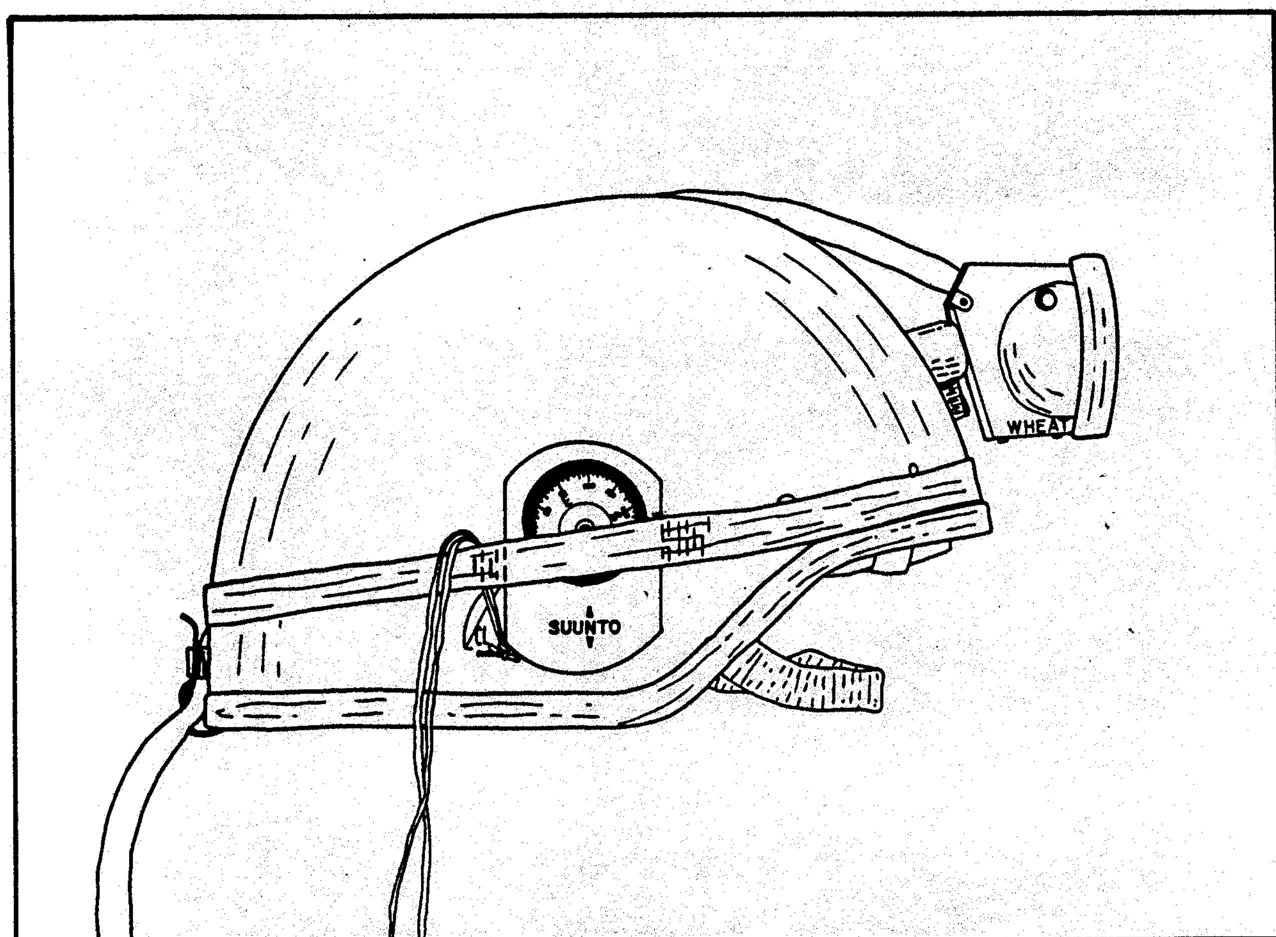
COMPASS & TAPE



Volume 3 Number 4 Spring 1986

COMPASS & TAPE

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Survey & Cartography Section - 1985/1986

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COVER: Helmet & Suunto, a drawing by Thalia D. Veve, who also designed and drafted the Compass & Tape logo at the top of this page.

CONTENTS

3-D Cave Models

by Peter Bosted
Stanford, California

What is the best method of portraying a complicated cave maze that is easy to visualize, accurate and inexpensive? Cartographers more skilled than I are continually struggling with this problem using colors and overlays in addition to the more standard plans, profiles and cross sections. Skilled artists make three-dimensional drawings, while computer hackers generate programs to portray caves on their graphics display terminals.

When faced with the problem of creating a visual portrayal of a rather unusual cave, I explored various alternatives to the pen and paper solution. I experimented briefly with cut-away block type maps (similar to the well-known map of Carlsbad Caverns) and wished I had the airbrush skills that were used in the rendering of Mammoth Cave. [See: C&T, vol 2:2, Fall 1984, p. 31. --Ed.] Even if I could draw that well, considerable visualization skills are needed for the observer to correctly interpret such renderings.

It became obvious that if I were to create a 3-D rendering of the cave, I would have to work in 3-D. I decided that the easiest way would be to make a clay model of the cave. For my first attempt, I chose a small (340 feet) cave, Music Hall, which follows two steeply dipping fissures: one to the southeast, and the other to the west. I used wire to set the shape of the cave (following the survey lines quite closely), and then covered the shape with wet modeling clay. Unfortunately, when the clay dried big cracks developed and I had to use more liquid clay to fill in the ugly lines. After making the model I realized that by using a clay which hardened after drying, I was limiting the option to extend the model should more passage be discovered in the cave.

I then decided to experiment with plastacene and was so encouraged by the ease of modeling in this medium that I was able to build a model of a complicated 4,000 foot cave (Soldiers) by learning as I went along. Aside from discovering unsuspected modeling skills, I learned a lot about the cave and with each trip to the cave my 3-D model improved.

My approach was to represent the cave passages using plastacene molded over pieces of wire. While this does not permit details of what is inside a given passage to be shown, it effectively shows the relationships of the rooms and passages to each other.

If you have any desire to create a 3-D model, the first step would be to obtain a survey and map of the cave which you wish to model. Make the plan view of the cave the same scale you will be using to make the model. When I made the Soldiers model, I chose a scale of 50 feet per inch. You could Xerox or stat the map larger or smaller to save redrawing. Most cave maps show the depths of the passages below or above the main entrance. You should find the lowest point of the cave and then convert these "elevation" levels into feet or meters ABOVE the lowest point of the cave. Write these elevations next to the passage at selected intervals. The intervals can be greater if the passage is very flat. For pits it is helpful to have profiles on hand.

Once the coordinates of every point are known, the next step is to make a wire outline of the cave. Starting with the main passages, bend stiff wire so that it follows the center of the passage (as shown on the plan view) and changes in elevation according to the elevation values. When the wire reaches a natural stopping place (as at a pit or other low point in the cave), bend it down vertically towards the base board and cut it about a quarter-inch longer. Later, this non-cave part of the wire will act as a "leg" to support your model. It is important to plan these legs ahead of time so that your model will be evenly supported. I built 8 such legs into the Soldiers model.

The wires that do not end up as legs can be "tied off" to the other main passages at convenient junctions using tape, solder or glue. (I used plastic electrical tape and epoxy.) You can minimize the amount of gluing or soldering by clever planning and doing some doubling back at strategic spots where the passage is reasonably large. Thinner, more flexible wire can be used for smaller passages, but be careful not to have too long a span of thin wire or it will sag.

Having made the grid, it is now time to apply the plastacene. Plastacene is a plastic-feeling clay that does not harden. It's very commonly used in schools and available at most hobby shops in various colors. The brand I use is 'Lite Plasteline,' which is made by the Morilla Co.,and costs about $7.00 for 5 pounds. Simply roll out cylinders of plastacene equal to the scaled down size of the cave passages and squeeze them over the wires. Use the cross sections from the survey to get the passage shapes modeled as accurately as possible. In big rooms, inserting toothpicks or bits of wire can help keep features such as narrow ceiling channels from sagging.

