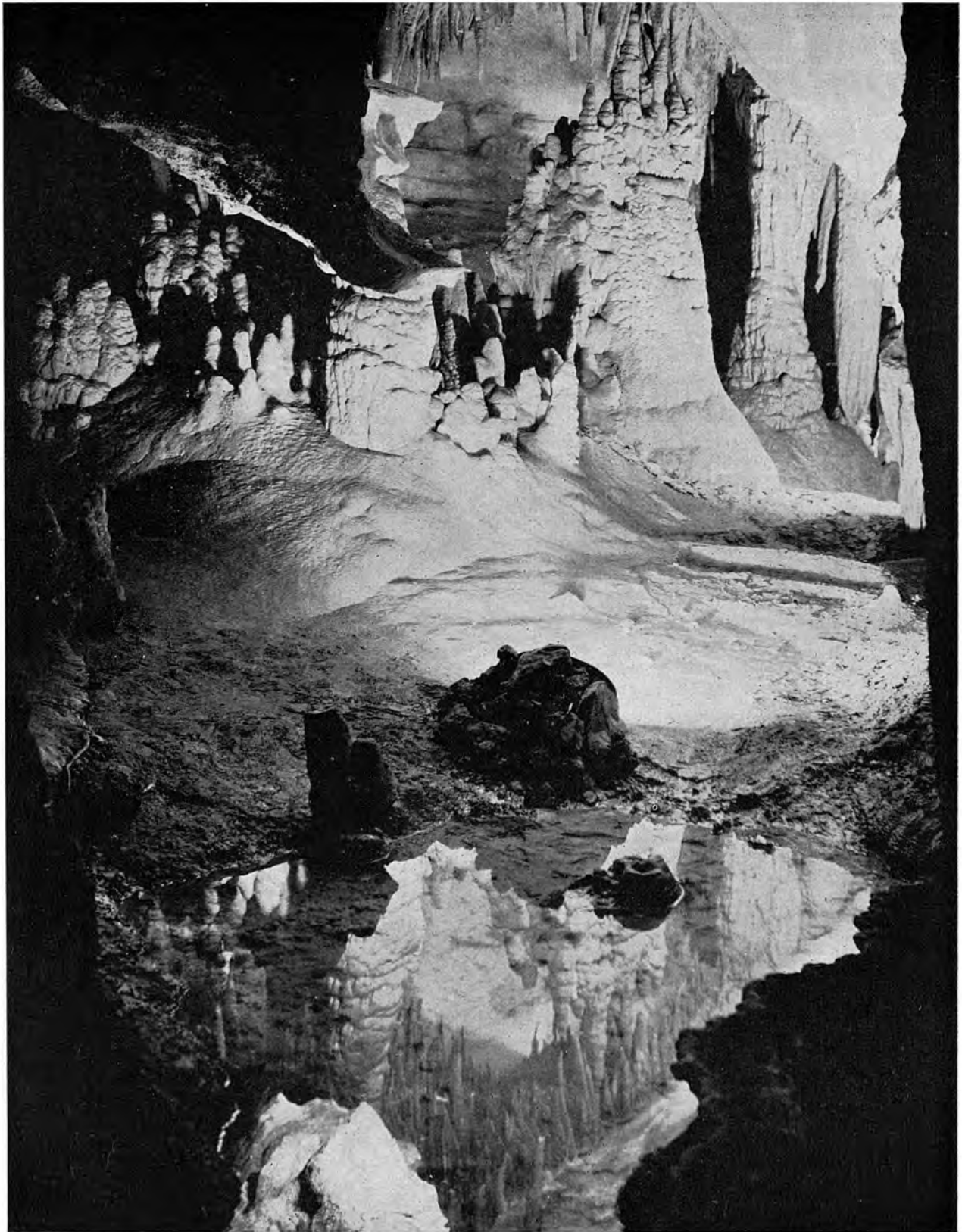
reached by a broad, paved drive which crosses John Smith Creek, a tributary of the Shenandoah River, fed by springs flowing from the Underground Stream in the caverns.

Almost touching the northern edge of the caverns' property is the famous "Fairfax Line," southern boundary of vast estates once owned by Lord Fairfax, surveyed in 1748 by George Washington.

Endless Caverns are like sparkling palaces of



1. In Endless Caverns.—A blue limestone grotto encrusted with stalactites and other formations, some in gorgeous natural colors, others white or crystalline.



2. Tiny blind white shrimp and blind white isopods are found in this clear, mirror-like pool—and other similar pools—in Endless Caverns. These pools, formed by the slow drip from stalactites, have no outlets, but virtually never overflow because evaporation equals the slow drip. In the swiftly-flowing Underground Stream, 90 feet below the first (top) level of Endless Caverns, no blind shrimp or isopods have been found.—Photo by Va. State C. of C.



3. One of the most amazing formations in Endless Caverns — "The Snowdrift," a gigantic mass of dazzling white flowstone precipitated from the watery solution which entered the cavern through a large opening in the upper right corner of the view. It has built not only a white stone cascade, but also conical masses on the cavern floor. A small grotto has been formed behind "The Snowdrift."

stalactites and stalagmites far beneath the earth, displayed by electric floodlights which bring out the natural varied and brilliant colors of the caverns' formations. Here Nature has formed out of rock, azure-blue ceilings like tropical skies, from which descend dazzling white crystal formations resembling frozen cascades and snowdrifts.

Endless Caverns are so noted for their exquisite natural coloring that scenes from them have been reproduced in color by The Encyclopaedia Britannica and The National Geographic Magazine.

One of the most entrancing scenes in Endless Caverns is the internationally known miniature Diamond Lake, the subterranean waters of which reflect, in the brilliant floodlighting, a miniature city of crystals that sparkle like diamonds.

Despite explorations by members of the Ex-

plorers' Club and the American Museum of Natural History, the end of Endless Caverns has never been found. Noted explorers who have taken part in these expeditions include Carveth Wells, Col. Herford T. Cowling, Horace Ashton, Henry Collins Walsh, and Dr. George K. Cherrie, of the Explorers' Club, and Dr. Chester A. Reeds, for many years Curator of Geology, of the American Museum of Natural History, New York.

The entrance grounds at Endless Caverns, on a rock-strewn hill, are ruggedly beautiful, and thick with shade trees and cedars. There is parking space large enough for hundreds of cars.

There are spacious fieldstone buildings, including a Museum, the visitors' Lodge, and a Coffee Shop noted among travelers for fine food. There are large picnic grounds, and a grove supplied

with pure water, electricity, and firewood for auto-trailers and for camping. The Coffee Shop is open from March to November.

Endless Caverns are open 24 hours a day the year 'round, with trained, courteous guides on duty at all hours.



4. This is "Gateway to Fairyland," in the Endless Caverns. Perfect examples of a stalagmite and stalactite are shown in this picture. The stalagmite, with the girl's hand upon its blunt apex, extends upward from the floor; the pointed stalactite hangs from the limestone ceiling directly above. Drops of water laden with calcium carbonate which created these stone formations through the ages, drip from the stalactite upon the stalagmite.

How Caves Are Found

While wandering among the ashes of a building burned near the Shenandoah River in that area (Harper's Ferry), a soldier's horse crashed through a charred trap door. In a tunnel below could be seen a stairway winding down out of sight. With the aid of torches, a party descended and found a cavern large enough to conceal between 200 and 300 horses. And stalls had been laid off along the straw-covered floor and at the far end was a narrow opening. Here was one of Mosby's principal hiding places. The mouth of the cave was so narrow only one horse could

enter at a time, and then only by wading through three feet of water. On the outside the opening was concealed by bushes and rocks, and above it towered a high cliff, directly across the stream from the point where rebel raiders frequently disappeared so mysteriously."—Virgil Carrington Jones' *Ranger Mosby*, Page 240. A footnote alluding to this passage says: "A description of this cave was given by John Lozier of N. Y., assistant surgeon of the First N. Y. Cavalry, in an undated newspaper clipping preserved in the war scrapbook of Mrs. Elizabeth Iller Fisher, of Shreveport, La."

T. T. Perry.

Reprints

CYCLOPEAN CAVE, COLO.

From George A. Croffutt's rare *GRIP-SACK GUIDE OF COLORADO* (Omaha, Neb.: 1881) comes this description of "An Underground World. A Leadville Attraction," p. 163-4:

"The Cyclopean Cave is said to be a wonderful cavern, away down in the bowels of the earth. We did not visit it, having a holy horror for any road in that direction; can not afford to go that way or get as low down; consequently, have compiled from a reported visit made by the editor of the *Leadville Chronicle*, one of those fearless 'quilldrivers' who are ever diving into hidden mystery. This cave is eight miles northeast from Leadville, under Gold Mountain. The story of its discovery is extraordinary; it was a 'prospect' unlooked for by the discoverers; one surprising in the extreme. Two miners, with a 'grub-stake outfit,' were engaged in sinking a shaft, and had got down some 50 feet; had put in a blast, lighted the fuse, and retired to a safe distance, awaiting the explosion; it came, and on investigation the miners found the rocks from the blast had gone down instead of up, and a chasm had been opened beneath, to an unknown depth. It was this subterranean mystery the *Chronicle* man explored.

"Descending to the bottom of the shaft (see Fig. 1) a depth of 45 feet, the further descent is

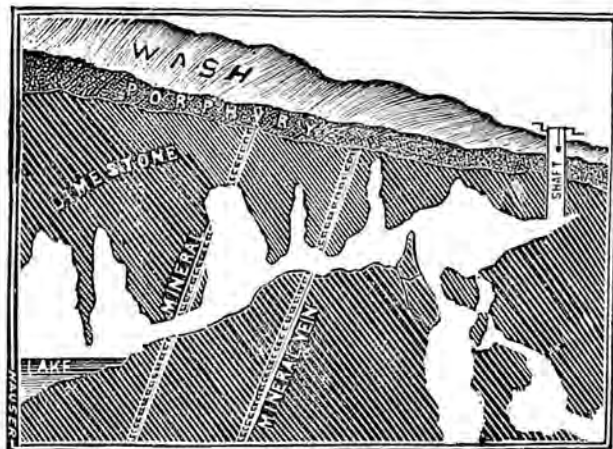


FIGURE 1.—Characteristic Section, showing Opening to the Cave.

at an angle of 40 degrees, over a soft composition of lime, sand, and water, when suddenly, a vast chamber appears, which forms the beginning of the main cave. This chamber shows every evidence of the action of waters; the walls of lime, bearing traces of the angry whirl-pool, leaving here and there in the forced channels, huge boulders, with veins of sulphurets, gold-bearing rock, and

streaks of heavily stained copper, showing plainly by the light of torches on every side. Again proceeding, first to the right, then to the left, now into large, open chambers, with ceilings glittering with beautiful stalactites, and, again, through winding, irregular avenues, the passage closing up, leaving only a small passage, to another and still larger cave, the walls reaching to only a few feet from the ground. Rolling, like a barrel, through this passage, a distance of about 15 feet, a beautiful lake is reached, the waters of which are as pure as crystal.

"The winding, intricate hall-ways are said to very much resemble the catacombs of Rome. The precious stalactites glitter in the dim light, like stars in the firmament. Perhaps the most symmetrical, if not the largest of the apartments, is called the *Chronicle Rotunda*. It is 500 feet below the point of entrance to the cave. The roof rises some 70 feet, and is nearly conical (sic), the general appearance being that of the interior of an immense wigwam. The walls are ribbed by the action of the water, and form a series of horizontal circles around the room. The floor is composed of a clear gravel, and through it trickles a crystal stream called the *River Styx* (see Fig. 2).



FIGURE 2.—Chronicle Rotunda—River Styx—Washing Gold.

"One of the wonders of the cave is the lake. No current seems to disturb its placid surface; no living thing finds life within its depths; all is silent as the grave, with this buried pool, where never yet a breeze has stirred a ripple or a sunbeam played, save when a stealthy drop shoots from the darkness overhead and sinks in the blacker night below. All of the lake is not visible from any one spot; in fact, its exact extent is not at present known, as it loses itself beneath a low, rocky arch into the inky darkness beyond.

"There are many other chambers worthy of special mention, and there is every reason to believe the cave extends for many miles.

"From the main rotunda, a place called the 'Bottomless Pit,' is reached, but whether it is bot-

tomless or not, has not been fully ascertained, and a stone let fall, returns but a faint sound to the waiting listener. On, and on, one is conducted, through narrow passages, arches, up and down precipices, among tumbling heaps of pilasters, columns, and friezes, divided by strata at regular or irregular intervals, like the ruins of some Old World temple. Other chambers, recesses, passages, etc., have been called Griffitt's Pass, O'Connor Grotto, Viele's Studio, Stein Gallery, Miriam Cataract, Davis Palace, Bridal Veil, Rachel's Piazza, Serpent's Glen, Bessie's Boudoir, Lady Harris' Drawing Room, Beelzebub's Nose, The Lover's Leap, etc., etc."

FROM LETTER of ALEXANDER WILSON*
(April 28, 1810)

It seemed as if the whole country (Kentucky) had once been one general level; but that from some unknown cause, the ground had been undermined, and had fallen in, in innumerable places, forming regular, funnel-shaped concavities of all dimensions, from 20 feet in diameter, and six feet in width, to 500 feet by 50 feet, the surface or verdure generally unbroken. In some tracts the surface was entirely destitute of trees, and the eye was presented with nothing but one general neighborhood of the concavities or, as they are usually called, sinkholes. At the center, or bottom of some of these, openings had been made for water. In several places these holes had broken in, on the sides, and even middle of the road, to an unknown depth, presenting their grim mouths as if to swallow up the unwary traveler.

At the bottom of one of these declivities, at least 50 feet below the general level, a large rivulet of pure water issued at once from the mouth of a cave about 12 feet wide and seven feet high. A number of very singular, sweet-smelling lichens grew over the entrance, and a pewee had fixed her nest, like a little sentry-box, on a projecting shelf of the rock above the water. The height and dimensions of the cave continued the same as far as I waded in, which might be 30 or 40 yards, but the darkness became so great that I was forced to return. I observed numbers of small fish sporting about, and I doubt not but these abound even in its utmost subterranean recesses.

The whole of this country from Green to Red River, is hollowed out into these enormous caves, one of which, lately discovered in Warren County, about eight miles from the Dripping Springs, has been explored for upwards of six miles, extending under the bed of the Green River. The entrance

of these caves generally commences at the bottom of a sinkhole; and many of them are used by the inhabitants as cellars or spring-houses, having generally a spring or brook of clear water running through them.

I descended into one of these belonging to a Mr. Wood, accompanied by the proprietor, who carried the light. At first the darkness was so intense that I could scarcely see a few feet beyond the circumference of the candle; but, after being in for five or six minutes, the objects around me began to make their appearance more distinctly. The bottom, for 15 or 20 yards at first, was so irregular, that we had constantly to climb over large masses of wet and slippery rocks; the roof rose in many places to the height of 20 or 30 feet, presenting all the most irregular projections of surface, and hanging in gloomy and silent horror. We passed numerous chambers, or offsets, which we did not explore; and after three hours' wandering in these profound regions of gloom and silence, the particulars of which would detain me too long, I emerged with a handkerchief filled with bats, including one which I had never seen described, and a number of extraordinary insects of the Gryllus tribe, with antennae upwards of six inches long, and which I am persuaded had never before seen the light of day, as they fled from it with seeming terror, and I believe were as blind in it as their companions the bats.

Great quantities of native glauber salts are found in these caves, and are used by the country people in the same manner, and with equal effect, as those of the shops. But the principal production is saltpetre, which is procured from the earth in great abundance. The cave in Warren County, above-mentioned, has lately been sold for \$3,000 to a saltpetre company, an individual of which informed me that, from every appearance, this cave had been known to the Indians many ages ago; and had evidently been used for the same purposes. At the distance of more than a mile from the entrance, the exploring party, on their first visit, found the roof blackened by smoke, and bundles of half-burnt canes lying scattered about. A bark moccasin, of curious construction, besides several other Indian articles, were found among the rubbish. The earth, also, lay piled in heaps, with great irregularity, as if in preparation for extracting the saltpetre.

Next page carries a fine picture of a typical caving group "at ease." For creating nostalgia in Ye Ed. it was worth the price of admission.

*The Poems and Literary Prose of Alexander Wilson. Edited by Rev. Alexander B. Grosart, Paisley, 1876: Vol. 1, p. 199ff.



Work party outside Elkhorn Mountain Cave, near Petersburg, W. Va. Taken in August, 1946, by Watkins.

Random Notes

Scientific

An Unusual Phenomenon

By Burton Faust

While a party composed of Petrie, Mitchell, Carter, Stephenson, and Faust were exploring "Salt Petre Cave" near Burnsville, Va., later known as "Breathing Cave," a most unusual phenomenon was observed. This preliminary report or statement of what was observed together with an outline of the approximate conditions of weather and description of cave structure insofar as the ramifications were explored are presented with the hope someone may present a possible explanation. Four suggestions of possible explanations have been presented. These will be outlined later. None has the aspect of plausibility even though all come within the realm of possibility and are only suggested to provoke thought and discussion.

The day was very clear with bright sunshine. A very slight amount of haze was in the air. The temperature was moderate, approximately 75° F. A gentle breeze of not more than 4 m.p.h. was moving.

The cave opened at the bottom of one side of a gently sloping sinkhole almost directly into the side of the hill. The entrance appeared to be an anticline, 16-20 feet wide, 12-16 feet high, sloping back and down from about 35°-40° for 30-40 feet inside the entrance then leveled to about 10°-15° slope for a distance of approximately 150-175 feet. The effect is of a large, nearly straight, sloping hall. At the end of the hall the floor is filled with a mixture of broken rock and washed-in clay and debris. Leading off to the right, within 10-12 feet of the end of the hall next to the floor is a small crawl, 14-16 inches in height by 4-5 feet in width. The flood water that runs into the entrance appears to exit largely through this crawl hole. The crawl hole continues as such for 10-12 feet and gradually open out wider and larger into a series of rooms and passages. The whole effect of the gross structure appears as a venturi opening with large spaces connected through a constricted passage. This discussion is included to give an idea of the structure involved. The back portions of the cave were not completely explored. An additional passageway to the left 10-15 feet closer to the entrance than the crawl hole and largely walkable extends with numerous bends and turns farther than a distance of the 200 feet explored. However, this left-hand passage apparently has nothing to do with the observed and described phenomena.

While waiting for the rest of the party to re-

turn from exploring the recesses beyond the crawl hole an unusual motion of the air through the throat of the crawl was observed. The writer stretched out on the ground across the opening, lighted a candle and a cigar and proceeded to observe and study the air motion through the crawl. The air motion through the venturi was discovered to be a regular periodic breathing. The breathing was observed for some time and the following cycle was noted. The air would start moving slowly, increase rapidly to a maximum, slow down to an apparent standstill, remain stationary for a period of time, then start moving in the opposite direction, passing through a maximum velocity to rest and remain so for a period of time and start the cycle over again. The length of each blowing and each rest period was approximately one minute each. Thus the entire cycle occupied about four minutes of time. Of course, it is to be understood only crude and approximate observations were made using only a guttering candle, a smouldering cigar, tactile sensations, sight and a watch, consequently the above observed and described cycle is to be considered only a fair approximation. However, the writer is convinced in spite of the crudities involved something very much out of the ordinary was happening.

At the first opportunity this cave will be revisited, more accurate and complete data collected, and further explorations conducted, all with the idea of discovering the explanation if possible. There is a possibility such phenomena as was observed were transitory and will not be in evidence upon further visits. However, such remains to be seen.