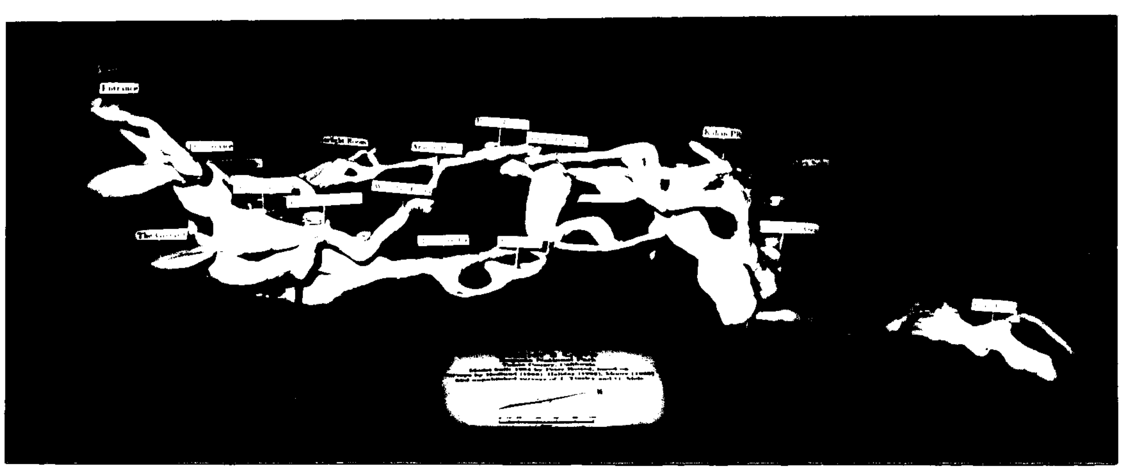
Mounting the model on a base is essential, but easy. Simply figure out where the legs should be and drill small holes for them. Once in, the legs tend to stay there and will help preserve the shape of the model. You may find that some legs can be cut off without causing the model to collapse. I used black paper to cover the base and enhance the contrast with the off-white plastacene.

Next, the rooms and major passages should be labelled. I used titles mounted on the ends of toothpicks as signposts. They are easily pushed into the plastacene. If you want to view or photograph the model from a different angle, these labels can be easily rotated. A legend with the cave name, north arrow and scale can be glued onto the base plate. I made a plexiglass case to protect the model from dust and accidental bumps.

The photos show the model that I made of Soldiers Cave using the techniques described above. Even though this was my first attempt, and the cave is over 4000 feet long, it only took about 30 hours for the whole project. Since this is comparable to the time that it would take to draw a plan and profile map of the same cave, I think more people may become interested in making such models in the future. Although they cannot be reproduced like 2-D maps, a series of photographs taken from different angles can be almost as good as looking at the model, especially if they are stereo slides.

For me, making the model was fun;seeing the cave in 3-D was enlightening; improving it is a challenge that will be with me for along time.

(from the CALIFORNIA CAVER, vol 36:2, Summer 1985, pp. 17- 18.)



Towards a Communicative Cave Report

by John Ganter
State College, Pennsylvania

A cave report transfers knowledge about a cave from one person to others. It does this by means of a description, which serves as a substitute for direct experience [11]. The description relies on a combination of four fundamental and complementary human abilities: graphics, text, numerics, and speech [1].

Graphics: provide a framework in the form of a map around which the rest of the cave report is organized. The characteristics of the cave are shown visually, and ancillary information like a scale and directional arrow relate the map to reality [7].

Text: gives a verbal, conversational account and description in language, which is of a permanent nature. References to previous, supporting or related works are provided.

Numerics: provide a distillation of the cave into simplistic terms (e.g. length, depth) which allow quantification and comparison between caves.

Speech: is direct, person-to-person dialogue. Discussion, questioning and elaboration take place, often involving the use of graphics, text and numerics as well. Speech is included for the sake of completeness and will not be discussed further.

Map Purpose

There are specific reasons why maps/graphics are employed in cave reports. They are extremely effective in the following areas.

1) Communication: maps incite a reaction in the user which corresponds to the cartographer's message [16].

2) Maps record place and time information after excessive detail has been filtered out and generalized for easier understanding.

3) Preserve both physically as an archive and conceptually as a set of relations in a users mind a cave's character [16].

Map Information

Cave maps commonly provide the following types of information.

1) Position, course and extent of a cave and its passages.
2) Relationship in space to other features and itself in a synoptic (overall) view.
3) The condition of a cave at a specified time, e.g. which areas are accessible to humans.
4) The character and contents of the passages and the nature of their relationships.

The Creation of Effective Maps: Design + Craft

After the objectives of a map have been decided upon, its success depends on two complementary cartographic abilities: design and craft. We will be talking a lot about design: it is the process of purposeful visual creation which achieves the best possible expression of the map subject [23]. Craft refers to the quality of the map execution: the line consistency, lettering regularity, lack of unwanted blemishes, etc. Craft requires manual dexterity and practice, because even the best-designed map must be translated to reality by the application of hand and eye to a drawing medium.

Symbology

One of the most important parts of communication by means of maps is symbolization, which requires a mutual understanding and agreement between the cartographer and the map user on symbol meanings and relationships [11]. The need for this mutual understanding is largely determined by the position of the map symbols on a continuum between realism and abstraction (Figure 1).

Realistic symbols are often called graphic, pictorial or iconic. They are a picture of what, precisely, is at a given place on the map. These realistic symbols have 'exhibitive import': the power to direct attention to other properties of an object besides its conventional meaning [11]. In other words, these 'symbols' are really pictures of what the cave is like. Because of our mutual understanding of the appearance of cave features, we recognize and identify them instantly [13, 19].

At the other end of the continuum are the abstract, geometrical or conventional symbols. These require a firmer understanding between cartographer and map user: they are somewhat arbitrary, and may have a limited resemblance to what they denote [2].

Symbol Scaling

Most symbols used on cave maps tend to be realistic or stylized, since the relatively large scale permits detail to be shown. However, some commonly used symbols are often portrayed at scales which are much different from the rest of the map. These will be considered before we go on to discuss appropriate symbolization.

The common portrayals of stalactites and clay (Figure 2) serve as an example of differing scales. The stalactites are drawn to scale: they are in proper proportion to their surroundings and thus there is little opportunity for the conceptions that the cartographer and the map users have of 'stalactites' to differ.

The clay symbol is a realistic, but greatly enlarged, pictorial representation of the tiny, platey structures that compose clay. As a result, it does not look exactly like a clay surface in an actual cave. Nonetheless, it seems to work fairly well because the fine dashed lines coalesce visually into a smoothly homogenous area, which is what clay looks like to the caver.

Problems may arise with exaggerated symbols, particularly when they denote features which are discrete or single. Cave coral is one example. In reality, these formations are usually less than one-inch long, but if they are portrayed on a map they are greatly enlarged. The result can be a visual distraction of the map user from the more important features being portrayed on the map. There is also the problem of quantitative information. When cave coral occurs, it is usually in expanses with hundreds to millions of individual pieces. If all this was portrayed, the map would be completely illegible. In the case of these tiny, extensive or ubiquitous features, it may be best to simply mention in the text description of the cave that they exist.

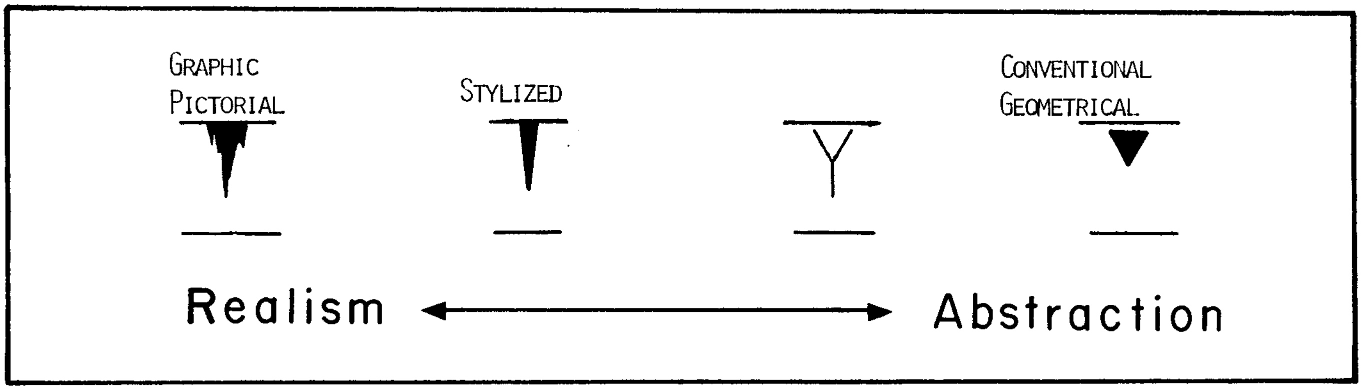


FIGURE 1: "A STALACTITE", ON A CONTINUUM FROM REALISM TO ABSTRACTION

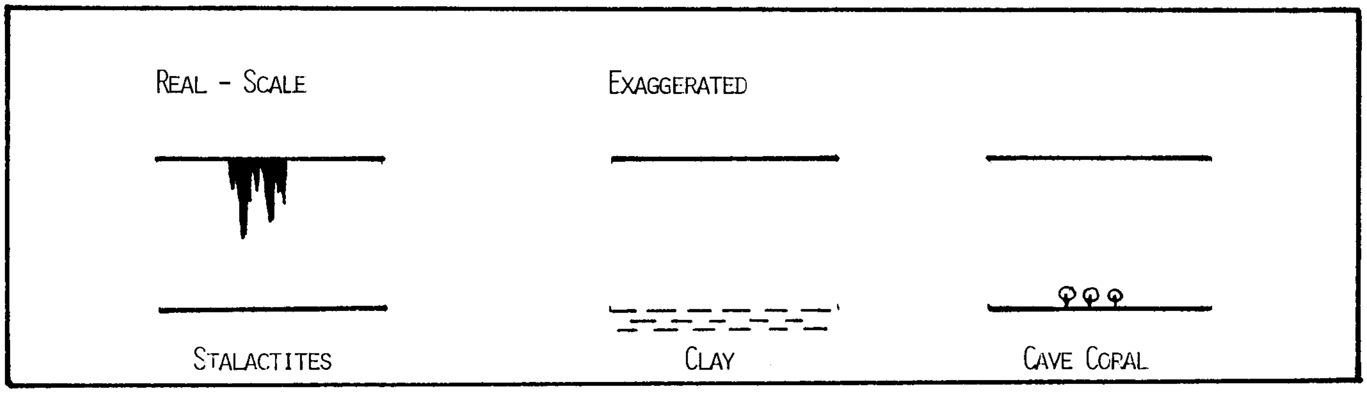


FIGURE 2: REAL-SCALE AND EXAGGERATED SYMBOLS/FEATURES

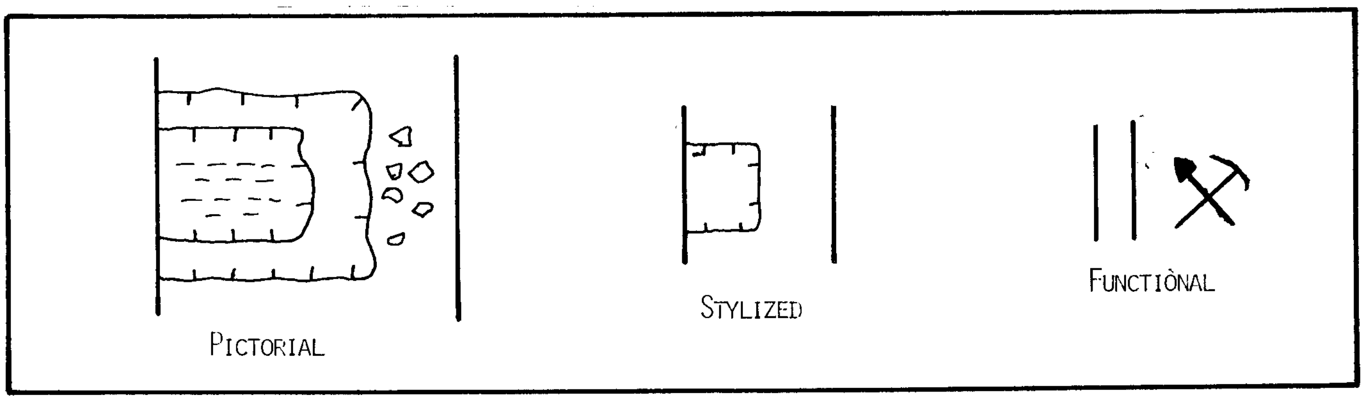


FIGURE 3 : THE EFFECT OF SCALE ON SYMBOLIZATION, IN THIS CASE A MINE.

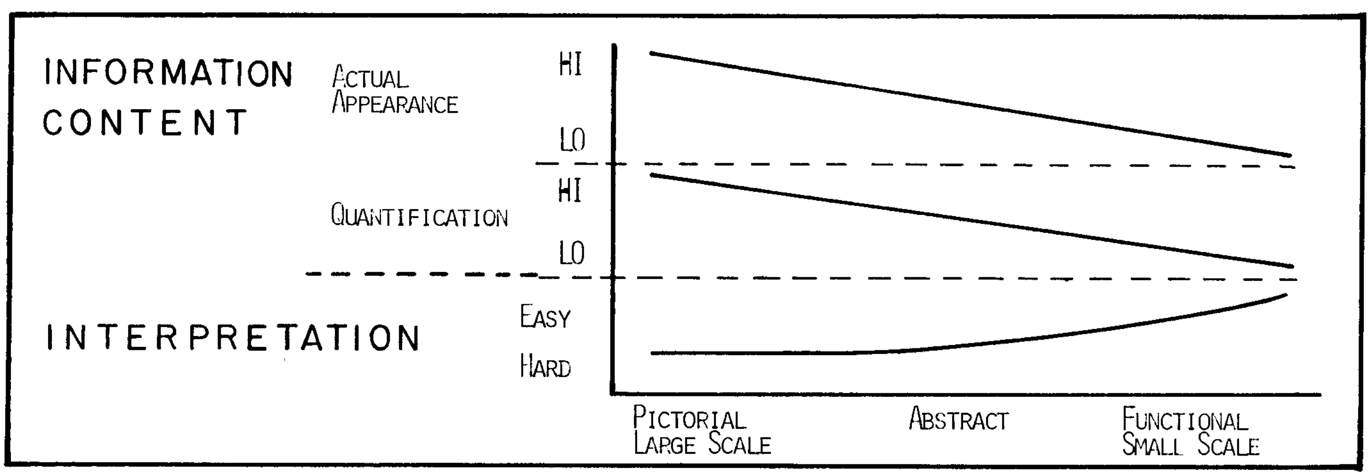


FIGURE 4: HOW SCALE AND THE DEGREE OF REALISM/ABSTRACTION EFFECT A MAP'S COMMUNICATIVE ABILITY AND EASE OF INTERPRETATION