Possible Explanations of Causes

Several theories have been advanced as possible explanations of this peculiar and unusual, and insofar as is known to the writer, the first time observed, phenomena. However, all are so far-fetched and highly improbable as to not seem correct or practical explanations. Each of the "explanations" will be briefly outlined and any suggestions, criticisms, corrections, or additional ideas will be welcomed.

1. Located in the distant and so far unexplored inner reaches of the portion of the cave beyond the venturi tube may be a large room that rapidly fills with water, compresses the air, forces it to pass through the constricted portion and thus to the outer atmosphere. After a lag of a certain time the large room may be emptied very rapidly by a syphon action causing a drop of air pressure within the cave and an inward rushing of air from the outside to replace the space occupied by the water. After a time lag during which the air is at comparative rest the room again fills with water and repeats the cycle of operations.

One very serious objection to this explanation is the fact that a tremendous volume of water would have to be moved in and out of the cave in a very

short period of time to move the large volume of air that passes through the restricted neck or tube connecting the outer and inner sections of the cave. Another is that no noise of rushing water was reported by the group that partially explored the cave beyond the crawl.

2. A regular periodic "humming" of the air pressure between the inner reaches of the cave and the outer atmosphere in attempting to equalize the difference in barometric pressures on the opposite sides of the connecting tube may be an explanation of the observed phenomenon. A condition of instability due to the momentum of the air as it rushes past the point of equilibrium causing a large volume of air to oscillate in a periodic manner might be the situation. However, the friction on the walls and through the crawl would probably prevent such rapid movement as was observed. An additional objection is the large and rapid barometric change probably necessary to produce the movement of the large volume of air being displaced every four minutes.

3. A third possible explanation based on Humphrey's explanation of the "Humming of Wires" as advanced in his book *The Physics of the Air* is offered as an additional possibility. According to this theory wind moving in a direction perpendicular to the stretched span of wire will cause an eddy to form on the lee side of the wire thus producing a variation in the pressure distribution surrounding the wire. The tension of the wire will cause the wire to move toward the area of low pressure whereupon another eddy will form on the opposite side of the wire with its attendant low pressure and the tension will cause the wire to move in the opposite direction. The frequency with which these eddies form and break will determine the frequency of vibration and the resultant audible or inaudible tonal range. If the wind moves across some body, for example, a rounded mountain top, that cannot vibrate, it is conceivable that eddies will form and the resulting high or low pressure volumes thus formed might cause a sufficient pressure variation on the lee side of the mountain and so react within a cave opening to produce a variation of pressure within the mouth of the cave and cause a "breathing" which might be observed within a constricted connection between two relatively larger volumes. Approximate calculations performed by William Foster appear to substantiate a relation between the rate of oscillation within the cave and the estimated outside wind velocity. Whether there is any real or only apparent correlation is difficult to say. One objection to this explanation is purely logical. It does not appear reasonable that the effect such as has been described would be evident in such a pinpoint, as the cave entrance is, in comparison with the great bulk of the mountain above the cave.

4. A fourth suggestion is offered that is a modification of the principles involved when a blast

of air is blown into the mouth of a closed vessel. It is a well known fact that if a current of air is directed into the mouth of a closed vessel the pressure will accumulate within the vessel up to a certain value dependent upon a number of factors, among which are the volume of the vessel, velocity of air directed into the opening and size of opening. When a condition of over-balance is attained a spilling of the confined air and an out-rush of the contained air against the jet of impinging air takes place, lowering the pressure within the vessel until the pressure is of such value the air-jet again can start the flow into the bottle. In this way an alternate in and out motion of air through the vessel entrance is maintained. It is conceivably possible a similar action and reaction promoted and maintained by the air and wind currents outside the cave might cause such a phenomenon as was observed and described.

This thought must be kept in mind. The results explained above have been observed only on one occasion. Nevertheless the phenomenon even though it might conceivably be transient must of necessity have a plausible explanation and the above is submitted only as a preliminary report, to lay the problem before anyone who reads, and provoke thought, suggestions, criticisms, and proposals of explanations. (1945)

Further Observations

Since the above was written at least five trips have been made back to Breathing Cave. On each trip the time cycle of the breathing has been observed in varying lengths, ranging from 8 to 20 minutes. On each trip the writer has explored additional and new passages and recesses of the cave. He has also received reports from other parties who have explored sections of the cave not personally visited. The most recent report was received from James Robertson of the Charlottesville Grotto. Robertson, leading a party from Charlottesville, reported traversing approximately 1,200 feet of what appeared to be absolutely undisturbed new passages. They reported finding channels that appeared to be used as water passages at times. However, no running water or any signs of such were reported.

A few remarks concerning the general nature of this cave may not be out of place. The portions of the cave that have been explored are all at a lower elevation than the entrance opening. The passages are all covered with very thick layers of overburden, apparently in the hundreds of feet in thickness above most of them. The general trend of the floor is downward but with very few abrupt drops of more than 1-2 feet. One drop of 8 feet and another of 3-4 feet and one of 12-15 feet have been observed. There appear to be at least three separate and independent drainage systems within this cave. These systems appear to be separated by considerable differences in level but

easily accessible from one to another. The systems appear more or less like a series of saw-teeth, each system corresponding to a single tooth. At least three of these systems have been followed as far as it is possible to go and each ends in a very small partly plugged hole in the floor at its innermost end. However, no evidence of recent water-flow was observed in either system except possibly after a very heavy rainfall.

Altogether approximately 1,500-2,500 feet of passages have been explored and studied during six trips, with a total of about 30 hours underground. However, the "breathing" phenomenon is as much a mystery now as on its first observation. On one trip we sat watching heavy dense black smoke from a smudge that had been lighted in the entrance. It drifted into the cave, was blown back out, then in a short time disappeared back into the cave entrance. As one member of our party exclaimed, "That is the most uncanny thing I ever saw!" If we did not pride ourselves as being fairly well educated and rational persons, we might find ourselves in harmony with those who used to believe that spirits lived in caves.

However, none of the suggestions advanced to explain this peculiar action appear to be any more plausible than at the time they were first offered. Nothing has been found in the literature that might give additional ideas. No one with whom the writer has discussed the matter has suggested anything additional to that already advanced. Any suggestions anyone might have to offer will be most welcome. This has been one of the most intriguing problems that has been presented to the writer in many a day.

Washington, D. C. (1947).

Mosquitoes Overwintering in Caves

By James W. Cunningham and A. C. Burrill

The United States may be divided into four great cave zones: Missouri-Arkansas, with 162 listed caves; Kentucky-Tennessee and Alabama, with 348; Pennsylvania and the Virginias, with 400; and the southern border, Texas and California, with 330. It was in Minnesota, however, where only three or four caves have been listed, that the first research on cave mosquitoes was done.

Owen (1937) states that in Minnesota the females of *Anopheles maculipennis* Meigen hibernate. He found that in two out of four caves under observation, places selected for hibernation did not afford adequate protection, as the adults were killed by becoming frozen in ice on the walls. In the anteroom of a larger cave all died. Apparently he assumed that those in the deeper recesses of the larger caves successfully passed the winter, although they were not located. *Maculipennis* Meigen overwinters in adult stage, and only females

hibernate. Males died in late fall, presumably after mating. With the appearance of warm weather in the spring, females come out of hibernation and deposit eggs. The earliest record of adults taken in the field is May 18.

Under what conditions hibernation may take place in nature is not only of scientific interest, but is of practical importance in maintaining the species.

In the fall of 1935, a survey of several caves in the banks of the Minnesota and Mississippi Rivers was made for the presence of *maculipennis* Meigen with the idea of following the species through the winter. In four caves, this mosquito was found in varying numbers. Two of these caves were very small—about eight feet in depth and large enough at the opening for a man to enter. A third cave was in the form of a long tunnel, narrow, and extending back about 20 feet into a bank of solid sand. The fourth cave was a very extensive one, originally excavated for sand, later used for growing mushrooms, but now abandoned. A few *maculipennis* were found in the deeper recesses of this cave, and a small group on the walls of an anteroom by the entrance.

The relative humidity of all these caves was practically 100 percent, and the walls were wet with moisture. The temperature of the small caves on November 11 was 35° F., while the temperature of the two deeper caves was 44° F. Again, on December 20, the temperature of the two small caves was above freezing and the temperature of the mushroom cave had not changed, even though on this date the temperature outside was below zero. The months of January and February, 1936, established a record for low temperatures for Minnesota for a period of 46 years. When the caves were again visited on March 2, all mosquitoes in the two small caves were frozen in the ice on the walls. None could be found in the medium-sized cave, while in the large mushroom cave all those on the walls of the small anteroom by the entrance were dead. Those in the deeper recesses could not be located. The significant fact is that these adults selected, in two cases out of four, a place for hibernation which did not afford adequate protection from the severe cold.

A single female of *A. quadrimaculatus* Say was taken in hibernation from a cave by the Mississippi River near St. Paul on November 11, 1935.

Females of *A. punctipennis* Say were under observation during the winter of 1935-36 in the small cave on the Minnesota River. When this cave was examined on March 2, 1936, all of the individuals were found frozen in the ice on the walls. This species, like *maculipennis*, had selected a place for hibernation which did not afford adequate protection. All of the above discussed mosquitoes are malaria carriers.

The northern house mosquito *Culex pipiens* L. is now a proved carrier of bird malaria, heartworm of dogs, and St. Louis encephalitis and yellow fever diseases of man. It may be a common form in cave hibernation. In *C. pipiens* L. the adult females hibernate in cellars, etc., and become active in early spring. This species has been observed to hibernate in large numbers in the large mushroom cave on the Mississippi River in St. Paul. It has also been taken in hibernation from the small caves along the Minnesota River and the Mississippi River near St. Paul. These caves were visited periodically during the winter of 1935 and 1936. On March 2, 1936, after the prolonged cold period of January and February, all the *pipiens* in the small caves were found frozen in the ice on the walls. The number of *pipiens* in the large mushroom cave was beyond estimation. In many chambers of the cave the individuals were perched on the walls so close together that their feet were in contact and overlapped. There were literally millions of them present. We gained the impression that all the *pipiens* in St. Paul had gone to the cave for hibernation. This large cave was last visited on April 10, when it was found that the *pipiens* were migrating from the deeper recesses to the entrance.

In order to predict what species will be found in caves, it is only necessary to note which species choose cellar shelter in cool weather. Such a study has been made by the junior author and in Tennessee Valley researches.

Ives found some *Anopheles quadrimaculatus* (malarial), but more *A. punctipennis*, a species non-malarial under normal conditions, gathered together in caves in southeast Tennessee. A count was made showing 2,018 anophelines to 1,084 culicines, as two is to one. In a cave at Chattanooga and at Shell Mound, he discovered also a male *A. quadrimaculatus*. These flies were always in the twilight zone, never in the deep interior of caves. He believes fall temperatures and relative humidity often coincide with those of average caves so that instinct would lead them to flee daylight hours by entering the twilight zone of a cave with heat and humidity factors equal to outdoors.

The junior author found these species common in caves near St. Louis, Missouri.

In North Carolina, wintering female of *quadrimaculatus* and *punctipennis* were seen to prefer vacant houses and hollow trees to occupied dwellings and large barns with livestock. They even collected in great numbers in Fort Jackson, southern Louisiana, like *pipiens* in the Minnesota cave. In Tennessee, after October 15, most *Anopheles* left occupied homes and barns of livestock where they were present all summer and gradually increased in numbers in caves and cellars.

A study of this movement of *Anopheles* from houses and barns to caves and cellars was made in Cave Spring area near the Tennessee River. Seventeen caves, six cellars, eleven barns, eight houses, four out-buildings, and one tree hole were checked.

Decreasing temperatures were accompanied by a reduction in gravid females showing a blood meal and eggs. After October 25 no eggs were developed beyond "stage 2." In the first half of November, there was an increase in numbers in caves and unoccupied buildings, there being as many as 69 *quadrimaculatus* in Cave Spring Cave near Decatur, Alabama, and the Wheeler Reservoir. Thereafter they decreased in number in caves; so that, by the third week in February, all *quadrimaculatus* had left the caves. They began biting by February 8 (temperature 54° F.) and were back in barns by February 13. In Georgia, likewise, *quadrimaculatus* were in all stages in February, and the first males were noted on March 15. The above was true also for *punctipennis* in the winter.

No doubt there are casualties during the winter, but in the South, freezing may not be the chief cause. In a small cave on the south side of the Tennessee River near Wilson Dam, temperatures ranged, according to self-registering maximum-minimum thermometers, from 51.5° F. minimum to 59° F. maximum, from December 16 to January 27; while, outside, they ranged from 13.5° F. to 73.5° F.

Along with this temperature record in Tennessee Valley, an outdoor insectary proved that a female life span can continue for 133 days and a male life span for 80 days. Many females survived 69 days in a cave. In long Minnesota winters, adults must survive longer periods; and the Missouri endurance and longevity, range in between. In the Tennessee insectary, 527 adults emerged after the first freezing temperature on November 25. As further sign of hibernation, females often accumulate a fat reserve, but no ovary development occurs during November and December even if they have blood meals or are fed sugar. So it becomes clear that mosquitoes can survive many days at low temperatures, with either or both fat reserve and blood meal to rely on. Like bats, they may mate in fall but have no maturation of ova till spring.

Tennessee Valley studies show that, with or without males present, our malarial species winter as inseminated females in cases where weather is too severe for immature stages to survive. Ovarian development is stimulated at 68° and above. These studies indicated that the malaria *Plasmodium* does not die in overwintering mosquitoes, since its oöcyst stage was discovered in one stomach of a female in a cave on December 1, though one case does not prove it usual.

In Missouri, other species may attack vertebrates late in October and November. At Osage bottoms on October 20, 1946, *Aedes triseriatus*, *A. trivittatus*, and *Psorophora confinnis* attacked a Lincoln University party at noon in bright sunlight in river-bottom woods. On October 13, 1946, a last stage larvae and pupae were bred out as *Aedes vexans* and *Culex pipiens*. So broods mature late. Far more younger stages were in pools of intermittent streams than the late stages chosen for rearing. In more open falls with warmer temperatures still later broods of these species could mature far north in Missouri. Most *Aedes* overwinter as eggs. *Culex* adults may overwinter in caves, as does *C. pipiens*.

It was found that a first killing frost in Missouri does not destroy all adults. During a warm December period in 1946, *punctipennis* was taken at an indoor reading light.

Adult mosquitoes have numerous places to survive winter such as caves, tree-holes, abandoned buildings, and cellars. Fluctuation of surviving adults must vary with winter severity.

We are certain some disease-carrying mosquitoes winter in caves in the best cave-hunting areas of America; and, unless equipped with DDT or other sprays, speleological parties, to avoid being bitten, ought not stop long in the twilight zone of caves in winter.

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Cave

Jewel Cave National Monument, S. D.

Under the authority of the Act of Congress approved June 8, 1906, entitled "An Act for the Preservation of American Antiquities," President Roosevelt set aside on February 7, 1908, an area consisting of 1,280 acres of land to be known as the Jewel Cave National Monument, now administered by the U. S. Park Service.

This cave was discovered in August, 1900, by two brothers named Michaud who were prospecting for minerals. Some development work took place from time to time until, in 1928, a group of local business men organized a corporation to develop or improve the cave and to open it to the public. This organization raised funds and considerable work was done in the form of opening passageways, providing stairways, other improvements, and necessary guide service for visitors.

The Jewel Cave is located along the Custer-Newcastle highway about 14 miles southwest of Custer, South Dakota, near the west side of the Harney National Forest. The two sections of land which comprise the Monument are located on a high limestone plateau cut by Hell Canyon on the east and Teepee Canyon on the west. Hell Canyon has precipitous walls, highly colored in many places, and is very winding and picturesque.

The opening to Jewel Cave is in the side of Hell Canyon about 60 feet above the bottom. Automobiles can drive within one hundred feet of the entrance.

This cave, located in a limestone formation, is apparently the result of the action of water. As far as explorations have extended, it consists of a series of chambers connected by narrow passages, with numerous side galleries, the walls of which are encrusted with a magnificent layer of calcite crystal.

On entering the cave one finds the main passageway leading in an easterly direction for about 100 feet. It then divides into two sections; one bearing in a northeasterly direction and the other southeasterly. The former has a few rapid changes in grade and several ladders or stairways are necessary. This route is composed of narrow, winding passages opening into side galleries and chambers of various dimensions.

The walls of the small connecting passages are of limestone and in places do not especially appeal to the ordinary observer. These narrow passageways, however, contain some very interesting formations, the boxwork or honeycomb crystallization being particularly attractive.

The larger chambers which are entered at intervals along the route have been given appropriate names descriptive of their shape or form. The Flat Top Room, Broken Chamber, and Ragged Top Room are the largest of those found

along this route which ends in a Gothic dome 23 feet high, lined with a thick scale of crystalline calcite. The walls at this end are honeycombed and unexplored passages lead every way. Some exploration has been done in an endeavor to find a passage of greater length but as yet none has been found. This route is in good condition, is about one-fourth mile in length and may be easily traversed.

The southeasterly or No. 2 route is longer and penetrates to a greater depth than No. 1. The most attractive scenic features of this section of the cave are beyond what is known as Milk River and continuing northeasterly from there to the end of the passage.

Milk River is about 65 feet below the surface and is an extremely interesting feature. Water seeps through the roof forming stalactites and flowing over these it drops onto a snow-like bank of limestone encrustation, falling into a small basin two feet below the top. The effect is that of milk flowing over a small falls into a lake below.

Beyond this point there are no ladders and some passages are small, opening up into larger chambers. At Junction Chamber, from which unexplored passages lead in many directions, the walls are honeycombed. At some distance farther the largest and most picturesque chambers of the cave are entered. Their walls are lined with a thick scale of calcite, giving the appearance of a room formed of the confection, "cracker jack." Most of the passages leading from Milk River to the explored end of the cave are relatively small.

Jewel Cave, as a whole, is a wonderful creation of nature. Several openings have been found through which wind blows in and out of the cave for more or less definite intervals. Many small holes have been found into which rocks may be dropped and no sound of their hitting bottom can be heard.

Route No. 2 is about twice the length of the other, and there is every probability that some of the numerous passages which radiate from the end and from various places along the route will be found to lead to additional galleries and chambers.

George Talbot's Cave

This account was given to Clay Perry by Carl Carmer, well known author and collector of folklore, especially for the Bulletin.

On Watson's Island, Md., in the mouth of the Susquehanna River, is a large mass of barren rock, rising almost straight up for several hundred feet above the east bank of the river about a half-mile below Port Deposit.

There was a cave in this high hill (traditionally called "Mt. Ararat") where George Talbot, a cousin of the Lord Baltimore, hid during the excite-

ment which followed his killing of Christopher Rowsby, a royal collector, in October, 1684.

George Talbot owned, through favor of his cousins, a large tract of land called "Susquehanna Manor," which was intended to be a genuine feudal estate. He was very fond of hunting with hawks. Tradition says that, through his love of falconry, he was able to obtain food while hidden in the cave, and it is supposed to be true that these falcons remained on the peak of Mt. Ararat after Talbot had left the country.

It was the Rowsby killing which put an end to the excitement aroused again and again in Maryland by Talbot. There had been a growing animosity between Charles II and the Baltimores. Capt. Thomas Allen, then cruising the Chesapeake in a royal brig, so enraged George Talbot by his conduct that he went on board to demand an explanation. Talbot, Allen and Rowsby got into a violent quarrel, and when Talbot wished to go on shore he was prevented from doing so.