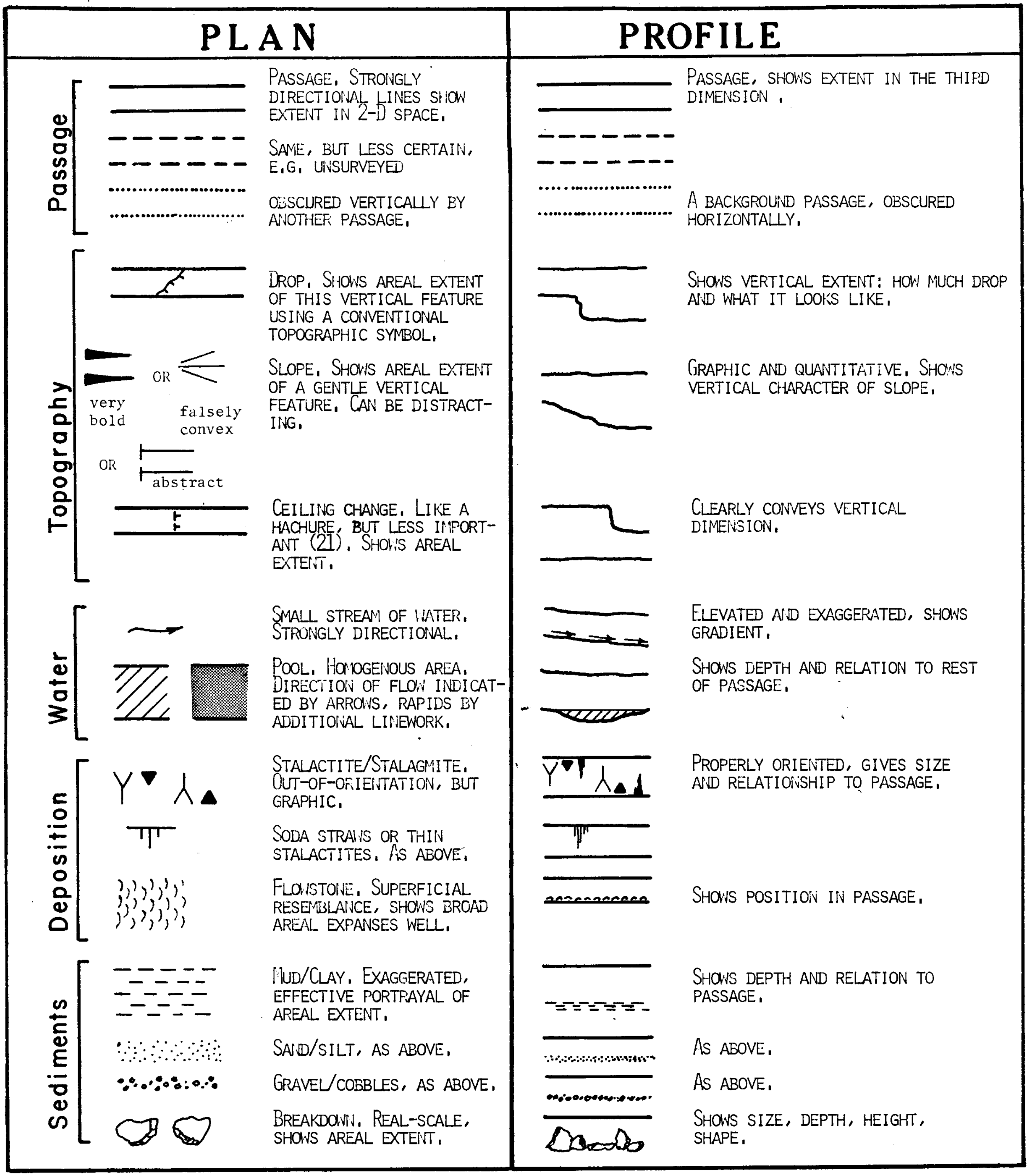


FIGURE 5: SOME CONVENTIONAL CAVE MAP SYMBOLS, WITH COMMENTS ON USE AND EFFECTIVENESS.

Effect of Scale on Symbolization

The question of appropriate symbolization, i.e. the choice of where one's symbols will lie on the continuum between realistic and abstract, depends intimately on the scale of the map. At a large scale, pictorial detail of small objects and features is possible, while at smaller scales the symbols must be abstract and simplified. An example might be a saltpetre mine in a cave (Figure 3). At a large scale, pictorial details of the actual excavation are possible. As the scale becomes smaller, the representation becomes more stylized and abstract, to the point that the symbol may represent an associated function (e.g. a pick and shovel for a mine) instead of what actually exists [10]. At each level there are tradeoffs (Figure 4). Large scale, pictorial representation shows the actual appearance and quantitative aspects (e.g. size, area, etc.) very effectively, yet it places substantial interpretive burdens on the map user. The solution is obvious: tell the user what the feature is, either with text on the map, in the written description, or both. At smaller scales the actual appearance and quantitative aspects will be diminished, but the interpretability puts little strain on the map user: they can simply consult the map legend.

Conventional Symbology

A number of sets of 'Conventional Signs' have been proposed [8, 22] and adopted to varying degrees. A short list of those which seem most popular and useful (Figure 5) will be discussed here in an attempt to get the reader thinking about how symbols work and the pros and cons of their various forms. The discussion takes place within the figure.

This is also an appropriate time to discuss symbol orientation. The figure is divided into plan and profile areas, reflecting the fact that many features are best shown in one view and not the other. Objects can in general be viewed from two aspects: plan and profile. The plan is a view wherein objects and features are projected to an imaginary plane perpendicular to gravity. A profile displays the third dimension of height or depth above and below this plane. The way in which an object or feature is normally viewed affects the choice of symbol [10]. The stalactite discussed earlier, for example, is viewed normally from the side, in profile. Thus this effects the symbol which we find conveniently representative of a stalactite.

Unfortunately, applying symbols which are essentially profile views to the plan (or vice-versa) can be distracting. The solution is to show these features in profile in different map views, which will be discussed later.

Appropriate Symbolization

Choices of symbology involve potentially difficult decisions for the cartographer. In order for a map to work, the user must perform three tasks in acquiring, organizing and using the knowledge therein [11]. These tasks are:

Detection: seeing what is there.
Discrimination: distinguishing between detected things.
Identification: establishing a correspondence between the symbols discriminated and their associated meanings.

The way in which the cartographer helps the map user to perform these tasks will depend on map scale (which will be discussed further), the intended audience and their abilities, symbolic conventions and the cartographer's ability to produce pictorial or geometrical symbols. Throughout, the problem of real-scale vs. exaggerated symbols will appear. 'Conventions' will continue to evolve and change as people's tastes and ways of looking at the world grow.

Viewing Conventions

As complex three-dimension voids enclosed in rock, caves do not lend themselves to depiction on flat media like paper. The only way in which this can be accomplished is by means of multiple views of the cave, which are absorbed and combined in the mind of the viewer to produce a mental model of what the cave is like. These views are projections onto the three imaginary planes of the space within which we exist (Figure 6). Each view is complementary to the other two. As a cave becomes deeper, the amount of information contained within the profiles increases and that of the plan decreases (Figure 7).

The Plan is projected to a level plane normal to gravity: it effectively displays the areal extent of the cave, and is thus analogous to most other maps which humans make use of.

The Longitudinal Profile shows the vertical extent of the cave and its relationship to the topography of the earth surface above. The term 'longitudinal' or 'axial' is arbitrary and simply refers to the profile which is longest, i.e. that which shows the most [22].

The Latitudinal Profile shows the remaining dimension of the cave. This profile, also called 'radial', is often deleted from cave maps, but can display valuable information which is lost in the plan and longitudinal profile.

The Cross Section is a local profile, a 'slice' through a cave passage, or adjacent passages, which allows the map user to see what the passage looks like from the inside. Cross sections are extremely effective, but have the potential to seriously disrupt the visual qualities of a map. Unlike the profiles, which are separate areas of the map sheet onto themselves, cross sections are usually scattered about the plan view, so that they may be easily associated with the area they refer to. Problems arise when these somewhat 'out-of-place' map parts detract and interfere with the plan portion of the map. One solution to this problem is moving the cross sections to their own area, and keying them, usually with letters, to the location on the plan to which they refer. This is effective, but requires the map user to switch back and forth between plan view and cross sections, and to search alphabetically.