He thereupon drew a dagger and stabbed Rowsby in the heart. Allen carried Talbot to Virginia, refusing to surrender him to the Maryland authorities.

Talbot was rescued from Gloucester by his wife and a few retainers. It is said that this was accomplished by "Irish wit and suavity." They then fled to "Susquehanna Manor," but there was such a hue and cry that Talbot went secretly to the cave, about 12 feet wide, 10 feet high, and 20 feet deep, which was in the granite bluff on the northern end of the hill. This cave was later destroyed to improve river navigation.

Talbot also used a blond wig and other means of disguise. Finally, "to save his friends further anxiety" Talbot surrendered himself and was convicted, but was soon pardoned by the King.

Talbot then left America to fight in Ireland in the James II and Protestant Wars. Following the downfall of the Stuarts, he again took up arms with the Irish brigade in France and was killed.

There is nothing left of the "Susquehanna Manor" (save this story).

New Virginia Caves

I have some new caves to add to the list of Wm. McGill which was published in *Bulletin* Number Eight.

On the weekend of Sept. 14th, I led a party on a cave hunt around the Cleveland-Lebanon area in Russell County. We entered and partially explored five caves but did not have time to locate others we heard about. There are at least two or three more of appreciable size in the immediate vicinity.

Those located were:

Smith's—2 miles north of the village of Clinchfield, Entrance has sloping rock at entrance, about 8 feet long, then drop of 10 feet to shelf below.

Floor of the cave is about 60 feet to 75 feet below entrance. Long main passage which rises somewhat nearer the surface. We explored for half a mile. Could have gone on much further, but mostly crawling. Other small caves near at hand would indicate that there might be many small openings to this same main passage. Also we found surface toads and fresh animal footprints about a quarter-mile in, which would also indicate other openings. No animal could go and come through the main entrance.

Bundy's—On highway, $3\frac{1}{2}$ miles from Lebanon en route toward Dickensonville. The one facing the highway has large arched entrance leading into large room which resembles a huge pit with a balcony all around. There is a water course leading from lower level too small to enter comfortably. Few passages from upper level but not extensive. Directly back of this cave is one of an entirely different type, though only a few hundred feet away. Entrance is in the side of a depression (may be a sink) and the cave follows the curve of the side of the depression close to the surface. Formations and flowstone shone in the light of our lamps—full of large quartz(?) crystals.

Gray's—On route 82 between Lebanon and Cleveland. Entrance at bottom of a large depression, about 40° angle down. Can be reached easily without ropes. We did not have time to penetrate far into it, but Mr. Gray says there are rumors of its being two miles long.

Dougherty's—Route 82 out of Lebanon toward Cleveland. Sharp right on dirt road at foot of hill near Gray's Cave; 3.4 miles on dirt road there is a wide creek with bridge over it. Cave entrance is about a few hundred feet upstream. The cave is small but beautiful. Most of the formations are covered with what seems to be a white fungus growth, or moss.

As is true in so many of the Virginia caves, three of these contained dead animals—one, a dog which was said to be rabid, shot, and thrown in to get rid of it. The others had dead sheep near the entrance.

I hope some of our enthusiastic members who live nearer Russell County can go out to one large cave we did not have time to locate. Its initial drop is of unknown depth, reputed to be around 100 feet to 200 feet. The Ballard Smith children can take anyone there, or perhaps anyone in the village of Clinchfield knows of it.

Chrissy V. Mansfield,
Arlington, Va. (10/9/46)

Maybrooke Sinkhole, Virginia

One day Lemon told me that there was a big sinkhole on the south side of the road about two miles west of Maybrook, Giles County, Va. He had heard from people who live nearby that there was a hole in the bottom into which it was possible to drop rocks straight down and hear them bounce again and again until the sound disappeared in the distance. Even allowing for the exaggerations that people usually make about such things, this sounded like it might be a hundred feet deep, and be another Clover Hollow Cave or Pig Hole. Since there was no known cave indicated in that area on the VPI Grotto's maps, we decided to go out there and investigate the story.

The next Saturday (February 1, 1947) Rainey's car happened to be in working order (but just barely), so Thierry, Rainey, Lemon, and I embarked in it toward Maybrook. In order to be prepared for this huge cave, we took along a 160 foot length of nylon rope.

We had almost reached Maybrook, when we saw that a State Patrolman was following us. Just a little later, he stopped us and asked Rainey for his driver's license. It seems he had noticed the car weaving back and forth and had decided it must have been an inexperienced driver. He soon found out that the trouble was in the steering wheel; so, after he cautioned us to get the steering repaired, we continued merrily on our way.

We arrived at the sinkhole (located at latitude and longitude $37^\circ 19' 55''$ and $80^\circ 34' 10''$ on the Pearisburg quadrangle) and saw that it was about 500 feet long and 200 feet wide, runs in a general east-west direction, has a flat bottom about 50 feet down from the surrounding fields, and is within plain sight of the road. As we went down inside this sinkhole I noticed something familiar about it, and said so to Rainey. He replied that he remembered having been there about two years before, and having searched the sinkhole for caves at that time. I then recollected that I had been in a party that had come there about four years before and searched the sinkhole for caves. This sinkhole is so large and obvious that apparently we have been looking for caves in it about once every two years.

Just to be sure it was the same one, we looked for the little caves we had found previously, which were five holes in different parts of the wall of the sinkhole. None of them was more than 50 feet long, but one of them did have two entrances. This was just as we remembered it, but on the first two visits no one had thought it worth while to write up any report of the trip.

We climbed back up and got in the car once again. After some more cave-hunting we eventually arrived back in Blacksburg.

The moral of this story is: Always write up a report of a cave-hunting trip, and indicate it on a map, even if you don't find any cave. It may save the members of some future expedition a lot of trouble.

(ED. Also, give complete names of individuals in your party . . .)

E. F. Moore,
Blacksburg, Va., (2/21/47).

They Went A-Caving

Friday, March 8th, 1946. In search of Great Cave of Cheat River, located on east side opposite Beaverhole, and mentioned by Samuel Wiley in his *History of Preston, Co., W. Va.*, published in 1882. According to Harry Pell, a resident of Valley District, there are two other caves near the Great Cave.

The following students of Masontown High School accompanied me and Ariel: boys—Fred Smith, Paul Soccorsi, Felix Tiberio, Ronald Mason, Henry Stone, James Sacco, Clifford Trickett, Bud Bjorkman, Richard Plum; girls—Eleanor Gosciwski, June Turner, Edyth Shaffer, Nila Burger, Lucille Savage, and Geneva Smith.

Log:

Met at Masontown at 5:30. Left at 6:00. Arrived at Cheat River Bridge, lowest in Preston County, at 6:30 a. m. Walked $\frac{1}{2}$ mile west on old road; 400 yds. north through Rhododendron Jungle; 300 yds. west along face of cliff, holding to Laurel roots. Placed fallen tree across Big Sandy River south of island in order to cross a swift, swollen torrent. 75 yds. through Jungle on Island—Rhododendron. Repeated technique, by placing fallen tree across stream on other, north, side of Island.

Walked north along edge of Big Sandy River: Boulders, Pot-holes, etc., $\frac{1}{2}$ mile. Turned right, walked north-east-north, working our way tediously and painfully up to base of first cliff escarpment, following Cheat River down-stream 1 mile, then slid down diagonally to edge of river, following down stream. At times necessary to climb bank in order to circumvent a cliff or boulder that jutted out in river, cutting off path. From the place where we commenced walking along the river's edge, to our destination at the lower part of Beaverhole, the boundary between Preston and Monongalia Counties, we estimated, according to Topographical Map, the distance to equal $2\frac{1}{2}$ miles.

On our way down, about 350 yds. below the stone base and top frame building by the river's edge that is used to measure flood-water, I noticed a cascading rivulet coming from the base of a high cliff. We investigated and found the rivulet proceeding from the base of the cave.

We arrived, by a steep and treacherous ascent, to mouth of cave at 12 noon. I decided to take the boys in, leaving the girls to wait outside. Fred Smith and James Sacco were not in the party, as they had continued downstream. The entrance was narrow, just allowing clearance for a man's body to squeeze through, and very little margin remained for headroom. Then we had to crawl through mud. It was up and down, squeezing and crawling, and most of the time walking in the stream, water coming up to ankles. There was every indication of the passage being open enough to penetrate back under the mountain a considerable distance. There were two fairly large cavities which could hardly be called rooms. One was a side cavity—the shape of a dome—20 ft. to apex. The sides of the cave were of sharp and smooth crenelated ridges; presumably the cave created was by corrosion within the strata known as The Great Conglomerate. There were a few species of myotis and some cave flies. Saw the tracks of a raccoon. I did not penetrate much more than 100 ft. Decided to name the cave "Kirk," as this was the name found at deepest penetration.

Coming from the cave, I decided not to allow the girls to go in. We ate lunch; then went down to edge of river, where we resumed our painful trek downstream. Smith and Sacco were waiting for us at Beaverhole. Sent Plum, Sacco, Ariel, and Trickett up side of Canyon to investigate the cliff bases for cave openings. No success. We shouted across the river to woman standing in door of a house. She directed us to cave we had already discovered. She evidently did not know of caves opposite Beaverhole.

At 2:30 p.m. we began our return journey. I decided to keep to roads and trails that bore to top of Canyon, rather than follow the river upstream. It would have been more direct to follow the river, but much slower because of the ruggedness of the terrain. Besides, there was not the slightest path.

The nature of the Canyon top was a series of deep, rough and briar-entangled draws, making it necessary to bear away from the river and then turn sharply back on the other side of draw, circle again, down the other side to edge of Canyon, then repeat the process.

Came off of top by climbing down through break in escarpment; bore diagonally left, sliding most of the way. Came down on Big Sandy below the island. Went upstream, crossed on fallen trees, still in position—then finished the trip over the same route as already described. It was necessary to take several compass bearings on top of Canyon. The trip was the equivalent of 30-mile hike.

We arrived at cars at 6:45 p. m. Gone from cars $12\frac{1}{4}$ hours.

Felix G. Robinson.

Any Discussion on This?

One of the articles I told you I was going to write was about the 1942 caving expedition when we discovered Wyandotte's only waterfalls by crawling through a hole 80 or so feet above the floor of one room. The reason I never finished it was because all summer long we have been planning to go back and try to get through one barrel-sized opening that was filled with rushing water when I saw it last. I thought that during the summer months the water would be very low and we'd make it without the aid of submarines. Trip was scheduled for this weekend, but cloudbursts all week long decided us against it. Now I'll have to wait a while, I suppose, until some of the water drains off. I have been consoling myself with the thought that there isn't anything back of the rushing water anyway! Still, one never knows, does one? And, that I think, is one reason a lot of us keep on exploring caves; who knows but what around the next bend, or beyond that peculiar-shaped opening may be the most wonderful, most exciting, most spectacular sight man's eyes have ever gazed upon?

The enclosed pictures aren't very good, but if you can find use for them in the *Bulletin* (if they are "reproducible") we might get an interesting discussion started.

The photos of the rock with the "lines" on it are some made several years ago. When the first white men entered Wyandotte Cave in the early



1800s they found this rock, and rumor has it that the lines were made by Indians or the possible prehistoric inhabitants of the cave. I believe that they are older than the oldest date I've ever found in Wyandotte: 1801. They have that appearance, and I've examined them closely many, many times. The rock, incidentally, is not on the main route and visitors seldom see it.

Were those markings made by the race of people (Indians?) who left the immense quantities of hickory-bark torches in the various parts of the cave? The same peoples who tied the grass knots, shown in the photographs (to the right)?



Incidentally, these knots are authentic. I still have them. They were evidently used for tying together bundles of hickory bark. Photo shows the knots almost actual size. They appear to be of grape vine, but I have others made of tough reeds, etc. At one time I had an idea that the species of reed used for these knots was extinct, but am not sure now. Archeologists from Indiana University also thought the reeds were extinct, but we never did go into the matter thoroughly.

One of the small photos shows a quantity of hickory bark, some partially burned on the end, on the floor of the "Wolf's Lair," a room just below the place where the rock with the curious carvings was found.

The other small photo shows the pole leading upward from the Wolf's Lair. This pole, also, was in the cave when the first white men entered.

The pole is evidently of great age (is hickory), but is in a dry portion of cavern and naturally has not decayed.

My thought was that if the photos appeared in the *Bulletin*, some of our NSS archeologists might be able to tell something about them.

George F. Jackson,
Evansville, Ind. (8/18/46)

The Land of a Thousand Caves

These caves are located in Berkeley County, W. Va., about one and one-half miles north of Blairton, and about one-half mile east of Opequon Creek at Greensburg church.

It is a place of several thousand acres of wasteland used for grazing only. It is made up of rocks, cedar trees, and thousands of sink holes; and some places are so thick that only a dog can crawl through. It is a fine place for rabbits and quail, and not visited very frequently except by hunters.

One day, while hunting with my father and uncle, I saw a fox go into a hole. Being curious, I moved some leaves and small rocks, and found a big hole in the ground. I called my companions, and with the aid of a makeshift torch, we crawled between two big, wedgelike rocks for a distance of about 20 feet.

We found a large, barrel-like room, about 30 feet in diameter, and approximately 40 feet straight down from where we stood. The bottom seemed to gleam like a small lake of water. We worked our way to the bottom and, to our surprise, we found it was not water at all—it was marble-like stone, crystal white and blue.

We then followed a passageway about 20 feet high, five feet wide, with pantry-like shelves. The passageway extended downward at about a 40° angle for approximately 60 feet to a dead end. About 10 feet behind us, we discovered a small opening barely large enough to crawl through. It extended about four feet. We then entered a large room about 100 feet square with a ceiling about 75 feet high, which was very dry and had no formations.

After crossing the room at the far side, we found another passageway about two feet wide and four feet high, extending downward in about a 40° angle. As we did not have proper light, since our makeshift torch would not burn, we did not enter this passageway at all. We worked our way back, thinking we would give it up until another date with proper light.

After traveling back to the distance we thought we had come in, we found ourselves in another entrance. Being a bit uneasy, but also curious, we marked our place and went on through this passage, which was about 10 feet wide and 20 feet high with many formations. After going downward for about 100 feet, the passage widened

out into a large room, which was very smooth and granite-like, with a small stream crossing the floor. About 10 feet to our left, the stream fell downward for about 10 feet to make a beautiful waterfall.

As our lights would no longer burn, we then made our way back to the way we came in. After finding our way outside, we discovered it was dark, the night had overtaken us, and we had lost all sense of direction. We were also tired and hungry. Finally, after wandering around for a couple of hours, we found our way back home.

To this day, none of us has been able to find this cave. I have tried several times; once with the aid of the Society, but without results. We did, however, find the adjoining land to be full of thousands of sink holes, for which we call it the Land of a Thousand Caves. I believe there is a beautiful cavern beneath some place because upon entering the sinks, no matter how great the distance, they are always dry. This means that there is an underground passage to carry the water away.

Charles Stevens,
Martinsburg, W. Va.

Meyer's Cave,* Tomahawk, W. Va.

The location of this cave is in Berkeley County, W. Va. A good starting place is Martinsburg Square. From there follow North Queen Street, (Route 11), for about two miles northeast of Martinsburg until you reach the overhead railroad bridge. From there take Hedgesville-Berkeley Spring road. Follow on through Hedgesville across Back Creek bridge. You are then on the west side of North Mountain. One-half mile farther on, you come to Shanghai Valley road. Turn left and keep this road for about three and one-half miles. Then a left turn on the first hard-surfaced road, which is known as Park's Gap Road, will lead you to Meyer's Bridge. After crossing the bridge, and half a mile farther on, you turn left on a small path leading approximately 300 yards northeast. A big locust stump marks the cave entrance.

I have never visited this cave, but I have talked with people who have tried to explore it. They say it is a very large and difficult task without lights and equipment. I have given this cave and land location much thought, and my theory is that this cave extends all the way through the mountain. The reason for my belief is this: Once while hunting on the east side, I found an opening in the ground under a big slab of rock about three-fourths of the way up the mountain side. As it was late in the evening and I didn't have any light, I entered approximately 50 feet on about a 40° angle northwest, which is about a direct line with the cave entrance on the west side. Some time ago, I spent several hours trying to find this same entrance to the east side; but the land was so rough

*Possibly "Siler's Cave"

and rugged, the foliage so heavy, and the heat so intense, I had to give up without any results.

The only route to this cave on the east side is directly west from Martinsburg on the Tuscarora Road to the foot of the mountain, and the rest on foot. The directions up the mountain side are as follows: Park your car at the foot of the mountain. You are then halfway between the beacon light on Round Top and Buzzard's Roost. Start on foot and go directly north up the mountain towards Buzzard's Roost. About 500 yards from the top of the mountain and about the same distance west of Buzzard's Roost, is the entrance to the cave.

It is not advisable for anyone to undertake to explore this cave in the summertime as the rattlesnakes are rather numerous; and furthermore, not at any time without a guide. Most any man along the mountain would be glad to act as guide for a little sum, but they will offer no information, as I have tried several times in vain.

This mountain is said to contain several wonderful caves.

The roads mentioned above are mostly all good roads and nearly all are hard-surfaced. They are without numbers, but are not hard to follow.

Charles Stevens,
Martinsburg, W. Va.

Cat Hole—Deepest in N. E.?

I am writing this on my return from the Cat Hole-Ice Gulch-Bartholomew's Cobble expedition, about which you doubtless have been getting an earful from some of the Waterbury folks. They really surprised us when we got to Canaan, Conn., with two carloads, plus a couple from Boston (Wm. Nolan and girl friend) and we had five in our party, a total of 14, including Frank Solari of New York, who arrived at my house Saturday night, with Dick Logan from the Adirondack climbing trip he had all last week. We were very fortunate in having a volunteer with a car to take us on the trip, Albert Giegrich, a near neighbor of mine but whom I had not met (as he has just moved in.) I hope he'll join us. He is a mineral collector and has been around some in the caves of this region. Others were Frank and Ruth Wilson, Max and Harriet Hirsch, Eleanor Bagley, from your area; also Robert and Mildred Reynolds of Meriden; E. K. Lane of Pittsfield; and M. E. Barnard of Boston.

We measured Cat Hole, and I am sure it is the deepest natural cave in New England, with an almost vertical descent of 50 feet, a sloping descent further of 45 to 50 feet that is negotiable, and 20 to 30 feet of an adit that narrows to an impasse at the deep end, an old stream bed, dry now, but with moist mud in it and a well, very small.

The largest chamber is 25 feet wide, 65 feet long, highest ceiling six to seven feet, lowest about

three feet; the second largest, a sloping chamber 20 by 35 feet with headroom of not over four feet. The main passage is not more than 25 feet long, with a ceiling some 75 to 80 feet high, above a circular, bottomless bowl like a miniature motorcycle-racing bowl. At the far end of the main passage is a steep climb to a dead-end grotto about 35 feet above the floor. The entrance to Cat Hole is through bastard granite or gneiss, then into limestone, in a long cliff that ranges north and south in the village of Southfield, town of New Marlboro, Mass., about 300 yards from a dirt road in the abandoned old village of Konkapot, near Konkapot River. (Dick Logan may make a map of it.)

I regret that we did not have the proper apparatus for taking temperatures, altitudes, etc., for one reason because I was out of contact with Logan all week and did not know who was coming at all, until we got to Canaan. It was necessary to guess at the temperature in the cave, as from 52° to 54°; outside temperature, near 80°; with about 100 percent humidity.