Other common problems with cross sections are as follows:

Universal cross section orientation: Cross sections must be oriented consistently so that down in the cross section is down on the map sheet. The reason is that the plan view can be scanned by the map viewer in any direction on the map sheet, with gravity always into the paper. The plan view is thus always oriented 'correctly', even though the passages may run in all directions. This is not the case with cross sections. Since these are slices made in parallel to gravity, they have a definite direction and it must be consistent throughout the sheet (Figure 8).

It should also be kept in mind that cross sections are separate and subordinate to the plan view. For this reason, they should be de-emphasized in terms of line weights: this will be discussed further under 'Visual Hierarchy.' The plan should 'float' as a distinct form on the map. For this reason, the lines indicating where the section runs must not actually be drawn through the plan, nor should they touch it. The viewer's mind draws a conceptual line, yet is never distracted by an actual physical line chopping through the plan [23].

Grouped cross sections: The value of cross sections can be increased greatly if they are grouped together (Figure 9). This has the advantage of showing the distance,

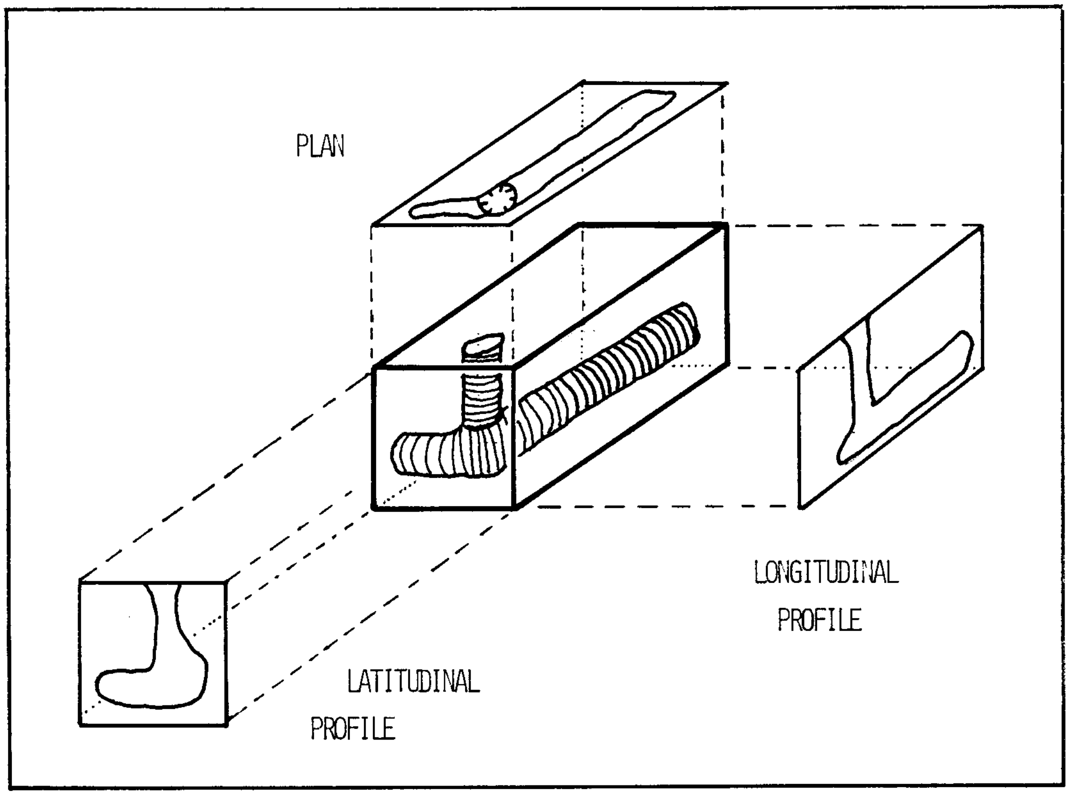


FIGURE 6 : CAVE VIEWING CONVENTIONS; PLAN AND PROFILES

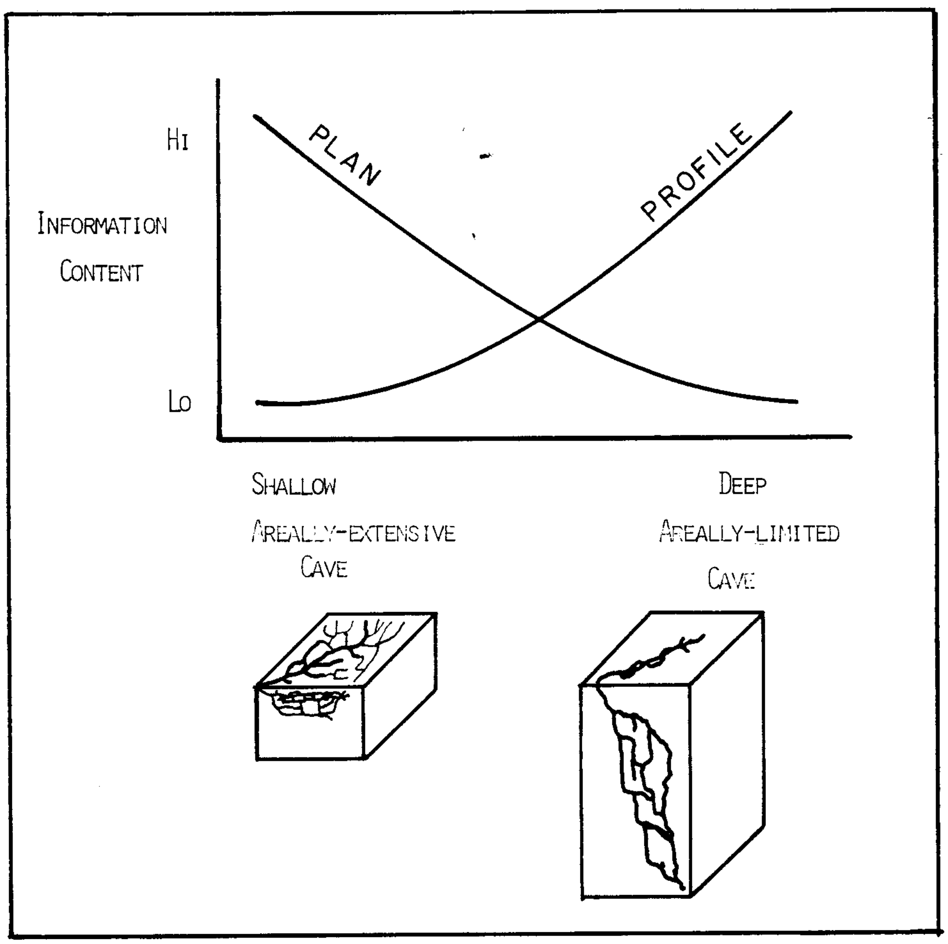


FIGURE 7 : HOW THE INFORMATION CONTENT OF PLAN AND PROFILE VARY WITH CAVE TYPE

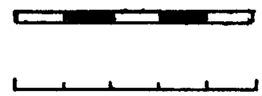
both horizontal and vertical, which separates the sections. It can also be a much more efficient use of space and viewer attention, particularly in reducing clutter. Sections should not be placed in blank areas of non-cave enclosed by passages, as will be discussed under 'Figure-Ground Contrast'.

Ancillary Information

There are several types of map information which are not represented by symbols, but with words, numbers and simple graphic devices like lines and arrows.

Scale: The scale displays the relation of the map to the reality which it represents, specifically the equivalence between distance on the map, and distance in the cave.

$$\frac{\text{Map Distance}}{\text{Cave Distance}} = \text{Numerical Scale}$$



Maps are considered large or small scale depending on the relative size of this fraction. A large scale map shows detail over a small area: the map features are a large fraction of their real size. A small scale map is more generalized, but covers a broader area: its features are a small fraction of their real size.

It is very important for a map to have a graphic or bar scale, since it is impossible for people to visualize fractions. A graphic scale translates real distance in the cave to a tangible 'seeable' distance on the map. Sample bar graphic scales are shown above [14]. They have the additional advantage of changing size along with the map if it is enlarged or reduced. It is suggested that bar scales display both English and metric units, so that they may be easily interpreted by the greatest number of users.

Directional arrows: The directional arrow is similar to the graphic scale in that it relates the map to reality: in this case the orientation of map to cave, and the cave to other caves, local landforms and the world in general. Most map users are used to seeing the top of map sheets correspond to north, an obvious aid to orienting oneself to familiar world-scale features like continents [20]. Since cave maps are for the most part novel viewing experiences, this is not as important and the cartographer can rotate the cave in order to best display its form and shape.

There is an unfortunate tendency among cave cartographers to produce dramatic and ornamental directional arrows. This is destructive, because the arrows are simply ancillary information and much less important than other features of the map which they draw attention away from. Individual arrow styles are a matter of personal preference, but they should be clean and simple. The particular north should be specified, and indication of magnetic declination is desirable if there is any chance that further survey could take place in the cave.

Legend: The legend, or key, is the area of the map sheet where language, ideas and concepts are equated to visual symbols. It initiates those unfamiliar with cave maps, or a particular mapping style, to the conventions being used, and brings the viewer's knowledge and ideas into conformance with those of the map maker.

Text: There are several types of information which must be conveyed with text, either in a written report or, as we will discuss here, on the map sheet itself. Typically, they are:

Cave Name (a proper noun for identification)
General location (cultural setting)

Surveyors (who recorded the cave)
Date surveyed (when this took place)
Instrumentation (the equipment used in measuring the cave)
Features (place names on the map)

This language text is produced by means of lettering, or typography. It is important for the lettering to be 'invisible': it must not intrude itself between the map reader and the thought or information being expressed [4]. Lettering has a strong effect on the appearance of the map and how the user feels about it [15]. Cave maps should be authoritative: they are portraying a complex geological form. Fanciful, decorative or calligraphic styles of lettering are thus inappropriate: they should be reserved for advertising, and formal or intimate social interaction where mood and emotion are as important as factual content [5].

Effective type has the following requirements [9]:

1) It must be easily read and discriminated.
2) It must not disturb other map contents.
3) It should assist in establishing a hierarchy of map features, by means of style and size.

There are two general styles of lettering which are appropriate for cave maps [4].

Roman: dignified, classical and extremely legible. The serifs (the small curls on the letters) facilitate a horizontal flow as the map user reads, and also help to identify the individual letters.

ABCDEFGHIJK

Sans Serif: clean and contemporary, this style is uniform, efficient and factual. It is somewhat more difficult to read for extended periods. The use of lower case letters (instead of all capitals) produces distinctive word shapes and thus makes reading easier in all styles.

ABCDEFGHIJK

Numerical Information: Numerics are often included alongside the cave map in order to give the viewer a number to go with the image being conveyed. This practice is becoming less popular because of the potential for 'noise': clutter and distraction which pull the viewer's attention away from the more important contents of the map. The heights and depths shown here for an example can often be shown quite effectively on profiles and cross sections [19].

5	$\boxed{10}$	$\underline{20}$	$\overline{30}$
Ceiling Height	Drop Length	Height above	below entrance

Summary Numerical Information: The cartographer can provide useful summary information about the cave, commonly in the form of length and depth [3]. This provides a simplistic quantification of 'how much cave there is', and can:

1) compensate for confusion over scale.
2) compensate for deceptive passage configurations, e.g. complex mazes.
3) allow quantitative comparisons between caves and cave areas.

Map Types

By now the reader is probably wondering how one map could possibly be expected to communicate all of this information to different people having various needs. The answer: one map can't. The choice is either to compromise part of the information and thus possibly part of the audience, or to make multiple maps. There are two broad types of multiple maps that one can make.

Multiple scale maps: It is often desirable to give an audience maps of different sizes, so that they can consider a cave in a broad context, then in specific detail. For example, one might provide:

1) a small scale outline of the cave passages overlain on a topographic map, in order to convey the general layout and setting in relation to the local topography and landforms.

2) A medium scale map showing place names and major features, which will permit the user to organize in their mind a framework around which detailed knowledge can be assembled. This scale map might, for example, have the pick-and-shovel symbol at a saltpetre mining site, and other abstract symbols to tell the user that "there is a feature known as a _____ at this point in the cave." Notice that at this scale the user is not overloaded with details about the particular feature, and that the map is not disrupted visually by attempts to show too much information.

3) A large scale map: at this scale, the user can gain knowledge about passage characteristics, floor detail, etc. Continuing our example, the entity known previously as 'a mine' would now have shape and dimension, permitting the map user to make further interpretations about what went on there.

Special Purpose Maps: In order to avoid the mess that can result when many types of information are displayed on one map, a series can be made to express different themes. Special symbols, with identifying legends can be provided, and subsidiary detail can be reduced and generalized. Theme maps might be on the following areas, or combinations thereof:

1) Archeology
2) Biology
3) Geology
4) Hydrology
5) Paleontology

Special Considerations in Making Effective Cave Maps

Theorizing aside, there are two problems which often occur in cave maps which reduce their effectiveness greatly. Often a map which just looks 'messy' or hard to understand is one which has no clear visual hierarchy and/or lacks figure-ground contrast.

Visual Hierarchy: It is a simple fact that someone viewing a map can't attend to it all at once: the short-term, active part of our memory, in which so much of the thought process occurs, has a limited capacity [11]. Realizing this, the cartographer must try to design the map so that the most important subject matter appears graphically to be in the foreground, while less important and supporting information appears in the background at a lower visual level [10].

This can be done quite consciously in both graphics and text by varying line weights, symbol size and density, and lettering size and style [6, 18]. The first step is for the cartographer to prioritize the elements of the map. For example, he or she might

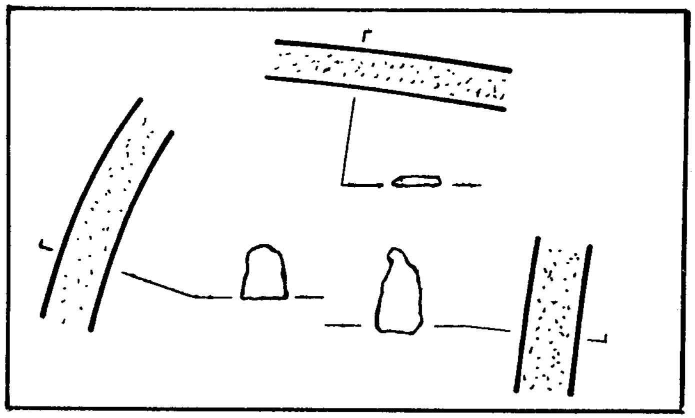


FIGURE 8 : CROSS SECTION ORIENTATION SHOULD BE CONSISTENT.

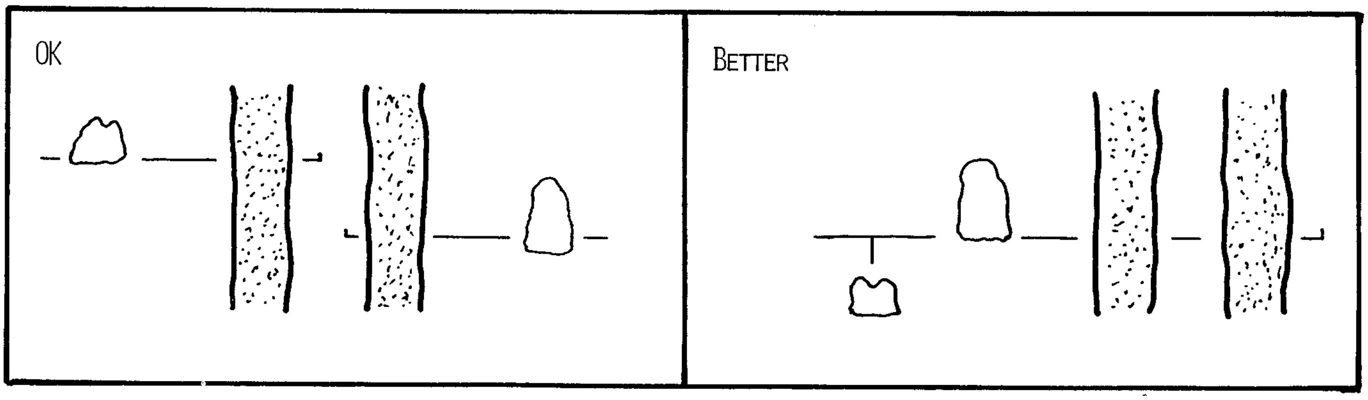


FIGURE 9 : HOW CROSS SECTIONS CAN BE GROUPED IN A MORE EFFICENT AND INFORMATIVE MANNER.