We were unable to call a meeting for adoption of by-laws of the grotto, because we had no by-laws and felt that we hardly had a quorum, anyway. So, we called this a cave trip.

Clay Perry,
Pittsfield, Mass. (9/9/46)

For Subsequent Issues

Submitted to the Editor for this BULLETIN, but omitted *only* for lack of space, are these and other splendid articles. They are left as legacy to my successor . . .

"The Pictured Cave of Lacrosse Valley," by E. L. Krinitzsky. Illus. Condensation of article first published in 1879.

"Niter and Mining Bureau Papers," also by Krinitzsky. A complete summary of this fascinating subject from official sources.

"Report on Trip to Mammoth Cave Area," by John Meenehan and others. Illus. (A Portfolio of Crystal Cave [Ky.]. Photographs, by O. Roach, Denver, Colo., to accompany other illustrations for this article.)

"The Home of the Troglodytes," by E. T. Hamy. Reprint of a fine address from *L'Anthropologie*, in 1891.

"Origin of Cave Life," by Arthur M. Banta. Reprint section from *The Fauna of Mayfield's Cave*, first published in 1907.

"New England Cave Convention," by Clay Perry. Illus. "Man-Made Caverns in New England," also by Perry. Review of a new book about pre-Norsemen monks in America, and the strange ruins left by them.

"Schoolhouse Again," by Jack Wilson. Illus. Another "final" trip to that marvelous cave in Pendleton County, W. Va.

This is only a partial and unselected list of things we hope to see in print.

Cave Log

TO GRIZZLE OCEAN AND ON

This was designed to be a mountain climb and a cave crawl plus a hike into a secluded little lake in the Adirondacks known as Grizzle Ocean, in the midst of a State Forest about two miles from the tiny settlement of Chilson, northwest of Ft. Ticonderoga, on N. Y. Route 13. Rain, wind, and clouds smothered out the mountain climb project and Treadway Mountain, the first objective, was left with its head in the rain clouds, untouched by the ten adventurers. Nine of these were members of the Albany Chapter of the Adirondack Mountain Club, the tenth, Clay Perry of Pittsfield, Mass., representing the National Speleological Society, as a guest in search of Lost Pond Cave, supposed to be a considerable limestone cavern at the outlet of a lake that once was included in the hunting preserve of Stephen H. Pell, owner of Ft. Ticonderoga. Leaders of the party were A. T. Shorey of the Lands and Forests Division, New York State Conservation Department, and William Endicott, chairman of the ADK Club.

A drive from Albany of 125 miles landed the well-loaded party at the Forest Ranger's home at Chilson late Saturday afternoon. There, directions were given by Ranger Alex Stowell, a native of Chilson who had been in the Lost Pond Cave in his youth.

An old road, once used as a long-haul logging road from Pharoah Mountain cuttings to Ticonderoga, was passable by car to Putnam Pond, a sizable lake about two miles in, where it became a rough trail. Over this the hikers trudged with their loads of duffel, including tents, sleeping bags, food, fishing equipment, etc., to an Adirondack shelter at Grizzle Ocean, named from an old trapper who had once made it his headquarters and facetiously gave it the name of "ocean." A tiny, pretty pond in a hollow, ringed by evergreens, it was also in the Pell preserve until 15 or 16 years ago, when it became state property, but has not been developed as a public camp site as yet.

Since the shelter was designed to house only six persons and only one of the party felt like tenting on the damp forest floor, arrangements had been made to have the guest spelunker housed at the Ranger's home after the outdoor meal at the shelter and a return hike to Putnam Pond. The Adirondacks, piling onto their "brush bed" of spruce browse, huddled in early to escape the rain which grew to a torrential storm during the night. The Treadway Mountain project was regretfully abandoned when morning showed all

mountain peaks completely obscured in clouds and mist.

At 10:30 a rendezvous at "Put" Pond, a drive back to the former gateway of the Pell Hunting Lodge area, and a half-mile hike, brought them to Lost Pond. En route, exploring limestone ledges and gullies, an interesting cavern was found with a stream emerging from it, and it was explored for some 50 feet up the stream and "surveyed" with lights some 50 feet farther in where the roof came very low to the water.

There are three entrances to this lower cavern, openings in moss-grown limestone, joining inside, one of them very picturesque. Later, a careful tracing of the underground stream in the gully, revealed that the stream comes from Lost Pond, and that these lower openings must be a continuation of the upper cavern, which was found with little difficulty close to the outlet short of Lost Pond.

No surface water flows from the pond; it seeps into the ground and rock and does not appear at all in the upper cavern, which proved to be a true, live cave, with several adits, grottoes, and passages, some joining, its total crawlable extent estimated to be about 150 feet, and an added 100 feet of low-roofed cavern extending on to an unknown vanishing point over a deep bed of soft sand which had evidently been washed in by surface waters long ago, filling the passages to a depth of several feet in places.

Considerable spade work might enlarge this cave so that it could be explored much farther and made comfortable for walking about upright in its larger portions. It was curiously carved by water and chemical action, with odd "banks" and "terraces" carved in the side walls; the roof perfectly flat for the most part, and glistening with drops of water and calcium or silicate. A geologist in the party, Dr. E. E. Barker, analyzed the rock as crystalline limestone with traces of graphite. The sandy floor was littered all over with the droppings of porcupines, and out of them grew tiny white fungus and mould. In one small adit was a pile of the manure where it was evident a family of porkies had huddled, but none were found in the cave on this day.

Very tiny stalactites were found, queer "knobs" of rock here and there; and in a grotto too small to be entered, a twisted column, a combined stalactite-stalagmite about a foot long, some flowstone and, in places, lively flow of surface water from cracks, making it a very live cave indeed.

From Ranger Stowell came the story that at one time, years and years ago, this cavern could be crawled clear through from the upper entrance to the lower one. Evidently the lower caves from which the stream emerges, were once to be reached from above, an estimated quarter-of-a-mile. No

other caves, but several large and small sinkholes were found in the vicinity.

A legend of buried treasure surrounds Lost Pond and nearby areas—indeed, two of them. One has to do with an old Indian who inhabited the area and used to emerge now and then with some silver coins, sufficient in value to keep him in provisions so that he did not have to work, and "provisions" included a bout with firewater now and then. This was along in the early 19th century or even before 1800 according to Ranger Stowell, who got the story from his father, a native of the area. A family by the name of Barber that lived at or near Chilson, started a search for the Indian's hoard, said to be some of Spanish coinage, and by others to be "silver bars" from a "lost mine." Three generations of Barbers hunted in vain for this lost treasure; the third, George Barber, returning periodically after he had removed to Vermont, died without discovering such a cache nor has anyone else found it.

But the legend of silver ore to be found in the mountains nearby persisted; and one Adolphus Lavigne was said to have discovered a mine or a cache of bullion but lost it, and he died without ever finding it again. This was supposed to be on Putnam Mountain, across the valley.

Trailing out from Lost Pond at mid-afternoon, the "Adkers" tried a bit of fly fishing in the small pond and brook with no success. The expedition arrived at Ft. Ticonderoga at about 5 p.m. Sunday and was met by Mr. Pell who had advance notice of the intended visit. The party was extended the freedom of the fort after a lively talk with Mr. Pell, who did some "debunking" of various tall tales about the fort and its reputed "cave dungeon" recently discovered.

He exhibited his restored Indian shelter, however, found some years ago in the cliff under the "Grenadiers' Battery" of the fort, which contained the skeleton of an Indian clasping to his chest some bone tools for splitting stone articles. Estimated by an archeologist to have been 6 feet, 10 inches tall, the Indian had been buried amid a clutter of arrow-heads, flint and bone instruments, etc., in this shelter looking out on Lake Champlain. Mr. Pell spoke of a "Bears' Den" cave in the cliff at another spot below the fort walls which he used to enter as a boy, about 10 feet. It had been reputed to "run right through under the hill," for a mile. (A cave mile is about 10 feet, according to Spelunker Roger Johnson of Springfield.) Lack of time prevented a closeup inspection of this cavern dungeon with its reported iron ring to which prisoners were chained.

Preliminary to the Adirondack trip, Clay Perry spent a day and a half on research at the State Museum and Library, at the Department of Commerce with Darwin Benedict, an enthusiastic cave-

man, trailer, historian and collector of scenic sites and stories. On the evening of May 16, Mr. Perry gave an illustrated cave talk to a full dress meeting of the Albany ADK Club, with 60 to 70 present at the Institute of History and Art. Chairman William Endicott of the chapter promised to assist in securing members to the NSS sufficient to form a Grotto in Albany.

Members of the trail and cave trip, besides those mentioned, were Mr. and Mrs. Darwin Benedict, Mrs. Endicott (Midge), Miss Nell Plum, Miss Bessie Little, of Menands, and R. H. Fussell.

Clay Perry

CAVES NEAR MONTEREY, VIRGINIA

On April 27th, a party consisting of Dr. William Welsh and Miss Mary Evans, both of Rockville, Md., and Jack Wilson of Washington, D. C., visited two caves near Monterey, Va.

The first cave was located on the farm of Mr. Hamilton, at the bottom of a cliff rising from the Jackson River. The farm is on the left as you drive south from Monterey on U. S. 220, and is 8.6 miles from where U. S. 220 intersects with U. S. 250 in Monterey. At this point there is a field containing several outbuildings, between the road and the river. Across the river will be seen what appears to be a cave entrance in the rocks, but this is a false lead. Continue downstream for about 100 yards, and the entrance can then be seen from the bank of the river, but is not visible from the highway. There is no bridge here and it is necessary to wade across.

The entrance to this cave is not large, but is level and high enough to get around in without crawling. There is a lead that goes straight back, and Miss Evans crawled through it for about 40 feet. At that point it became narrower and was about two feet high and one foot wide. The passage continued as far as her light would reach and could probably be forced, although no effort was made to do so. Mr. Hamilton's son, Kermit, about 11 years old, showed us the cave and stated he had not gone back in it himself because his father had forbidden him to do so. He also knows of another larger cave that is "quite a piece over the hill."

Returning to the highway, we proceeded one mile toward Monterey, again under the guidance of Kermit Hamilton. Here we pulled off to the right for approximately .1 mile on a dirt road that crosses a bridge consisting of two wooden plank spans without railings, and a middle section built up solid from the bottom land. The property is that of a parsonage, at present vacant, and which includes a wooden frame house, a garage and other smaller outbuildings.

We parked about 100 feet before reaching the house and walked across an abandoned garden

and crossed a weathered board fence to reach the foot of a steep hill. About 100 feet up the hill is the bottom of a rock face that runs off to the south. To reach the cave, climb up the slope past the north end of this rock face, until abreast of the top of it. Then veer off to the left at about 45 degrees and continue upward for another 80 feet. There is a tangle of slash and stumps and the cave entrance is in a small hole going straight down beside a large stump, that has the remains of a big branch protruding almost straight up from it for several feet. Again, the entrance is small and may require some searching to locate.

At first, this cave appears to require a rope to get into. However, we entered it without difficulty and found the first room to be quite large—possibly 100 feet long, 20 feet wide and 15 feet high. The cave appears to be constructed of huge stone blocks, and the ceiling is so flat as to give the appearance of being made of concrete poured into forms. There is much debris on the floor from falling rocks. To the right and left are passages that require crawling, and young Hamilton advised us the passage to the left dropped off into another room, which contained a further passage into still another room. Around the entrance to this first passage were a large number of small formations.

Because of the lateness of the hour we did not further investigate this cave. There was a slight struggle to wiggle up through the entrance, and after making mental notes of the location. Dr. Welsh, Kermit Hamilton, and myself returned to the car where Miss Evans was waiting for us, and drove on to Monterey.

Jack Wilson

NOTES ON GIBSON'S HOLE CAVE, VIRGINIA

Named for the hill in which it is found, Gibson's Hole Cave is located nearly six miles west of Waynesboro, Va., between U. S. Route No. 250 on the north, and U. S. Route No. 12 on the south, in the Stonehenge member of the Beekmantown limestone formation.

A number of the cave's aspects are rather unique and make its study both interesting and speculative. The entrance to the cave is through a large sink nearly 100 feet in diameter, with extremely steep sides. Ninety feet below the surface, in a concave recess in the southwestern wall of the sink, is the entrance to the cave proper. That portion of the cave with which this study is concerned is partially filled with water, varying in depth up to a recorded maximum of 52 feet.

Entrance into the main body of the cave has thus far been impossible except by descending the 90-foot slope down into the sink—the last 10 feet of which descent is a nearly vertical drop to a small ledge at the water's edge. From this point further exploration is virtually impossible save by navigation over the water. Members of the Society built

and transported to the cave a raft large enough to carry one man and a quantity of equipment sufficient to accomodate several swimmers. By these means the inner reaches of the cave were explored, photographed, and mapped, and various data were collected.

The cave extends in a generally northeasterly direction for a distance of 260 feet, varying in width from three to 30 feet. The ceiling is approximately 65 feet above the surface of the water, varying somewhat in different parts of the cave, and often exceeding this height. Throughout the upper regions of the cave are beautiful and profuse calcite formations, liberally draped with white flowstone. The lower walls are nearly vertical and devoid of interest except for large quantities of chert, flecking with black the otherwise smooth gray walls.

In the upper limits of the cave lie a newly-discovered system of passages which seems to be very extensive. At this writing, however, these passages are virtually unexplored because of the danger and difficulty of gaining access to their opening, some 70 feet above the water's surface. When the proper equipment is available further study of this section will be prosecuted, but presently available information indicates that these passages, while elaborately decorated, will not be of unusual geologic interest.

With the aid of a homemade maximum-minimum water level recorder, and by observation and measurement of high water marks on the cave's walls, the variation of the water level in the cave was determined to be approximately $4\frac{1}{2}$ feet. The mean temperature of the water was found to be 53.3° Fahrenheit, with less than one degree seasonal variation. The water flows through the cave from northeast to southwest, entering and leaving the cave by passages below the surface of the water. At mean low water, the rate of flow on the surface of the water is 100 feet per hour. Experiments to determine which, if any, of the streams in the immediate locality were fed by the water from the cave were unsuccessful; but upon the acquisition by the Society of adaptable aniline dyes, it is entirely possible that the water in the cave will be found to feed Barterbrook Spring, located some two miles southwest of the cave. The water level of the spring is 10 feet below the mean average water level in the cave, and the topography of the intervening land is such that the water table between the two bodies of water might coincide in elevation with the water level in Gibson's Hole and gradually drop to the elevation of the water level of Barterbrook Spring without rising to the surface anywhere between.

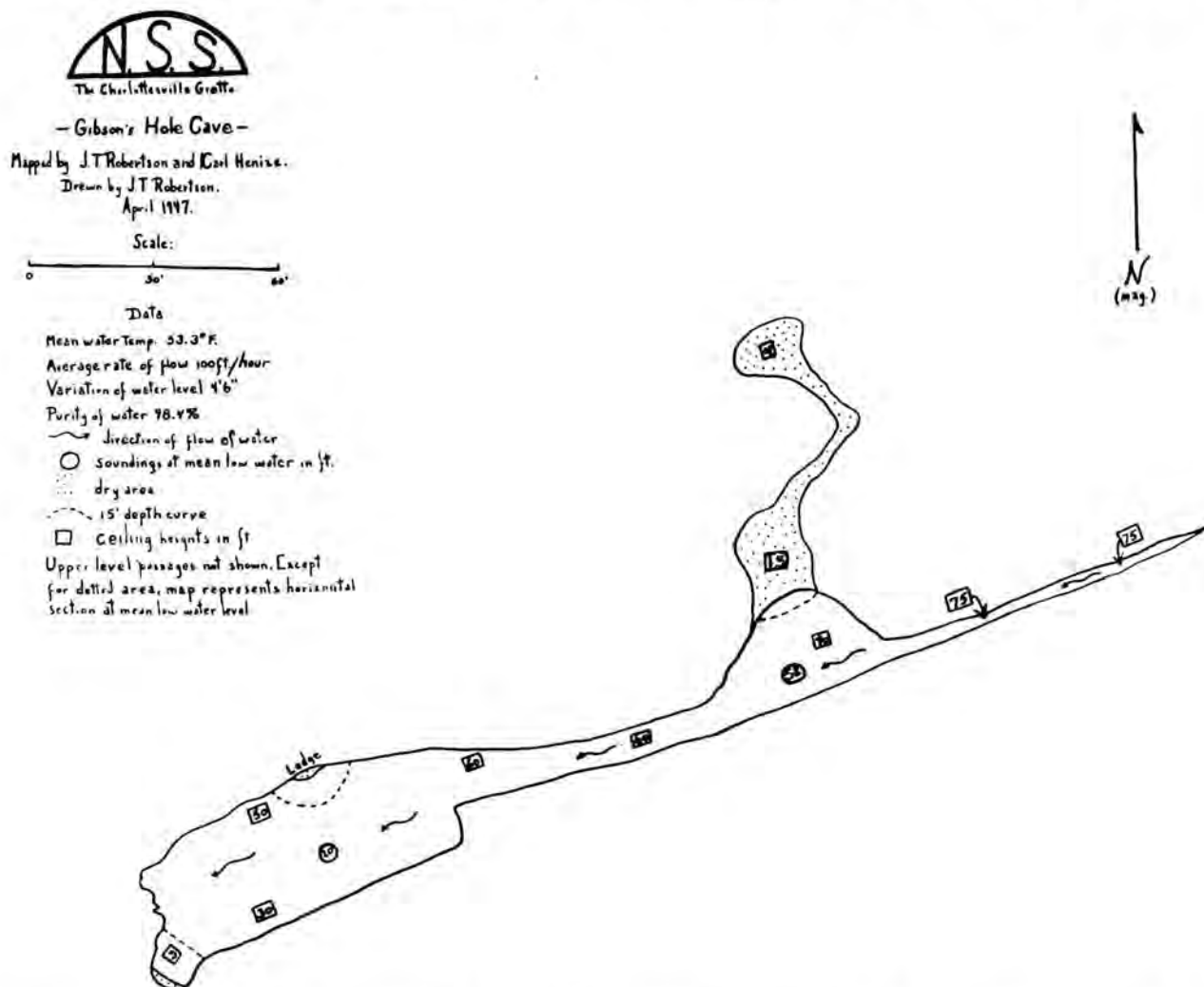
Tests run by the duPont plant at Waynesboro indicated that the water in the cave was 98.4 percent pure. Confronted by a shortage in their supply of cool, uncontaminated water, the duPont company conducted an investigation last summer to de-

termine the adaptability of the cave water to its uses. If used, the water might be transported to the plant by gravity feed, once raised to the surface, inasmuch as the elevation of the earth's surface at Gibson's Hole is from 155 to 185 feet above the elevation of Waynesboro, varying with Waynesboro's elevation—it, like Rome, being built on several hills.

On the occasion of the group's first trip to the cave, it was fortunate enough to observe a drop in the water level of about four feet during a period of 15 minutes. The only evidence of the cause or manner of the sudden drainage was a clearly audible gurgling sound coming from the southwest end of the cave, giving rise to the suspicion that

those of us who conducted the survey that the siphon—if, indeed, there is a siphon—is not activated unless the water reaches an abnormally high level, inasmuch as the high-water marks on the walls indicate that the primary drainage system is adequate to provide exit to the water exactly equal to the rate of inflow when the level is $4\frac{1}{2}$ feet above the low water mark. Since the water level was observed to drop about three inches a minute during the rapid drainage, it is obvious that no water mark would be left on the walls at a height equal to, or exceeding the height necessary to activate the secondary drainage system.

Limited exploration conducted underwater, using diving equipment and underwater breathing



some sort of siphon action was the responsible agent—such siphons as are attributed to be the explanation of the so-called "intermittent springs" not uncommon in the areas where there are substantial deposits of limestone. No recurrence of this phenomenon has been observed, and the recently installed water-level recorder has given no indication of such a recurrence. It is believed by

apparatus, gave no clue to the exact point or points where the water enters or leaves the cave. Experiments conducted with dyes and floating particles indicated that the cave is fed from one end and drained from the other, but no large underwater conduits were discovered.

As to topography, the sink through which entrance to the cave is gained is in the southwest

side of Gibson's Hill, near the top. The surrounding country is rather flat and noticeably devoid of large hills, except for Round Hill, half a mile south of Barterbrook Spring, which rises steeply to a height of 200 feet above the adjoining surface level—Gibson's Hill being 60 feet above the surrounding landscape. Two large sinks appear near the bottom of Gibson's Hill, one about 200 yards southwest of the cave, and the other about a quarter of a mile southwest of the cave. The nearest sink to the cave is dry and rocky, its bottom being 15 feet above the mean average water level in the cave. The other sink contains water several feet deep, the surface of which water is five feet above the level in the cave. At the bottom of Gibson's Hill, on the east side, is a small shallow lake situated at the bottom of a very gradual depression sloping downward from the east. The water level in this sink, though the sink is not more than 150 yards from the cave, is 20 feet higher than the water in the cave.

The Beekmantown formation, on a Stonehenge member of which Gibson's Hill is located, extends as an interrupted ridge from Round Hill through Gibson's Hill and on in a northeasterly direction, marked by several distinct gaps, as between Round Hill and Gibson's Hill. The ridge does not, however, seem to be the dividing line of the watershed in the area. The divide apparently lies half a mile to the east parallel to the ridge, along the crest of a lower but less frequently interrupted ridge.

J. T. Robertson.
Charlottesville, Va., (5/7/47).

SPANISH CAVE, COLORADO

Our party of 12* left Denver at 2:30 p. m., Saturday, September 9, 1933. We drove to Florence and up Hardscrabble Canyon to West Cliff, arrived at 8:00; then south to Heinrich's Ranch, and up the road south of ranch house where camp was made in a meadow. Up at 5:00 a. m., started about 6:30, at cave 9:45. After a rest and change to heavy clothes, started in cave at 10:30. Entrance tunnel about 50 feet long and three feet in diameter (with a very strong draft of extremely cold air rushing out) leads to a large-size cavern pitching down about 45° out of sight in a double curve.

The cave here was all covered with snow and quite smooth, being water-washed. We attached a 150-foot rope and started down. There is part of an old ladder here, and several pine logs about five inches in diameter propped along the sides offered some support. This is quite a spectacular sight looking down, especially with the several candles we left lighted along the way. At the end

of this drop it levels off for about 15 feet to the pit. Here are two parallel logs held down on one end by a very heavy stone, and fastened on the outer end with a cross log. This reaches several feet over the edge of the pit. It is apparently the remains of an old windlass, the drum of which was at the bottom, all rotted and now like so much punk. The spindles of the drum, at the bottom also, were of wood, and were broken off.

The pit in general is shaped like a milk bottle, largest at the bottom. It is 110 feet straight down (at least eight stories). At the top of the pit was about a five-foot snowball that looked as if it might have been rolled down the first part of the cave. There is also a large slab of rock leaning against the side wall which made an admirable place to tie the ropes to.

Louie Hough was first to disappear over the edge, rappelling down while we held on to the safety rope. Every so often we would ask if all was well. His only answer was, "Give me some more rope," until we were sure we would run out of it. Finally the rope slackened and Louie hollered, "Okay; send down another victim." One by one they disappeared until ten were at the bottom.

Here we began to appreciate the distance we had descended. Even by flashing a powerful light to the top one can hardly distinguish a man looking out over the edge of the pit. This is really a picturesque place. Off to one side is quite a flow of water which comes splashing down from way up. The floor here is quite level, covered with considerable dirt and gravel; and where the water splashes down over the walls of the rough limestone, each pebble is building up and trying to become a stalactite. Looking up, tall columns of rock disappear into the darkness. Using knee and back work one can climb up about 75 feet in and out between these columns and still the opening goes up, at least 150 feet, to where the water seeps in from a crack, probably open to the surface of the mountain.

On the other side the cavern, like a huge slanting crack, goes down on about a 25° angle with large slabs of sharp-edged rock standing on end composing the floor, and with dark, deep pits yawning between them. We fastened a 120-foot rope and used this to go down with. Then another 120-foot rope. Here appeared numerous stalactites and stalagmites, and the formation of marble was everywhere in evidence. Many small pure white stalactites hung from the ceiling, others hung in ribbon form. Not really needing this last rope, we gathered it up to take along and decided it was time to eat lunch.

Another stretch of rope and we were on level floor and in what looked like a mine tunnel. This ran along for a couple of hundred feet, and ended suddenly in a hole not large enough for a man to crawl in and nearly full of mud. There was an

*From Denver: Carl Blumrock, Louie Hough, Paul Garham, Orville Settles, Howard Moore, Art Lamb, Bee Van Wegener, Glen Stewart, Elwyn Arps; a Dr. H. S. Scranton of Florence Colo.; a Mr. Bull and a Mr. Pickson of Canon City, Colo.

opening about five inches in diameter with a strong draft of air coming through, so no doubt there is more to the cavern beyond if we only had time to dig it out.

Near the end of this tunnel we found an old shovel, and in several places on the way down were sections of the old 1¼-inch rope that had been used on the windlass at the pit. It was so rotted, however, it could be easily pulled apart in the hands. We retraced our steps near to where we had eaten lunch, and there started down a well apparently 10 feet deep and four feet in diameter. This well spiraled down for about 300 feet, quite steep and small, and finally ended like the other opening.

After exploring every side passage, we started back to the pit to meet the two who stayed at the top to help us. We hollered and hollered and hollered, but no one answered. We had made a date to meet at 3:30 p.m. It was now 5:00 p.m. Had they gone back to the cars or were they just outside where it was warmer?

We didn't find out until later . . .

In the meantime, we had to get out. The difficulty was, we didn't know which of the two ropes hanging down was anchored. We had to take a chance, however, so we began working with the one that didn't seem to pull loose. Finally, from above, we heard a voice: one man had come back into the cave.

One man alone couldn't pull anyone up, but he could help. So, finally, to get out, we used the anchor rope around the man coming up, bringing the second rope under his foot, over his back, and looping it over his shoulders. The man above hoisted, the man on the rope climbed a bit at a time—so, gradually, by a very unorthodox technique of shifting weights, we got one man up.

Then, with two to haul, the rest got up and we all came out—several hours past the time we had planned to.

We found out later that both men on top, having gotten cold, had gone out of the cave—and one simply wouldn't come back in.

From the notebooks of *Elwyn Arps*,
 Colo. Mountain Club, Denver, Colo.

NICKAJACK TO GO "PRO"

It has just been reported from member Leo Lambert that plans are definitely under way to commercialize the famous Nickajack in southern Tennessee. Nickajack Cave lies about 20 miles southwest of Chattanooga, near the point where Tennessee, Georgia, and Alabama join. While Lambert alleges that the cave itself extends under all three states, the Society reserves its opinion on this point until some of its engineering members have actually surveyed the cave. The cave has been known locally for nearly 100 years, and

has probably one of the largest entrances of any cave in the United States. The accompanying photograph of the entrance which unfortunately doesn't take it all in nevertheless gives some indication of size when one observes the two cars parked therein.

The proposed commercialization will include a boat ride of approximately three "cave" miles in electric-propelled boats. The level of the lake in front will be raised to form Lake Charm, where swimming and diving facilities will be provided.

Some of the individual members of the Society had the pleasure of visiting Nickajack under the guidance of Promoter Lambert in 1941, and were taken back to see "Mr. Big," a huge stalagmite which Leo claims to be the largest in the world. Not having yet measured all the stalagmites in the world, the Society will therefore not at this time dispute his claim. We did, however, actually measure the distance across the upper portion and find it to be in excess of 53 feet, so Leo's "Mr. Big" appears to have just title to his claim until a bigger one comes along. It is interesting to note that "Mr. Big" appears to extend through at least two levels of the cave. It was probably formed first by a rock fall or breakdown in which the roof at one level broke down and fell to the floor of a lower level. Thereafter the entire rockpile was apparently covered by dripstone formation to form what on the surface appears to be a true stalagmite.

Unless Leo's commercialization project includes considerable tunnel work, it may be some time before many of the public are able to inspect "Mr. Big," for the present trip back to see it entails a 170-foot crawl with the ceiling at no time being much over 12 inches high. This crawl can not be made generally under 20 minutes in one direction.

An interesting occurrence—at least it was interesting after we all got out—on our trip was the failure of the lighting system of the entire party. While a majority of the members may feel that many of the officers of the Society have been far too cautious in insisting on adequacy of lights, this occurrence really bolsters the latter's position. The party started in carrying a three-mantle Sears-Roebuck pressure gasoline lantern, which lamp alone should have been adequate for the entire party of five. Each of the party had his own personal carbide light and each had flashlights, candles and matches. In other words, each man at the start of the trip thought that he had three independent lighting facilities besides the main lantern relied on. At the start of the crawl leading to "Mr. Big," the gasoline lantern failed and was discarded soon after. After negotiating the crawl, the entire party stopped to refill carbides only to find that the entire carbide supply had been inadvertently left on a rock near the entrance of the cave. Each man after filling his light had pre-

sumed that somebody else was carrying the reserve supply of carbide. A few of the members had a private supply so it was decided to continue and see "Mr. Big" now that the party had progressed so far. During the inspection of the stalagmite carbides began to fail and flashlights were resorted to. Alas, however, the flashlights had all been in more or less general use for the past few days and none possessed batteries of adequate strength. On the return trip these began to fail, one by one. Then candles were resorted to. Here again we found that our supply had been depleted by the previous days' active caving. Though each man knew of his depleted stock, he had presumed that the others' stock of candles was better. Candles of normally six inches in length had somehow shrunk to $2\frac{1}{2}$ inches.

Well, anyway, everybody got out safely, even though Leo was threatening to light a cigar and puff his way to daylight, and I'm not at this time entirely sure this wouldn't have given as much light as Pete's flashlight which he claims did not entirely fail! Though the candles did prove adequate to see the entire party to safety, a few more minutes in the cave would have resulted in burnt fingers for more than one of the party. The moral is, never take your lighting equipment for granted.

In spite of our digression relative to the lighting experience, Nickajack is a well-worthwhile cave, and its development should be a valuable addition to the country's commercial caves. Members passing this way are urged to drop in and make themselves known to Leo, and pass the word along to their friends that Nickajack is one of the commercial caves in that section of the country that should by all means be included. In spite of the crack about Leo's three "cave" miles, the fact remains that Nickajack's boat ride will probably be one of the longest underground water trips now available in any cave and an experience never-to-be-forgotten. The development of this cave along the lines which have been planned should also preserve the rich cave fauna and make its study by the naturalist much easier than heretofore has been possible.

Anonymous,
(By request) 3/15/46.

SPRING CAVE, COLORADO*

To effect an investigation of Spring Cave on the South Fork of the White River, a party was organized and a trip made to it on September 27, 1931. The party consisted of eight people, four of whom had been in the cave from one to several trips previously.

*Written as a memorandum, upon request, to his Forest Supervisor, and resurrected from old files by The Editor.

The Spring Cave is located within a strata of limestone that underlies a portion of the White River plateau. It is entirely within the White River National Forest and about one mile by trail from the Forest Boundary at the point where the boundary crosses the South Fork of the White River. The cave varies from three to 30 feet wide and is about 750 feet long. The general form is that of a tunnel changing to a closed crevasse. There is a rise of about five feet to the first chamber and a decline of about 50 feet to the furthest point reached. The cave has a general southwest and westerly course and was formed by the action of running water. The source of this water, or the original route of the underground stream has not yet been determined. The formation of the cave can possibly be explained by one more versed in geology, or by a more intensive study of the surrounding formation.

In exploring the cave, start was made at the entrances and direction of travel was noted by observations with a Forest Service Standard Compass. Distances were paced where possible and estimated where not possible to pace. A rough map was drawn at the time, a copy of which is attached, which should be referred to in order to determine the part of the cave mentioned in the following discussion.

There are two entrances, A and B. The A entrance is the larger, being about 30 feet in diameter and cone shaped, with the apex of the cone turning up and south, gradually getting smaller as it approaches Chamber C. The length of this entrance is 90 feet, and the diameter at the point of contact with Chamber C is three feet. Entrance B is very broad as compared to A, but is not a desirable entrance as it is wedge-shaped, being only two feet high where one enters Chamber C.

Chamber C is a long room with flat floor, which is covered with a fine white sand, and a domelike roof. This chamber is about 120 feet long and the roof has a height of about 25 feet from the center of the floor. The walls are dark colored, irregular, and are indented with many small round to oval niches, none of which are of great size. The entire room has a gradual downward slope towards D.

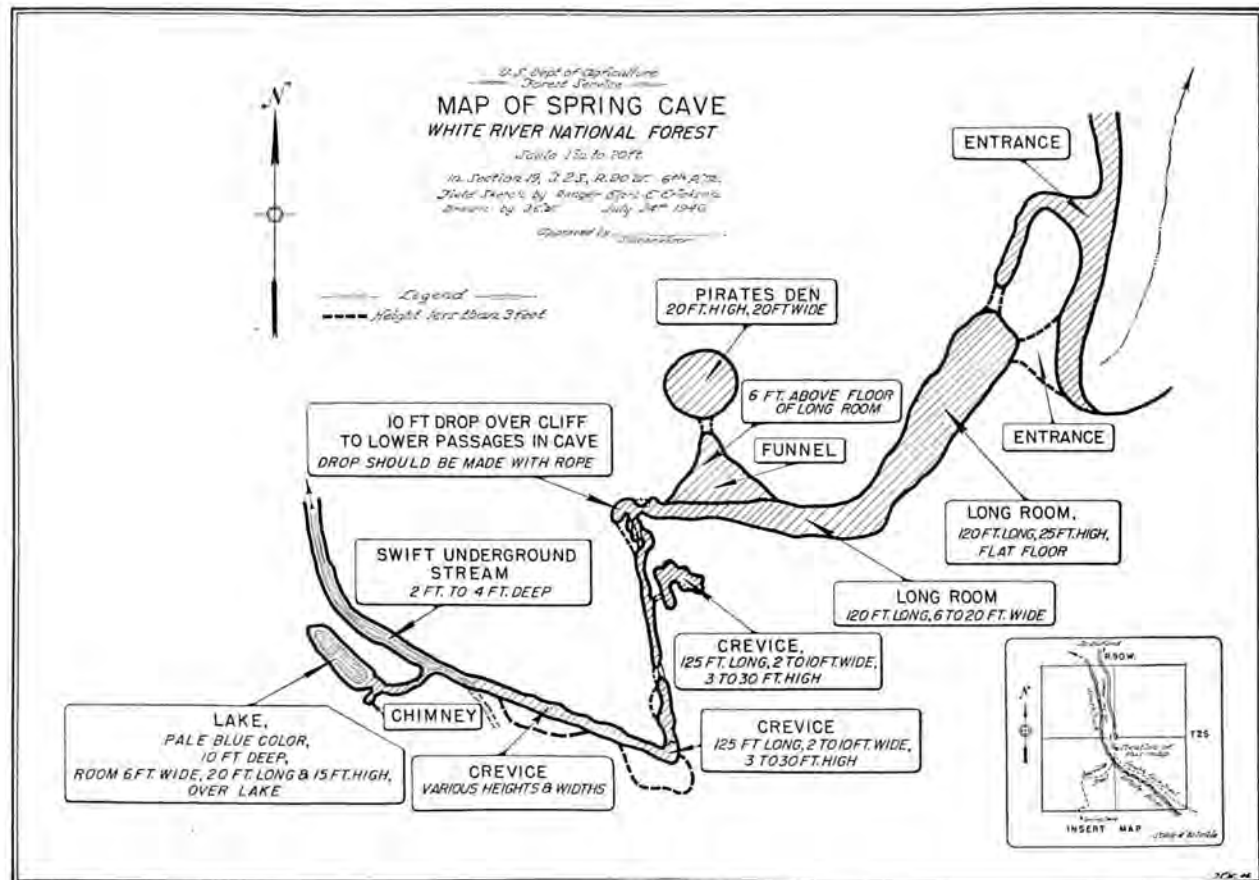
Chamber D is really a continuation of the last room, but narrows very rapidly at the lower end and is about 120 feet long. It is about 20 feet wide at the large end and eight feet wide at the lower end. The height of the room is correspondingly increased as one nears G. The floor is V-shaped, and is covered with large boulders. The entire room has a decided pitch downwards. About six feet above the floor of this chamber, one notices a long, triangular wedge-shaped niche that we called E.

This niche might be compared with a flattened

funnel, as it ends in a tunnel which is about six feet long and two and a half feet in diameter. The floor of E is flat, about 30 feet wide at the mouth and 20 feet long, and has a slight pitch towards the Chamber D. Through the tunnel, one crawls into Chamber F or the Pirate's Den.

The Pirate's Den, named by the many children

shell-like cavities throughout its entire length. These cavities are all in the horizontal plane, vary from 10 to 15 feet wide, two to three feet high and five to 15 feet long, and are not entranced to other cavities as far as has been determined. There is, however, one small chamber joining the larger crevasse.



who have played in the cave, is a round room about 20 feet across and has a domelike roof about 20 feet high at the highest point. The floor is flat, is covered with a very smooth white sand, and appears to be level.

G, the point at the end of Chamber D, is the first point of departure for the lower regions. It is a cliff about 10 feet high and wedge-shaped. Descent was made by aid of a rope that had been brought along for the purpose, through a very narrow defile and under a large overhanging ledge. This cliff is not dangerous, but is one that a fat person might have difficulty in getting down. At the bottom of the cliff one finds a long narrow crevasse running in almost a straight line for about 125 feet in a southeasterly direction.

This crevasse from G to the next turn at I, is of varying width, being from two feet to 10 feet wide. The height is also irregular, being from three to 30 feet high. The walls are indented with many

This chamber, which we will call H, is an odd-shaped room about 10 feet wide and 15 feet long, and has a roof that is about 12 feet high at the highest point. Entrance to this chamber is made through a tunnel four feet long and three feet in diameter.

Instead of being just a turn in the crevasse, it was found to be another cliff of about 10 feet in height. Descent was made by using an old plank with cleats fastened upon it. This plank is made in the form of a boat, and is known as "the boat." Who built it, and when it was put in the cave is not known, as it has been in place for many years. At the bottom of the cliff we turned west-northwest, and saw the crevasse that is lettered on the map as J.

J is a large crevasse varying from two to six feet wide and showing evidence of much erosion that has been more effective in the horizontal plane as shown from the many small and large

horizontal shell-like niches. These niches are similar to those seen in the crevasse from G to I, but are more numerous and larger. The height of this crevasse is very hard to estimate due to its irregularity, but is considerably greater than the previous height. Continuing down this chamber or crevasse for a distance of about 130 feet, we came upon an underground stream entering from the south and flowing in a northwesterly direction.

This stream, lettered K, is a swiftly-flowing stream filling the bottom of the crevasse to a depth of from two to four feet depending on the width of the crevasse. The water is very clear and has a very pleasant taste. Because of the fact that the water was at this time lower than it had been for several years, the party was able to walk farther down its channel than is usual. By keeping to the overhanging wall it was possible to walk about 100 feet further, and it was seen that the crevasse held its size though its height became less and gradually turned into a more northerly direction. With waders or higher boots it might have been possible to go another hundred feet before the crevasse became too narrow or low to go farther.