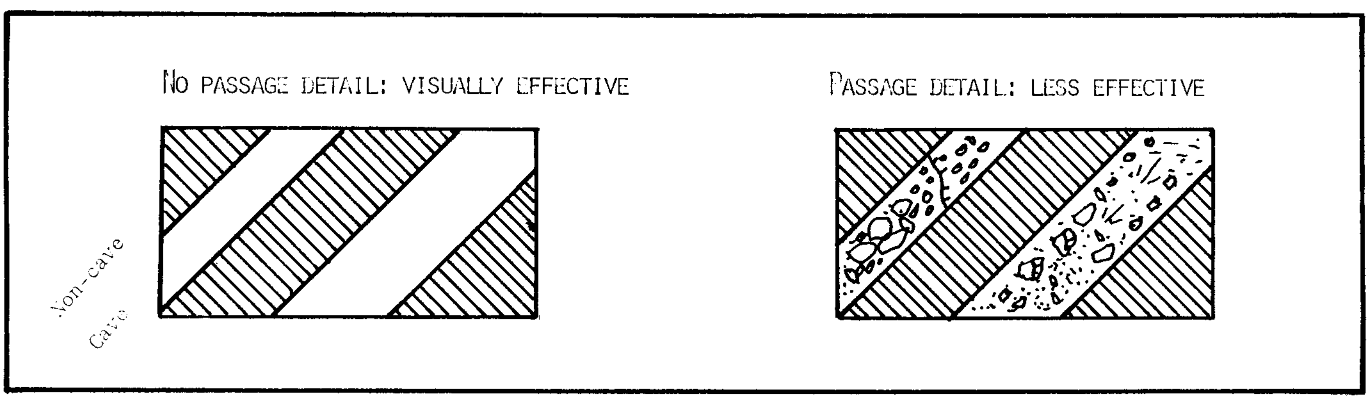


FIGURE 10 : HOW THE CAVE/NON-CAVE DISTINCTION IS AFFECTED BY THE PRESENCE OF PASSAGE DETAIL IN A SCHEME WHERE NON-CAVE IS REPRESENTED BY A DARK OR 'POSITIVE' FORM.

decide that they are, from most to least important:

1) main passage outline
2) secondary passage outlines
3) floor topography
4) floor sediments
5) ancillary information

In thinking this way, the cartographer will design a map which is naturally organized for quick and efficient processing by the map viewer, who will comprehend it without ever consciously reacting to its careful organization.

Figure-Ground Contrast

This term refers to the fundamental problem which cartographers have in distinguishing (providing contrast) between the cave (the figure) and non-cave (the ground or background). The cartographer generally works with black ink on a background of white. Black is considered to be a 'positive form': it denotes a cave or cave feature [23]. (Note that we map the contents or boundaries of a cave, not the void or 'nothingness' itself.) A white form is negative: it means no cave or no information, which, of course, is information in itself [17].

One solution which has occasionally been tried is to shade or darken the non-cave area in order to highlight or accentuate passages in areas of complexity. This can cause a very strong black/white contrast which is bold and distracting to the viewer [11]. The other problem is that any attempt to show passage detail begins to reduce the cave/non-cave distinction (Figure 10). The opposite solution is to have a moderate amount of detail throughout the map, which will identify what is cave and what is not. There will be some reduction in the prominence of non-cave areas which are encircled by passages, but the map viewer should be able to distinguish them with little difficulty in a well-designed map.

Another area where figure-ground contrast becomes important is where ancillary information, like numerics or cross sections, is shown with the plan map. If this is not included in moderation it will seriously disrupt the more important plan information by making the non-cave areas so cluttered and 'noisy' that the viewer becomes distracted [12].

Conclusions

This discussion has not been intended to tell people how to draw maps. Rather, I have tried to raise some simple, but sometimes unobvious, points about how we see and comprehend the various forms of communication with which we are constantly bombarded. By working with, rather than against, these constraints, cartographers can produce effective maps. Keep asking your audience: Do you understand? Does this work? Listen and fine-tune your techniques, and you will produce communicative cave reports.

[This article amounts to a draft of what will hopefully evolve into a more complete, better illustrated essay. Your comments and criticism would be greatly appreciated. John Ganter, 1016 Taylor St, State College, PA 16801.]

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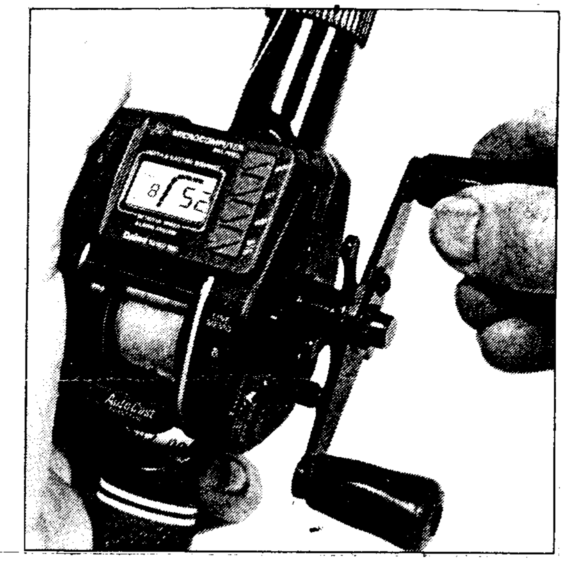
Alternative Measuring Devices

Bill Torode

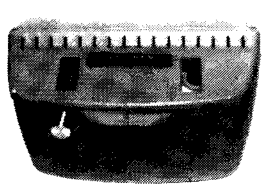
Daiwa Digital Fishing Reel

Daiwa Reels has gone high-tech for fisherman: their computerized PT10E spinning reel has a LCD digital readout which indicates the amount of line which is out and its rate of retrieval. Conceivably, cave surveyors could use the device ($189 in Sears boating and fishing catalog) in place of standard measuring tapes. Daiwa Reels Corp., 7421 Chapman Ave., Garden Grove, CA 92641. (from POPULAR SCIENCE, March 1986, p. 39.)



The Hip-Chain

This is a small box worn at the waist which dispenses and measures a thin thread. The user ties the thread off to any convenient object and starts walking. At the end of the traverse the distance is read and the thread broken off. Quick and handy, particularly for solo surveyors. The thread will eventually degradein sunlight, but must of course be removed from caves. The Hip Chain is available in meters, feet, and yards models, weighs about a pound, and has a maximum range between resets of 3,000 to 30,000 feet, depending on the model. Thread costs $3 - 4 for 9,000 feet. Price is $100 - 130. Available from: Ben Meadows Co., 3589 Broad St., Atlanta, GA 30366. or Forestry Suppliers, Inc., PO Box 8397, Jackson, MS 39204. 800-647-5368.



Surface Sensing of Caves: The Petro-Sonde Service

by John Ganter
State College, Pennsylvania

Late this spring I was passing through San Antonio, Republic of Texas, and dropped in for a Bexar (that's pronounced "Bear") Grotto meeting. The program topic looked most interesting: we were going to hear about a system for detecting voids in the earth which --get this-- was not related to any existing seismic, resistivity or gravitational methods. I smiled and didn't say nuthin'.