While following the stream, we came upon a smaller channel that ended in a room about six feet wide and 20 feet long with a roof about 15 feet above the lake, M, that covered the bottom. This lake appeared to have neither inlet or outlet at the time, and is evidently filled during the period of high water. It was very pretty, being a pale blue in color and had the appearance of being about 10 feet deep. To the left and south of the lake we saw the Chimney.

The Chimney, L, is an irregular vertical opening extending upwards to a height of about 30 feet into the roof of the cavern. It varies from about three feet in diameter at the bottom to about two feet at the top and resembles a circular staircase.

Return to the entrances was made over the same route as outlined; a total time of two-and-one-half hours had been used in making the trip. Clothes that one should wear on the trip should be rough hiking clothes with waterproof slickers as the cave is usually very wet. Flashlights were carried and used for light.

The only living creatures encountered in the cave were bats, though a great many pack rat nests were seen. The creek, as far as could be determined, did not contain fish. The absence of structural curiosities—stalagmites and stalactites—is noticeable, giving one the impression of drabness and gray stone.

There are rumors that there is one chamber in the cave of which, even with the aid of a flashlight, one cannot see the opposite wall. There is also a rumor that there is a lake within of similar size. Since no adjacent or connecting chambers were found or are definitely known, it is assumed

that these rooms are mere rumors. However, near the entrance of the cave there is a small hole about two-and-a-half feet in diameter that opens into the top of an underground cavity. From reliable sources, it was found that a party of boys lowered one of the members into this, by using ropes, to a depth of about 50 feet. It was reported that though he carried a lantern he was unable to see either side or bottom at that distance. Lacking longer ropes, no further exploration was done. Therefore, it is possible that there are other and larger chambers in connection with or separate from the cave proper.

An interesting question is the source of the stream and its exit from the cave. An attempt will be made next season, if possible, to definitely locate this exit and also make a ground survey of the cave in order to locate it more accurately and tie it in with the General Land Office Survey. At the time of the survey, a further and more intensive exploration is planned with the purpose of adding to this report if possible.

Quite a number of persons visit the cave every year. These, however, are mostly local residents, though it is possible several tourists also visit it. With the increased use of the South Fork of the White River as a recreational area and the establishment of campground facilities, it is possible that the number of visitors will be greatly increased.

Earl E. Ericson, Forest Ranger,
White River National Forest,
Glenwood Springs, Colo. (12/2/31)

EXPEDITION IN THE ADIRONDACKS

A. T. Shorey, whom I call the chief spelunker of New York State, and Darwin Benedict, his side-kick, were responsible chiefly for an ambitious joint expedition of hikers and spelunkers, to visit the abandoned Mt. Hope Iron Mine in West Fort Ann, N. Y., a ghost town located about 30 miles northeast of Glen Falls and a bit less than that east of Lake George Village. It took place September 22, 1946, on a brilliant Sunday.

The expedition, planned for months by the combined Albany Chapter, Adirondack Mountain Club, Mohawk Valley Hiking Club, of Schenectady, and a scattering of spelunkers, members of the National Speleological Society, began to assemble from various points at an early hour. The Albany-Schenectady groups loaded into a big chartered bus, plus a private car, as an annex or trailer, and the NSS members came from Washington, D. C., New Jersey, Pottersville, N. Y., Springfield and Pittsfield, Mass.

William J. Stephenson, President of the NSS, Elton Brown, Chairman of its Safety and Equipment Committee, had driven all night Friday

from Washington—at 35 miles an hour in a new car—to get to Albany, with side trips from there Saturday, to Knox Cave, for a visit with the inimitable owner, D. C. Robinson, then back to Pittsfield to pick up the writer and get a few hours' sleep at his home. Their slumber for 24 hours had been snatched in shifts of two or three hours as one drove and the other lay on a mattress in the seatless rear end, making a virtue of a bed out of a necessity of taking the car without a back seat!

Sheer accident brought the bus party and the Stephenson party together at Streaked House Corner, where the house had no longer any streaks, after the Stephenson trio had done some wandering about the Anns and got down into the tucked-away hamlet of Queensbury. All went well with these pilgrim groups until the driver of the bus did a close-haul turnaround, smashed his windshield and crumpled a fender, fortunate not to go off the very narrow dirt road into a ditch, and fortunately without passengers, who had alighted at the west end of the Mt. Hope Mine tote-road to trail in.

Under the leadership of A. T. Shorey, of the New York State Conservation Department, an able guide and an enthusiastic trailer and spelunker, some 30 persons of all ages and two sexes trudged through the leafy woods, still as green as in June, with the babble and roar of a brook and waterfall far down in a deep gorge at their right, so deep that none ventured the detour to see the waterfall. Three-quarters of a mile hike—and where the road that once bore tons of magnetite drawn by oxen and horse teams to the forge a few miles away, climbed up along the edge of the gorge—there were two mine entrances, but they went in only a few yards, being evidently the last new workings. Beyond yawned the big hole leading into a horizontal shaft or drift, with its totally black interior, black with ore and black from lack of daylight after a short distance. Carbide lamps on tin hats, flashlights, and candles fitfully illuminated the rough way as the party strung out in single file behind guide Shorey and his able assistant, Darwin Benedict, of the State Department of Commerce, who had done the spade work on organizing the expedition.

Some one observed that there should be a sign over this gaping hole in the rock, reading "*Abandon all hope as ye enter Mt. Hope Mine.*"

It was not as tough as that, although requiring caution not to walk into deep, black pools of water, or to bang one's cranium on a stretch of very low roof, or to stumble on the rubble of loose ore and rock on the uneven floor. Upper shafts provided grottoes for exploration here and there; and, after a slow journey of about an eighth-of-a-mile, the party saw daylight and emerged at the convenient other entrance or exit.

During the journey, two observant members thought that they had discovered some "fossilized" tracks of animals registered upon the rock, perhaps a bear or two and a fox, or some small-pawed wild beast. Close inspection on the return trip revealed the tracks to be the result of water drip from the roof, now ceased, leaving the suggestion of bear-paws and fox-paws to the imagination.

To make the scenery more eerie, a railroad flare was lighted on an eminence midway of the tunnel which threw its red light throughout the mine. The intense humidity, too, of the outer air, brought a thick fog into the interior which hastened exit of the party. The spelunking was over, save for another party delayed by distance of travel, flat tires, and lack of directions, and whose presence might have gone unknown to the rest save for another unlucky accidental meeting—of which, more later.

The serious purpose of this exploring was to ascertain whether Mt. Hope Mine might possibly be a suitable site for military uses or civilian shelter in case of atomic war. The decision was left to the United States Corps of Engineers, after making further study, with no definite recommendation made by the NSS members who had been assisting in the survey, throughout the nation.

The thrills of spelunking in the mine were augmented, outside, by demonstrations of expert rappelling from the top of the ledge overhanging the mine entrance, with big Bill Stephenson sliding his 200 pounds nimbly down a brand new nylon rope that he and Brownie were asked to test for the manufacturers. It proved more than stout, and had the value of smoothness over manila. Bill and Brownie, the latter anchorman for the nylon and the manila safety rope, inveigled various fascinated hikers into trying their skill at the wrap-around slide and the ascent by hand-over-hand climbing, with feet "walking" the sheer cliff and the safety-rope about the body, being pulled up by Brownie and assistant at the top.

The usual question asked by the uninitiated, "How do you get back up out of a cave?" was ably answered by this uphill feat, and proved a valuable lesson to the "Cloud Splitters" of the ADK clan.

Following lunch and a fruitless search for a lost thermos bottle, the sleepy Washington spelunkers, with the writer, decided to tear away for a return trip to the Capital. Rushing along the road which passed the trail to the mine, a winsome miss in overalls flagged the car and anxiously inquired of the driver whether he had seen any spelunkers around these parts. She was recognized as none other than Miss Lydia Neubuck, the twenty-two year old owner of the Adirondack Natural Stone Bridge and Caverns.

"Lydia, are you lost?" was our first question.

"No, but I've lost my boy friend and Roger Johnson is stuck back in there with his car. He drove in from the other side. I hiked through, past the mine, to see if I could get help. I've been down in the gorge, trying to find someone. I ran into some deer tracks and someone hollered to me and asked what I was doing. It was someone upon this trail."

"And what did you answer?" asked Bill.

"That I was hunting deer tracks. I thought it was Mr. Johnson shouting to me."

"That," said Bill, "was I, I went back to hunt for the lost thermos bottle, and I thought someone was hunting deer down in there, and not knowing the game laws in this part of the country I did not make further inquiries."

"Mr. Johnson tried to drive to the mine. My boy friend and I happened to meet Mr. and Mrs. Johnson at a corner, just by accident."

"Some magic working around West Fort Ann," mumbled Bill. "This is the second fortunate accidental meeting of the day."

Putting it all together, it did seem like magic working. The Johnsons, driving from Springfield, Mass., about 150 miles, and Robert Godfrey and Lydia from Syracuse—having six flat tires en route—had met as if by appointment at Streaked House Corner, arriving there at the same moment. Neither knew the other party was coming and neither did we three, though I expected Johnson, and bet he could find his way to the Mt. Hope Mine.

He had found it, all right, by the usual methods employed in years of seeking caves and mines, and Bill lost his bet to the writer—but now, the doughty Roger was in need of succor. We took Lydia to our bosoms and drove around to the other side of Mt. Hope to where Bob Godfrey's car was parked, for he had not attempted to take the plunge into the woods with his automobile for good reason. After six flats in one day, a retreaded tire he had purchased had lost one-third of its tread in less than a few hours!

It turned out that the Johnson-Godfrey-Neubuck party had first trailed in on the old skid-road, and Johnson had decided it was negotiable with his experienced "cave car," fitted with a rack atop for toting a rubber boat or a kyack to paddle about in wet caverns, quarries and such, and with various other cave equipment in the boot.

Lydia led us to the place where Johnson had got stuck. The car was gone, deep ruts, rocks half filling them, and torn up sod told the story of his progress. Brownie and Lydia volunteered to trail in and find Mr. and Mrs. Johnson, while Bill drove back around to the other end of this miserable tote-road to catch Johnson if he drove through—which seemed an impossibility but might hap-

pen if he had an axe to cut some fallen trees that lay across the route.

Arrived at the west end of the trail, with a note that had been left on a stick in the middle of the trail addressed to Johnson—gone! Here was a puzzle. Bill decided to hike in. I sat in the car to catch Johnson and party if they came out some other hole in the woods. Our Capital District friends had long since hiked away to the old forge and knew nothing of all this adventure.

Half an hour passed, and a few cars, and suddenly Lydia appeared on the trail.

"We found them," she said. "Mr. Johnson's car is hung up on a ledge of rock *with a flat tire*. I thought I'd come out and see if you were here."

"Did you meet Bill Stephenson?"

"Yes, and Mr. Johnson and I went into the mine. Mrs. Johnson went out to Bob's car to get a pump and a jack. Mr. Brown is fixing the flat. Mr. Stephenson wants to have his car driven around to where Bob's is."

No sooner said than done. By this time even I was becoming familiar with the roundabout journey; and, within a few minutes of our arrival, to our astonishment, out came Johnson's cave car, covered with leaves and twigs, muddy to the hubs, but intact and containing the rescuers and Mrs. Johnson, all smiles and grins—and perspiration.

How they managed to jack the stuck car off the ledge, meanwhile patching the puncture, turn it around, and drive out without being hung up or bogged down again, seemed another result of the magic of West Fort Ann.

Mt. Hope Mine is historical. It is one of the series that stretches from New Jersey, up through the Ramapo Highlands, into the Adirondacks. It was opened by the famous Baron Hasenpfeffer, a Dutch patriot, and S. S. Smith, equally famous in the mining world of England, having come from the Forester-Dean Mines in that country, an expert, to open a huge mine in the Ramapos which he named for Forester-Dean. Mt. Hope Mine was operated continuously until after the Civil War when litigation that dragged out for years, brought an attorney's bill to the concern of \$30,000, from a New York lawyer.

The story is that the owners looked at the bill and said, "We have won the suit; you can have the mine and the whole damned property."

Undoubtedly the owners were wise to get out, but the lawyer was also wise. Instead of reopening the mine, he went into logging and is reputed to have made a fortune out of timber from the 2,800 acres that he had acquired. Huge old stumps of hardwood tell the story of an early cutting, and sizable deciduous trees that stand today promise a new growth—but the valuable hickory is gone, perhaps forever.

There is a cave at Podunk Pond, a natural

cave, but no more than a shelter (perhaps an Indian shelter?) and there is a hermit—or was—who lived on a dead-end road, a little more than a path off the winding one that ends at Shelving Rock Bay on Lake George. There is also an old-time lumberjack who can tell you tales of the days of the scissor-bills and Paul Bunyan feats in the times when trees made logs like the butts of factory chimneys and tapered not much more toward the top.

Histories are rather vague about the mining industry in Fort Ann. A *Gazeteer of Washington County* by Allen Corey, 1849-50, makes no mention of Mt. Hope Mine, but does admit to "a forge and anchor shop conducted by Caleb Kingsley." French *Gazeteer of the State of New York*, 1866, says only that "a blast furnace was built at Mt. Hope in 1826 which makes 5 tons of pig-iron daily," and "a forge was built at West Fort Ann in 1828 for making anchors and chains." These publications devote more attention to the old fort and the Champlain Canal which runs through Fort Ann town and village, and one of them gives the population of the town as 3,100 in 1810. The *Gazeteer* authors differ widely as to the origin of Fort Ann as a citadel of defense, French's book dating it as 1709 and Corey's as 1757. Historical interest is heightened by the fact that Burgoyne's Road ran through here, two miles south of Fort Ann village in 1777. History further tells us that West Fort Ann was on the north branch of Halfway Brook and had two stores, a postoffice, tannery, plaster mill, etc. French says that the fort, a palisade affair of logs, was "one of a chain" erected through the wilderness, doubtless for defense against hostile Indians, but it was burned down by Burgoyne.

To make the grand tour of September complete, we spelunkers from Washington and Pittsfield must stop at the bridge at Glens Falls to explore the queer "caves" advertised as Cooper's, under that bridge, and to be able to boast that we went clear through two water-worn caverns in the strange gray rock in the river-bed, now high and dry from the damming of the Hudson above. Strange as it may seem, even to Hix, one of these caverns extends clear from Washington County into Saratoga County—a distance of about 25 feet! They are open at both ends.

Cooper's Cave, the larger one of the two, gets its name and fame from "The Last of the Mohicans," and it is typically illustrative of the tall tales that grow out of small caves.

Clay Perry.

See "Mitchell's Cave," by P. M. Van Epps. *The Museum* (Albion, N. Y.), 413, January, 1898, pp. 35-38; 4 (4) February, 1898, pp. 57-61; illus., 4 (5), March, 1898, p. 74. Cave is near Spraker, Montgomery County, N. Y.

Letters

From Members and Others at Home

"Non-Existent Cave" Found

I am what one calls an amateur cave hunter in my spare time. It is a hobby with me, when I go on vacations, to gather information enough from old-time mountain people to locate where caves might be. The old-timers of the mountains found caves 15 and 20 years ago, but there was no reason to talk about them in those days.

I became friends with the old-timers by being a good listener and placing faith in what they said. Being friends helped me locate and explore a cave which the people of Quincy, Calif., and the Forest Service, refused to believe existed. They said that the old-time miners and stage drivers were wrong and were subject to pipe dreams about things in the hills.

I enclose for your notice the newspaper (this was returned to the sender) which printed the story of my discovery of the so-called non-existent cave. I got together three other Forest Service employees, and we set out to find the cave with only scant information which I was able to get out of an old-timer who hadn't been near the cave in 20 years. As the paper shows, we did find the cave and got some information about two others; but time was short after exploring the one we found, and we had to return to duty. But I do believe I proved my point, and that is: "Listen to the old-timers and you'll reap reward." I plan other trips to locate more caves in that area when the time comes that I can take leave from work for about three months.

The cave discovered isn't much, but it is a start in the right direction to gathering more valuable information from old-timers in other mountain towns. The fellow who gave the tip on the location died two days after we returned and told him about finding his cave.

My main reason in writing you this letter is to find out what one has to do in order to become a member of your Society. I should also like any other information that might help me in being useful in locating caves and caverns in California, Oregon, and Washington.

If you have certain requirements which make a cave or cavern worth the effort to classify, please let me know. If you know where I may purchase books on the subject of caves and caverns, I will also appreciate it. In other words, I am only banging away on my own with no special knowledge on the subject.

Charles F. Erfttenbeck,
San Leandro, Calif. 1/13/47)

Data on French Speleology

I will be glad to translate De Joly's prose whenever you will send it to me. He has been our president for years and still was when I left France. Has there been some election in the board of the Society since I left that would have brought someone else to the presidency? Maybe. I doubt it very much though, and would have sworn that Ageron might be president of a local branch, or grotto, but not as far as I know of the Societe Speleologique de France. Besides, what you tell me about the correspondence that Robert De Joly sent you and his offering of an honorary membership to Stephenson, all suggests strongly that our Robert is still the leader of French Speleology.

I have a very great esteem for him as one of our best cavers and a real pioneer in speleological equipment. He has designed and executed these light aluminum-alloy ladders and dozens of pieces of equipment which are clever gadgets and fruits of an extensive caving experience and mechanical mind. If I had to limit to two names the top chaps we have over there (which, of course, should be absurd) I would say De Joly and Casteret.

To make a clear picture of the organization of French Speleology, you have one big thing, the Societe Speleologique de France which has tried and succeeded to realize a unity and has absorbed on one hand, and organized and encouraged on the other hand, the formation of a host of local grottoes and local societies. Apart from this big sort of a "Federal" organization, there is only one organization which, though connected with the S.S.F. and intermingled with her, has kept a certain autonomy. This is the Speleo Club Alpin, a speleologic branch of the Alpine Club of France, less numerous than the S.S.F. They are very active though, and have done nice work (*Sondeurs d'abimes*, the movie we checked with Frank Solari. has been done by them). They are mostly Alpine Climbers come to speleology, as one could guess, and mostly Parisians. Some seven or so of them, as I recall the membership, are also members of the NSS; so there is no hostility or rivalry between the two, save for a sportive emulation. If you are interested I will be glad, as soon as I am back in Paris, to establish connection between you and them, if not already realized, since I am on the friendliest terms with a good many of them, particularly F. Thrombe and Guerin.

I have seen the movie with Frank. It's a mighty good thing, and I hope you will see it soon. We have cooperated with Mrs. Buyer, who takes care of the translation into English, and tried to help her make the dialogue something faithful to the French text; and, at the same time, correct as far as technical terms were concerned and also understandable to the lay public. This last point seems to be the one she is most interested in.

Frank just came here to visit me tonight and

keep me company on an evening "on duty" when one has to stay in the hospital doing nothing but wait the emergency that does not come. He brought in a projector and I had the pleasure of seeing, amidst a lot of wonderful color slides, some that reminded me of good memories (a certain J. S. Petrie pulling hard on a rope at the mouth of Grape Vine Cave). Thus, what should have been a dull evening was transformed into a pleasant and entertaining one.

H. Henrot,

New York, N. Y. (7/25/46)

How Does It Strike You?

Several weeks back I managed to get in a trip to Springhill (that helluva muddy hole) and also Clarke's. Did some photographing in the last one, but as yet have not gotten them back. However, I made several good archeological finds—a pit with the best pick marks in it I've ever seen (and photographed it); also found a large saltpetre paddle, a small saltpetre paddle, and a wooden chisel apparently used by the miners to dig the saltpetre-bearing clay out from between the rocks that were too close together to permit the use of a regular pick.

I brought them home, and they bring to mind a wild idea I've been having lately: why can't we persuade the Museum of Natural History to have on permanent display a Department of Speleology? Just the same as they now have on geology, archeology, etc. It would not have to be a large space, but could include such items as caving equipment, cave maps, geological specimens like stalactites, geodes, flora and fauna specimens, several large framed photos of excellent quality, and some 16x20 foot framed natural color transparencies (like they had at the N. Y. World's Fair), also archeological and paleontological finds. The exhibit would in no sense be an exhibit of the NSS, but of the science of Speleology in the broadest sense.

If such could be done, I would be very happy to donate any photos or artifacts I have or may collect in the future. How does the idea strike you?

G. A. Robertson,

Richmond, Va. (9/14/46)

More Letters Like This, Please

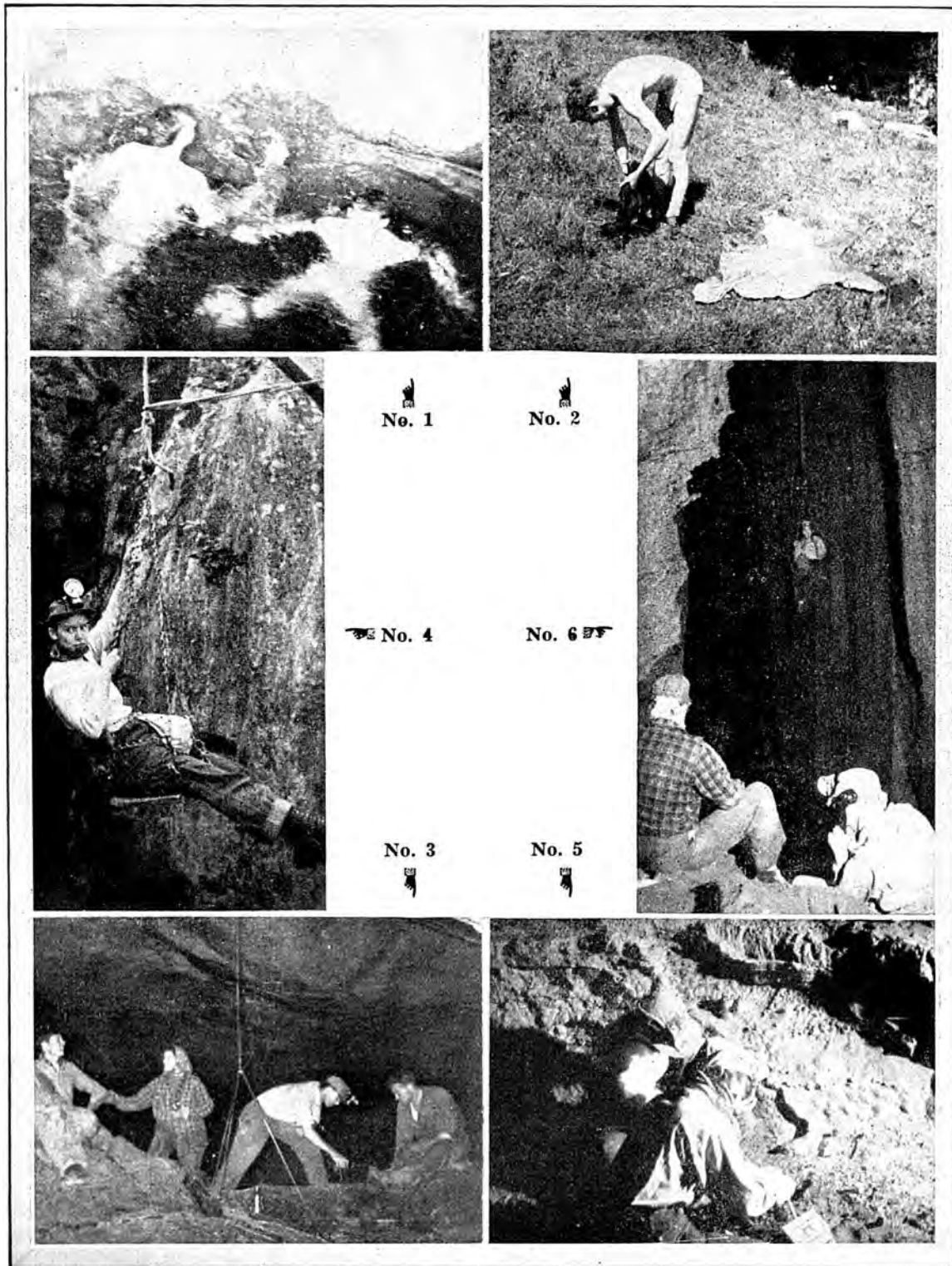
I am enclosing a few of my cave pictures for your consideration. If any of them look interesting, you can publish them; whatever you reject, just send on to whoever is supposed to keep the Society's photograph collection.

I have tried to select from my collection those of human interest value instead of just cave formation, etc., No. 1 is a picture of Petrie and John Fishburn swimming in a rimstone pool at Piercey's Mill Cave, W. Va. This rimstone pool is the larg-

est any of us had ever seen, and it might be able to claim the title of "the largest in the world."

Picture No. 2 is of Fishburn in shorts, wringing

Picture No. 3 could be entitled "The Mad Scientist at Work," for it shows Dr. J. W. Murray with all his scientific apparatus, about one-third of



out his clothes just after going through the waterfall in Taylor's Waterfall Cave, Greenbrier, W. Va.

a mile back in New River Cave, Giles County, Va. He is using the potentiometer to measure the pH of the water dripping from a stalactite in connec-

tion with his investigations on the relationship between the composition of the water on a cave formation and whether the formation is made of aragonite or calcite. Others in this picture include Bennett, Hopkins, and Griffin.

The other pictures were taken in Clover Hollow Cave, Nov. 10, 1946. No. 4 shows Mary Ellen Smith being lowered down the 80-foot drop at the entrance, by a winch. She looks somewhat scared. Then, No. 5 shows her and Marian Wormald setting a beetle-trap. No. 6 shows Marian being lowered down from the top of the 143-foot drop in the seat, while Ann White talks on the telephone and Mrs. Betty Loyd looks on.

I have a few suggestions about the *Bulletin* that I would like to make, because I know you are always trying to improve it.

I think the Pothole section is good, because it contains much interesting material in very little space.

Did you know that the VPI Grotto has recently run an ad in a local weekly paper asking for information about caves, and offering to pay \$5 per mile for any information about caves (over 1/2 mile in length) near Blacksburg which we have not previously visited?

What about publishing a group picture of one of the Society meetings or a Board of Governor's meeting? Many people have read in the *Bulletin* and *Newsletter* about some of our members many times, and would like to see what they look like.

The "George" who wrote the letter on page 102 of *Bulletin* Number Eight is George Crabb. (ED. Who are the "Petrie," "Bennett, Hopkins, and Griffin" in your letter, Ed?)

Dr. McGill's article about Virginia caves in *Bulletin* Number Eight was a little obsolete, it seems to me. For instance, he lists one cave in Giles County, Va., but the VPI Grotto has explored about 30, of which a dozen or so have been listed or mentioned in the *Bulletin*. I don't think such articles should be published unless someone brings them up to date. (ED. again . . . Did you read the italicized portion at the head of his article?)

Don't you think that the *Bulletin* should publish a list of errata in previous issues? Some of the errors which have appeared in the past are obvious misprints, but some of them could cause confusion. For instance, in *Bulletin* Number Two, Baldwin's Caves are listed as "7 miles" south of Skyline Caverns. This should read ".7 miles." A few other errors at random include 1929 as the publication date of *Underground New England*, on page 41, *Bulletin* Number Eight; Newport listed as the location of New River Fault Cave in *Bulletin* Number Five, page 9, instead of Goodwin's Ferry, as indicated on page 64 of the same *Bulletin*.

Most of these errors are due to the printer, but some of them are errors in fact on the part of the contributors to the *Bulletin*. I think a list of them

should be published. Incidentally . . . Frank Solari tells me that some of the caves he listed were also listed by Morgan in the same article, with a variation in spelling, but were not indicated as being the same cave. Perhaps you have noted a few errors yourself, and you could request readers to notify you of any they find. (ED. once more . . . Did you perhaps note the three blank pages at the end of *Bulletin* Number Eight, Ed?) I know there are several others I have noticed, but I can't find them at the moment. I'll send them along to you when I do. Many scientific journals publish lists of errata in the interests of greater accuracy. Examples are *Mathematical Tables and Computations*, which devotes an entire page of each issue to errata; and the *Nautical Almanac*.

Edward F. Moore,
Blacksburg, Va. (11/30/46)

The Editor could very well write a l-o-n-g essay upon the thoughts engendered by Mr. Moore's fine letter. He has foreborne, however, in the interests of economy. His fondest wish, however, is that Mr. Moore could be with him from the moment he begins the job of putting a new Bulletin together, until it emerges a printed thing.

Cave-Without-a-Name

Our opening on the 11th was a huge success. We went nearly mad trying to find places to park the cars, which overflowed our parking space, picnic grounds, and driveway. I think that except for Luray, I would rather work here than at any other cave. The enthusiasm with which visitors react to the cave is payment enough for all the work I've done here. For so small a cave, it has more beauty in it than any other I know outside of Massanutten. The management and guides of Carlsbad have sent us a great many visitors, and they all say that they enjoy this just as much as they did Carlsbad, which is satisfying to hear, as you can well imagine. Considering that we give them a 550-foot trip as compared to Carlsbad's five miles, you can realize that I am not exaggerating the beauty of the cave. I cannot remember having had a more pleasant job in my life.

Not that it is all a bed of roses. Our lighting, which is rather elaborate, gives constant trouble, and the cave itself requires constant work, which is true of all caves, after all. Texans as a whole are completely uninterested in their caves, and I have had no interest at all shown in my efforts to gather members for the Society. If the name could be changed to the Texas Speleological and Petroleum Society, it would probably go over with great success.

We've been so busy that I have not gotten around to further exploration of this cave, or of

the others on the property nearby. It would be a lifetime job anyway. When you do come down, bring a small collapsible boat, unless you can swim holding a lamp. And a diving helmet, without which you will not be able to follow our stream more than a half-mile.

Tom Goeller,
Boerne, Tex. (8/20/46)

Re. "Spelunk"

I have been enjoying the wide variety of articles, and congratulations also on the splendid format of *Bulletin* Number 8.

Page 111 in letter asking how to pronounce "Spelunker," with Petrie's answer that it originated in the New England group, is correct. My notation is that my mother found the word "spelunk," with accent on "lunk," in Webster's Unabridged Dictionary (while doing a cross-word puzzle), which gives the meaning as "Cavern, cave, lair, den."

I've loaned my cave scrap-books to Clay Perry while he is working on his next cave book on New York State, so that I'm not sure when it first was used in print. I do recall A.P. articles in 1938 carried it, and Clay Perry's book *Underground New England*, published in 1939, has "spelunkers" on page 219.

Curiously the Mumas' splendid glossary in *Bulletin* Number Six, omits "spelunk," but gives both "spelunker" and "spelunking," which we invented to express the fun we were having in the small caves in New England compared to the real speleological work being done by the "British Speleological Association" in their larger caves. (This was before NSS was started.) Webster also gives "speluncar: of, pertaining to, or of the nature of, a cave," with the base word "spelunk" they will probably want to include in the next glossary.

On page 34 of the last *Bulletin*, the late M. Beardsley remarks that "the book *Underground New England* is confused with reference to these two caverns," but from his description he obviously first only explored the first 100 feet northward of the "Cave of the Bashful Lady" and stopped at the well, then came out, so did not see the Bashful Lady. He then walked south a couple hundred feet and explored another entrance to the same cave, but did not find the connecting passage. It is also obvious that he did not at any time locate the small entrance a few hundred feet beyond to the "Jack in the Pulpit Cave," and so did not see the spectacular formation from which we named it.

The description in the book *Underground New England* is accurate.

Roger Johnson,
South Hadley, Mass. (10/7/46)

Some Virginia Cave Rambles

I am interested in the plan for regional cave reports. It will be necessary, I believe, for all local workers to set his own limits, and not be restricted to county entirely; for, as you doubtless know, many counties are entirely in limestone regions, while others have little or none. I have procured Butt's geological map of Western Virginia, and it simplifies matters very much; now I know just where the limestone strata lie, and don't have to go chasing around aimlessly. I located several new caves in the Island Ford region, most of which are quite small. One larger one is closed at the entrance by a pile of rocks.

I expect to just about finish my survey of the Alleghany County caves by October. I can then make a report as long or short as advisable, depending upon how much detail is desired. Each cave write-up could be as brief as a cave card; or elaborated in some detail, accompanied by a map. When I get around to it, I'll make up a rough outline of what I have in mind and send it for your approval or criticisms.

I was about to become a disgrace to the Society by losing my way and wandering around in Cassel's Cave, Burke's Garden, Va., some weekends ago; but that horrible thought gave me confidence and my friend and I soon came out again. The Burke's Garden region is full of big complex caves. Most of them have been explored by Dr. Mohr, I believe. We were primarily interested in the fauna, and got quite a few interesting amphibians plus bats and bones. Speaking of SW Va., during a visit there in May I spotted one or two likely prospects and filled out cards on their location. I'll send these as soon as I find them—they got lost during the moving of my junk from Charlottesville to here.

The article in the recent *Science Illustrated* was quite interesting, especially the photos of Porter's Cave. Did I mention that the last time I was there the owner was quite reluctant to let me go in. He professed to know nothing of the NSS visits; and, if it hadn't been for his son, my visit would probably have been unsuccessful. Contrariwise, the folks in Burke's Garden were glad to have me go through their caves, and professed a genuine interest in my doings underground.

Do you have any specific information on the cave at Richpatch, Va., which you planned to visit when you were here last September? According to my map there isn't much else in that region. I haven't yet canvassed the natives.

The Virginia Academy of Science *Journal* is to be resumed next year early, I am told. This is perhaps a potential medium of publication on Virginia caves, at least we can try when the time comes.

Richard L. Hoffman,
Clifton Forge, Va. (7/2/46)

Wind in the Wyandotte

I know that Petrie and others keep wondering why I don't organize an Indiana or Wyandotte Grotto; but, although I would like to very much, I simply haven't as much time for it as it takes. Then, too, I have had a very devil of a time trying to get some of the local speleologists to join. Most of 'em are well-to-do enough that they don't mind the payment of dues, but I can't convince 'em that they will gain anything by joining. After all, they have plenty of caves hereabouts they can explore, and if they want to know anything they ask me or my father-in-law, Charley Rothrock, of Wyandotte Cave, so it's a tough racket.

However, if I do get the thing organized, I'll bet I'll have one member farther away than any of the other grottos, for my friend, Stuart McMillan of Bristol, England, will become a member of the Indiana Grotto, he says! He is trying to get me membership in the British Speleological Association and his own Mendip Cave Club, so I thought it only fair to fix him up with the NSS, which I did. He is now member No. 491.

My argument (via letter) with the Eastern members about using string for finding one's way when lost still goes on; and if Hill publishes it, I should have some comments on the matter in the next Newsletter. I thought that if we got some sort of friendly argument started, via Newsletter, it might make things more interesting, so I started it!



I still contend that I gotta see with these two bleary ol' eyes the man who can carry enough string along to pay out behind him on a lengthy cave trip. If the cave is short enough that you won't need to carry much twine, then (I say) you cannot be lost in it for very long; for, if necessary, you can "run down" each passageway. But, if the cavern is very long, like Wyandotte, Mammoth, Old Salts, Carlsbad, Colossal Cave, Nica-jack, Longhorn, Hidden River Cave, or dozens of other Kentucky caves, or even Marengo Cave (Ind.), how the hell can you carry enough string? Ever since I told Stephenson that, he hasn't been the same. And I have yet to find any of the

Eastern cavers who can give me a satisfactory answer.

(Oh yes, you may use this in *Bulletin*, if you wish.) Re: that clipping from the *Indianapolis Star* of 3/11/23, on page 67, *Bulletin* Number 8, about the sandstorm in Wyandotte Cave. The four men were Charles J. Rothrock, my father-in-law; Mr. Robert Loudon, guide at Wyandotte; Mr. Sam Rothrock, old-time guide; and Miss Leala Austin, of English, Ind., a newspaper reporter.

They had been in the cave taking some pictures for an article Miss Austin was writing, and had stopped to rest when they heard a sound like water roaring through the cave passageways. Common sense told them it couldn't be that, but nevertheless it must have been darned frightening to hear such a sound in a place where normally the only noise is the sounds one makes himself or the slow drip of water.

Only one of them—Sam Rothrock—had ever heard such a sound before in Wyandotte. Years ago, when he was a boy, he had had much the same thing one winter day while exploring.

As told in the newspaper clipping, it was a gust of wind; but, the account as presented is quite exaggerated. They were not "buffeted, and frequently thrown to the floor," but the wind did put out their candles and must have scared the hades out of them.

Later, upon reaching the entrance, they found a terrific storm had been going on outside; and I suppose changes in atmospheric pressure had created the wind in the cave. At least that's the only sensible explanation.

Although it may have happened many times during the winter when no one was in the cave, there are records of at least occasions when a gust strong enough to move good sized pebbles has blown through the larger passageways of Wyandotte, and each time it was during a violent storm outside.

George F. Jackson,
Evansville, Ind. (11/7/46)

From Members Abroad

Add: Pot-Holes to Cave Lists

Your country seems to have an incredible number of cave labyrinths, but to be short of pot-hole areas, as in France, Italy, and this country.

I enclose a list of our first-class pots, all demanding skill and hard work:

INGLEBOROUGH — Gaping Ghyll Hole, Long Kin West, Mere Gill Hole, Alum Pot and Diccan Pot, Washfold Pot, Nick Pot, Juniper Gulf, Rift Pot and Long Kin East, Jockey Pot.

TENYGENT — Hunt Pot, Little Hull Hole, High Hull Pot.

KINGSDALE — Rowten Pot, Swinsto Cave & Simpson's Pot, Marble Steps (High Douk) Pot.

LECK FELL — Death's Head Pot, Rumbling Hole, Lost Johns' Cavern.

DERBYSHIRE — Eldon Hole, Oxlow Mine (a narrow mine shaft 80 ft. broke into a natural cavern), Nettle Pot.

E. E. Roberts, Editor.

Yorkshire Ramblers' Club Journal,
Yorkshire, Eng. (2/16/47)

More Hooper Highlights

I was glad to hear that you approve of the Gaping Ghyll article—I hope NSS readers will do likewise. The British Speleological Society are holding a Gaping Ghyll meet at Whitsun this year, and I shall do my best to get to it. I am keen to show the cave to my wife, as she has never been down it.

I have dug out a caving group photo which may amuse you—I am the one with the leer on the left



of the picture, and my wife is in the middle of the group. It was taken outside the entrance of Baker's Pit Cave (Devon), just after a very muddy surveying trip, and should really be in color to do justice to the mud. Incidentally, in fairness to the "gentleman" second from the right, I should perhaps point out that the pronounced bulge in his stomach is due to a coil of rope inside his boiler suit! Actually the photo was taken in 1939, but pictures of me are rare since I am normally the one behind the camera.