The usual business, trip reports, and discussion completed, Ms. Sarah Reid of Geophysics International was introduced and began her presentation. Promptly, the projector bulb burned out. Unfazed, Ms. Reid went on to deliver a very interesting talk. Here's the scoop.

The Petro-Sonde device is a passive geophysical instrument which detects and amplifies electrical fields. When solar radiation strikes the ionosphere the resulting distortion causes electromagnetic waves to pass into the earth. These waves travel vertically until they reach a change in conductivity corresponding to a change in lithological composition, porosity or mineral content. A new electromagnetic pulse is generated at this conductivity contrast and radiates to the surface, where it is detected by the Petro-Sonde. The frequency of this re-radiated pulse is a function of the depth at which it originates.

The device is operated by a highly practiced geologist (Fig. 1) who, wearing earphones, interprets the audible tones which correspond to differing lithologies at different frequencies/depths. Once the device is calibrated for a particular area and feature(s) of interest, it can be moved around and the operator will manually produce a graph (Fig. 2) at each location. A great range of depths (0 to 40,000 feet) and materials (oil & gas, coal, metallic/non-metallic minerals, voids, etc.) can be targeted.

Bexar Grotto got into the act when Geophysics International began looking for a cave to test the device on. The cavers were rather skeptical, but arranged for a test at Robber Baron Cave, a well-surveyed maze located under an attractive residential neighborhood in San Antonio. GI geologist Eric Jones met cavers Kurt Menking and Randy Waters above the cave and the fun began. After a calibration over an area where the size and depth of the passage was specified, Mr. Jones was put to the test. He was told there was no passage at one spot, but insisted there was and gave its dimensions: the cavers finally admitted he was right! This went on for some time, but Mr. Jones and the Petro-Sonde were impossible to fool.

Figure 3 is a sample Petro-Sonde profile, with the cave features drawn in by Randy Waters. Mr. Jones said that there was a void between 44.2 and 49.5 feet: the cave survey indicates that it's between about 40 and 44 feet.

So the Petro-Sonde seems to work, and work well. The possibilities are endless, but there's a catch. The device is proprietary and requires a very skilled operator. Cost? Around $3,000 per day. If you're interested in more information, contact: Ms. Sarah R. Reid, Geologist, Geophysics International, 9441 LBJ Freeway, Suite 504, Dallas, TX 75243. 214-699-9378. 1-800-527-7004.

Figure 1: The Petro-Sonde device in use.

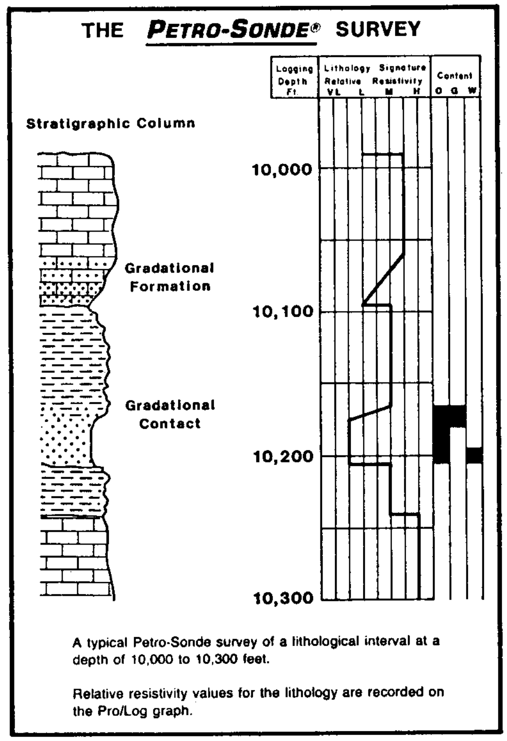


Figure 2: A sample Petro-Sonde profile showing relationship to lithology.

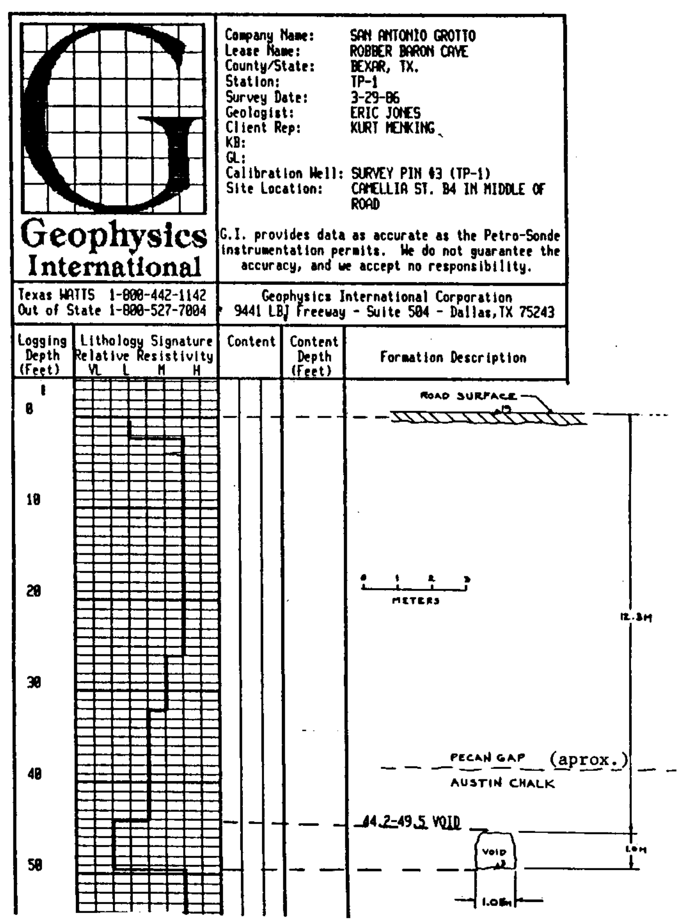


Figure 3: A Petro-Sonde profile at Robber Baron Cave, Texas, showing relation to cave passages.

(Illustrations from Geophysics International literature.)

Cartographic Salon Summary, 1978 - 1985

by Ernst Kastning
Radford, Virginia

No.	Year	Chair	Categories	Cartog-raphers	Maps Entered	----- Awards ------ M	HM	MED	SPEC
1	1978	JK	7	?	?	7	7	1	1
2	1979	AP	4	?	?	4	0	1	2
3	1980	EK	3	16	21	3	3	1	0
4	1981	EK	5	30	66	8	13	2	0
5	1982	EK	3	8	18	2	8	0	0
6	1983	EK	4	15	29	3	5	1	0
7	1984	EK	4	17	33	5	6	1	1
8	1985	EK	4	18	40	11	12	1*	0

Notes:

Salon Chairs: JK = Jan Knox
AP = Art Palmer
EK = Ernst Kastning

* = renounced

Awards: M = Merit (Blue Ribbon)
HM = Honorable Mention (Green Ribbon)
Med = Best of Show (Medal)
Spec = Special Awards (various)

All maps entered were exhibited at the Convention.
The 1981 Salon was that of the International Congress of Speleology.

IN CASE OF FIRE --

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SACS Events 1986 NSS Convention, Tularosa, New Mexico

Paper Session: Monday, June 23: 8:30 am to Noon, Guadalupe Room.
Section Meeting: Noon to 1 pm, location to be decided.

9th Annual Cartographic Salon

The entry procedures and rules for this event remain unchanged from last year. They can be found in the April 1985, NSS NEWS or the May 1986, ADMINISTRATIVE MEMO or can be obtained from Ernst Kastning, Cart Salon Chair, P.O. Box 1048, Radford, VA 24141. Submissions can be mailed to Ernst or brought directly to the Convention.

The Editor thanks...

The following people who have written articles, sent clippings, given advice, etc. C&T has made it through yet another year thanks to your efforts.

Cal Alexander
Ellen Bartsch
Peter Bosted
George Dasher
Mike Dyas
Mike Futrell
Tyler Groo
Paul Hill
Jim Hixon
Frank Hutchison
Jim Kennedy
Lance Lide
Phil Lucas
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