We managed to do a bit of caving over the Christmas holiday, and spent three pleasant trips grovelling in rich red mud in Baker's Pit Cave. We spent much time and energy digging through a choked tunnel, only to find after we had shifted vast quantities of particularly tenacious clay that we had merely gone round in a semi-circle and connected up with a tunnel that we already knew—such is life! However, in another part of the cave, we found another tunnel (at present about the

size of a large rabbit hole) which apparently leads off into a brand new section. So, on our next trip, we shall be doing our best to enlarge the "rabbit hole." It will be a painful business, I fear, since it can only be approached via a low bedding plane with sharp roof and floor.

During this last trip, I tried my hand at color photography, using Dufay Color (do you have this in U.S.A.?) The results are only transparencies, and have proved quite reasonable from the point of view of exposure. The coloring, however, seems to be much too red, and it is probably due to the fact that I failed to use a filter. However, I have bound the transparencies up to make lantern slides and they project quite well.

You ask for details about myself. I work as a chemist in the research laboratories of the Anglo-Iranian Oil Co., and have done so now for nearly 11 years; age, just on 30, and have been married for five years. My wife is as keen on caving as I am—in fact, it was through this common interest that we first met, since she and I had been exploring caves independently for some little time before we, so to speak, joined forces.

I envy you your "scores of 14,000 footers in Colorado"—Middlesex, the county in which I live, is unbelievably flat and rarely achieves 100 feet above sea level in this particular corner. It is moreover very much built over, so that the scenery is houses, and yet more houses. However, our move out to this new house has brought us some eight miles nearer more genuine countryside, and it is quite easy to get out to fields and woods and heathland on our cycles. I much prefer, however, to be in scenery where one has to look up to see the horizon; and during my all too brief summer holiday, I try to get out to the more mountainous parts of this country. I'm afraid they would seem poor mountains to you, since 3,000 feet is about the height of the bigger peaks. However, our English "Lake District" and North Wales can offer some very lovely mountain scenery, and one of these days I am hoping to extend my hill wanderings to Scotland. The highest I have climbed so far, and how little it seems (though not at the time—it was a very hot day!) is Snowdon, 3,560 feet. Before the war, I spent two very pleasant touring *cum* camping *cum* caving holidays in Ireland, and am looking forward to returning there.

During the next week or so, if the weather stays warm enough to let me do some enlarging without the developer freezing, I will try and print off for you some photographs of Gaping Ghyll. You may or may not find them suitable for reproduction, but they will at least give you an idea of what the cave is like.

John (2/14/46)

I am reading the *Bulletin* with very great interest—it is a fine issue and the art quality pages are also a great improvement. I must admit I was somewhat startled at the number of my own letters which reached the cold light of print (I shall have to take more care over my "style" in future ones!) and also at the grandiose heading "Highlights from Hooper letters." I can imagine NSS readers all over America sitting up with a jerk and exclaiming "And who in Hell is Hooper?"

This last week-end my wife and I had our first cave trip for about four months. This trip had a flavor of pre-war days as we went down by car instead of by train to Somerset. We decided that in spite of the present meagre petrol ration our so-called government allows us (nine gallons per month!), it was worth while licensing the car to allow us to do cave trips, etc. It certainly made the journey a lot easier and the car ran very well although it has not been on the road since 1941.

We were a bit late setting forth, and did not reach Priddy—a little village on the Mendip Hills of Somerset—until 5:30 p. m. Saturday evening. Our headquarters for the week-end were a barn and a hayloft belonging to the farmer who owns the cave—Swildon's Hole. As it was getting dark, a few of us went out to forage wood, before the light completely faded, from a nearby copse, and then after almost staggering back—completely hidden beneath mountains of brushwood and logs—we got a good fire going and had a very welcome hot meal.

Afterwards, somewhat loath to leave the warm comfort of the fire, we decided that as we had traveled 120 miles to crawl in a cave, we had better do something about it. So, with our usual reluctance, we changed into cold and muddy "caving clothes," donned helmets and nailed boots, and walked across fields to the entrance of Swildon's Hole.

The cave begins as a small fissure just large enough for the body, and lies at the foot of a low bank alongside a pool where a stream sinks below ground. The night air was cold, and the three of us—my wife, Alan Yeo (making his second trip), and myself—were glad to get into the relative warmth of the cave.

At first the roof is low; and, after crossing the stream and wriggling under a low boulder, one drops into a narrow gully. Here it is necessary to duck through a small opening, accompanied by the stream—an unpleasant place after wet weather! The stream then pours down an inviting pit, which to the alarmed eyes of the novice looks to be bottomless (it is really only about 12 feet), and one crawls along a none-too-adequate ledge to one side, and then inserts the body through a hole in some wedged boulders.

Beyond this comes a spell of crawling through a constricted tunnel whose hard floor is not appreciated by the knees, and three right-angle bends have to be negotiated. A descent of about 10 feet down a vertical fissure, known as Jacob's Ladder, then leads to a passage with a muddy floor, where there is rather more room to maneuver. This passage is the start of the "Pretty Way"; and being well decorated with white, brown, and orange formations, well deserves its name. We made our way along this slowly, partly to admire the scenery, and partly because not having been in a cave for some months, we were too much out of training to do otherwise.

After passing through a number of attractive grottoes, we scrambled down a sloping passage into a big cross-rift. The main route lay downhill to the left, but we turned right and climbed up a slope of scattered rocks to look into a little side grotto which was new to my wife and which I had only seen once before. The entrance was an unobtrusive hole leading vertically upwards behind a flake of rock which formed part of one wall. This hole opened, a few feet up, into a horizontal but constricted, rift-like tunnel. The approved method of entry is to insert the head in the hole, with face turned towards the rear side of the flake; and then, obtaining what purchase one can on slippery stalagmite bank below, one pivots on the right hip-bone and wriggles the long suffering torso up and 'round until it reaches a state of stable equilibrium in the horizontal section of the tunnel.

This tunnel is about 15 feet long and is decidedly narrow, but we soon found that the secret was to get the widest parts of the body up by the roof and let the legs take care of themselves in more vise-like section by the floor. A tilted bedding plane then gave us more lateral breathing space, and we were able to crawl uphill into a very dainty grotto, where I photographed a delicate cluster of stalactites, mirrored in a miniature pool. After my wife had made herself very wet by lying on a damp bank of the stalagmite peering into a hole which suggested a possible way on, we retraced our steps and after further complicated contortions re-emerged in the main rift.

An easy walk downhill led to a grotto whose main feature was a stalagmite toadstool nearly three feet high, and then a hole in the floor led us on downwards into a twisting rift, 20 feet high. This soon opened into a chamber—the old Grotto—some 20 to 30 feet in diameter, with an irregular floor of stalagmite domes and slippery slopes, interspersed with pools, and also holes dropping down to a lower level passage. There are some very fine stalactites here, including some flowing "curtains," 20 feet high, and I stopped to take a photograph before we moved on. We clambered down into the passage below the floor of the

chamber, and continuing to descend, then followed the zig-zag course of an impressive rift, 30 to 40 feet high, whose wall were draped with white and amber flowstone shaped into "pillars" and curtains.

We could now hear the sound of rushing water ahead; and, at a point about 500 feet from the entrance, we rejoined the stream passage, coming out opposite a small but noisy waterfall. Downstream, the water flowed on over a stony bed to the top of the first rope-ladder pitch—the 40-foot pot—but this was not for us today. I should perhaps explain that there are four main routes to the 40-foot pot, although in places they overlap, and these are: the Pretty Way, the Short Dry Way, the Wet Way (the actual stream route), and the 4th Way.

As already mentioned, we had entered by the Pretty Way, and now intended to return by the 4th Way. This is a most uncomfortable and little-known route (cause and effect?) which my wife was anxious to see for the first time. So we paddled upstream for a few yards and then squeezed up through a prickly-walled fissure high up in the right-hand wall of the stream passage.

For a short while we were able to crawl on hands and knees over an earthy floor, and then we entered a rift, not too tight at first, but which relentlessly grew more and more cramped with each foot we advanced. For a while we had to wriggle along horizontally just below the roof and at the same time endeavor not to get jammed in the narrower crevice below, and then we came to the worst part.

This was a fissure, little more than eight inches wide (if that), and perhaps two feet high. Before entering it, I had to empty my pockets, put the contents in my haversack, and take off my helmet in order to give my head turning room. Then, lying in a pool of liquid mud, I pushed my helmet in front of me (also the haversack), and inched my way forward. Soon the floor took a sharp upward slope, and the roof got lower, and my helmet and haversack, laboriously pushed ahead, showed a regrettable tendency to slide back down on top of me and then balance on my face, usually at a moment when I was unable to get an arm forward to shove them out of the way. In spite of the cooling effects of the mud and water in which I lay, I found the combined effort of squeezing and overcoming gravity to be decidedly warm work.

I was not sorry when I reached the top of this tight section, and found a relatively capacious tunnel where I could at least turn over, although it was still not possible to advance on hands and knees. Soon I reached a more convenient resting place, an earthy chamber where—joy of joys—I could stand up again! I ate some chocolate here and waited for the other two. I also explored a

number of side tunnels, including a steeply ascending rift, but was deterred by the extreme looseness of a boulder slope which towered up over my head. Meanwhile, my wife had got through the tight part of the squeeze, but Alan, behind her, got into difficulties with the final uphill part. Having rubber shoes, he was unable to get grip on the slippery rock and shove himself upwards as we had been able to do with our nailed boots. Also he had got an arm jammed under his body and was unable to free it.

At first my wife tried dangling a leg down for him to heave on, but this did not work; so I wriggled back down the slope and changed places with my wife. Alan was now getting tired, so I draped myself down the slope head first and by reaching out an arm was able to catch hold of the shoulder of his jacket on the side where his arm was jammed. Then followed an epic struggle during which it was a matter of some uncertainty as to whether I pulled him up or he pulled me down! However, we gained a few inches upwards, and this was apparently all that was necessary, as he was then able to wriggle up under his own power. Then, while Alan took a well-earned rest, my wife and I went down a side passage, as I wanted to show her a point where she could stand at the entrance of two tunnels, one going upwards and the other downwards, and yet hear the sound of rushing water (from the same stream) from each one. Looking down the lower tunnel, we could see the stream cascading along a dark rift about 15 feet below us.

Then we collected Alan and continued on our journey. First we swung across a pool and up into a steeply ascending rift, where again we had to keep up near the roof. Then a hole in the left hand wall led us along a watery tunnel where there was just room to crawl, for about 30 feet, and brought us into a stream passage once more. This was a fine example of a solution-enlarged bedding plane, but we were able to scramble up over the fast flowing rapids without getting particularly wet. Then we hurried round a corner—we hurried because of a heavy showerbath which came through from the roof at that point—and negotiated a slightly awkward hole up through the ceiling (footholds were all too scarce, and there was a tendency to be left jammed in the hole with feet waving wildly but ineffectually below in free space). A short scramble onto a sloping ledge, a crawl under a boulder, and we found ourselves under the entrance hole once more.

We climbed up into the cold fresh air, wet and muddy, and slightly conscious of the fact that we do not crawl underground often enough these days to keep in proper trim for the unaccustomed exercise. The trip had been a comparatively short one—only $3\frac{1}{2}$ hours—but it felt quite enough! And so we walked back across the fields to the

barn, where we found two other cavers had kept a most welcome fire going for us. The warm blaze, dry clothes and a hot drink felt as they only can do after a damp cave trip; and when we finally settled down to sleep, well after midnight in the adjacent hayloft, we did not stay awake for very long.

Next day, we had a real hearty breakfast, packed up our things and set off on our 120-mile journey home, only too sorry that our brief excursion into the underworld was over.

During that same week-end, cave exploration in the true sense of the word was being carried out in Wookey Hole, and I enclose a press cutting which may interest you.

John (10/16/46)

[Ed. Note. The clipping from the London (?) Daily Express, 10/14/46, is now in Society files. It carries the picture and story of "Mr. F. Graham Balcombe, first man to penetrate Wookey Hole's unexplored Eighth Chamber," which he did in full diving regalia. An exciting story!]

Glad you liked the Christmas card. If you really want to reproduce the picture on it in the *Bulletin*,



Entrance to Perry's Pot, Devonshire, Eng. Mrs. Hooper posed for this, used as their 1946 Christmas Greetings card.

I'll send you a larger print that will be more suitable.

I enclose for you a copy of *Illustrated London News* carrying an article of mine on one of our Devonshire caves.

This article had an amusing sequel, as it caught the eye of the British Broadcasting Corporation with the result that my wife and I received an invitation to be televised! As we are neither of us exactly practiced in the art of public speaking, let alone broadcasting, and still less television, we looked upon the idea with a certain amount of misgiving, but found it was very much less of an ordeal than we had feared! In fact, we very much enjoyed it all, and had a most interesting time seeing television from behind the scenes.

We had a sort of microphone interview lasting five minutes, and "showed" photographs taken in caves, a stalactite or so, our protective helmet, and so on. We found the big Good lights in the studio very brilliant, and certainly very warm; but I must confess I quite forgot about the television camera and microphone as soon as the interview had started! Unfortunately, I could not see what I looked like on the screen and a set at the same time—but I gather from friends who "looked in" that I was still recognizable.

John (2/17/47)

My own caving activities have been very limited during the past year. However, a week ago, the urge to go crawling again was so strong that my wife and I and three others paid an all too short weekend visit to the limestone Mendip hills in Somerset.

The weather was cold and frosty but we stayed in a barn which is an accepted cavers' headquarters and made ourselves comfortable with a nice big fire. We slept in the hayloft next door, and as there was enough hay for a two-foot layer underneath one and a similar layer on top I, for one, was not cold during the night.

The cave we visited is known as Eastwater Swallet—you have probably read a description of it in Mr. Balch's book, as I think Platten has sent the NSS a copy. For the first 100 feet in this cave, one scrambles down and down along a very torturous course through an immense "ruckle of boulders." Holes open up in all directions, and it is easy to go astray. One of our writers has very aptly compared a person in this boulder pile to a beetle in a heap of road metal.

When one eventually emerges from the bottom of this pile, he comes out into a big rock-strewn chamber where there always seems to be a heavy drip from the roof. A small hole then leads into "The Canyon"—a low and steeply tilted bedding plane which one slides rather than climbs down. The bottom section is best negotiated lying on one's back, and one finds all sorts of new muscles

while propelling himself downwards. At the end of the Canyon an awkward crawl round a sharp corner is known as the S-bend. There is always a puddle on the floor at this corner, and much ingenuity is necessary to avoid lying in it. Beyond this the cave continues to descend steeply, and two vertical pitches needing ladders for their descent are met.

We did not take any ropes with us on this trip, and so were unable to go down. Instead we explored a number of sections which are often passed by on a normal direct trip to the bottom of the cave. We went into two magnificent rift chambers where vertical walls, only a few feet apart, soar upwards for the best part of 100 feet. I took a photograph in one of these, and my flash powder filled the place with so much smoke that we had the utmost difficulty in climbing out again.



Flexibility! And neither end is Hooper.

We also went for some distance along a more recently discovered route which "by-passes" the Verticals mentioned above. This by-pass route was new to me and I found it very interesting indeed. It includes one satisfying but comparatively easy climb down a roughly circular vertical chimney, about 40 feet deep. For most of the way it is only necessary to straddle the hole and walk(!) down the ledges, with a wall at one's back to lean on, but the last 15 feet need more care, as the

hole gets rather larger so that the cleft is too wide to stretch across. At the bottom of this chamber one passes through two very fine rift chambers where the roof almost disappears out of sight in lofty, narrow avens. Altogether—a very enjoyable trip. The cave is impressive rather than beautiful; in fact, there are hardly any stalactites, but when I come out of it I always have the feeling that I really have been a long way down into the hills.

My wife and I are planning a trip to some of the Devon caves over the Easter holiday, and at Whitsun we hope to visit what is probably the finest of our British caves—Gaping Ghyll Hole in Yorkshire, where one starts off with a sheer drop of 340 feet. I have been down this before, but my wife has not, and I am looking forward to showing it to her.

John (3/22/47)

I didn't get home (and hence to bed) until 3:00 this morning, after an Easter week-end cave trip in Yorkshire; and, as I had to get up again at 7:00, I am not exactly feeling at my brightest at the moment.

Nevertheless, it was a good trip in spite of the distance we had to cover (about 290 miles each way), various mishaps on the journey—namely, two punctures and two "bursts," and miserable weather (12 hours of rain which nearly flooded our tents, followed by violent gales, which all but blew the aforesaid tents from over our heads!)

The cave we visited had a very picturesque name—"Bull Pot of the Witches"—and we spent about five hours finding our way through its quite complicated ramifications. It has some very fine big chambers and high rifts and ovens, and some quite good stalactite formations. Unlike most of the Yorkshire caves, it does not require much in the way of tackle and equipment, and we only needed a rope and one 20-foot ladder. Due to a misunderstanding, this ladder was taken out while some of us were still below, so my wife and I and another fellow had to climb up the "pitch" without its aid!

John Hooper.
Middlesex, Eng. (4/8/47)

Ave Atque Vale!

Don Bloch, Editor.

SOME SOLID POINTS FOR GENERAL CONSIDERATION

I DON'T REMEMBER exactly what the suggestions were that had been sent you some time ago, but following are a few other thoughts that the Board of Governors might consider discussing:

1. Dues should be raised to five or six dollars. A raise in dues is the logical first step in getting funds for an increased budget. Also the raise suggested would not be any sort of a hardship on the membership, yet it should furnish enough cash to pay for more than a full issue of the *Bulletin*. If this increased fee might cause a hardship in recruiting new members, a provision could be made which would permit a new member, just signing up, to be billed at the old rate of dues for the first year.

2. The VPI Grotto should be altered so that the student members would become full members in the NSS, pay full dues, and individually receive the *Bulletin* and the Newsletter. It is my opinion that the bulk of the student grotto membership do not have any idea of the activities, aims, etc., of the National Society, or how they might participate in the organization; and, as a consequence, a great many of them, when they leave VPI, sever all connections with the Society. At the time that they leave Blacksburg they are most valuable members because of their ability to carry the NSS into new localities. An attempt should be made to knit the student members more closely into the National organization and make them feel that they are a part of it. Requiring them to take out full membership and supplying them with publications of the Society should do the trick. Considering that they are students who don't earn much, some concessions could be made in the way of their dues.

3. It is reasonable to expect that before long the Newsletter may build up to a circulation of 1,000 or more. A publication of that size would be large enough to attract some national advertising contracts, and that would pay most of the extra cost involved in printing the Newsletter as a magazine. The Committee reports, reports on trips, and letters from members that had been appearing in the *Bulletin* could then be shifted to the Newsletter and thus make it a first-class publication. If a good number of semi-scientific articles of general interest could be attracted, the magazine could eventually be worked into a newsstand and library circulation that might pay all of the costs of printing. A program ought to be started now with the object of reconverting the Newsletter as soon as it is feasible to do so.

4. The *Bulletin*, if it is to get any scientific reputation, will have to be revamped so that it would carry only purely scientific articles that are a contribution to knowledge. Since the Newsletter would become the organ of the Society, the *Bulletin* could then be published at stated intervals as a very slender and inexpensive pamphlet. Only when it has achieved a scientific reputation would it get into wide library circulation and attract good quality papers from workers outside of the field. As a stimulus in getting scientific papers for the *Bulletin*, the Society might establish scholarships in which graduate geology or geography students who agree to write master's or doctor's theses on speleological topics and agree to publish them in the *Bulletin*, would be paid reasonable stipends.

E. L. Krinitzsky,
Norfolk, Va.

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