SOLUTION AND DEPOSITION OF CALCIUM CARBONATE IN A LABORATORY SITUATION II†

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This article is the second in a series of interim reports on attempts to produce cave-like $CaCO_3$ structures, i.e. simulated stalactites and stalagmites, in the laboratory. The effects of such things as differences of temperature, and acetic acid in the water, were investigated. It was found that it is indeed possible for limestone to be dissolved, and the $CaCO_3$ later precipitated, very quickly.

It is evident that this matter of dripstone must be investigated in conjunction with the process of formation of caves, and also the formation of limestone. Some suggestions are made about these matters; clearly more research is needed.

Original Laboratory Apparatus

The laboratory apparatus used to obtain the results reported previously[1] is shown in Figure 1. The solution box on the left contained chunks of Indiana limestone. Demineralized water and CO_2 were introduced into the solution box from the top through separate pieces of tygon tubing. The water was allowed to drip into the container from a large plastic bottle. A pinch clamp on the entrance water hose controlled the water drip rate. The tygon tubing through which the CO_2 flowed was coiled at the bottom of the solution box. Many very small holes in the tubing allowed the escape of the gas through the coils. Gas bubbles rose up through the water and around the limestone chunks.

The precipitation box is on the right in Figure 1. It was connected to the solution box by two pieces of tygon tubing. The upper tubing allowed excess CO_2 from the solution box to go into the precipitation box to maintain a CO_2-rich atmosphere there. The lower piece of tubing was used to transport the water-calcium bicarbonate solution into the precipitation box. The rate of flow was controlled by an adjustable pinch clamp. Twelve strings, prepared as previously reported,[1] were suspended below the solution box. The strings were knotted in holes in the box and the solution drips down them. A fan provided air movement around the strings.

In the natural situation, a calcium bicarbonate solution would have moved as droplets or as a small stream over a large amount of surface area. This would allow the necessary time to lose CO_2 and cause the precipitation of $CaCO_3$. The strings were intended to simulate a six inch path for a droplet to travel before it fell into a pool of water below the strings.

Excess Supply of Carbon Dioxide

Experimental equipment was arranged to ensure that excess CO_2 was present at all times to go into the solution in the water. The volume of the box (216 in.^{3}) was the total volume allowed for the solution process; whereas natural soil water might pass through jointed limestone for miles, dissolving material before finally entering a cave.

It is felt that the solution water did not contain an unnaturally large amount of CO_2 as compared to soil water that enters and dissolves limestone. For instance,

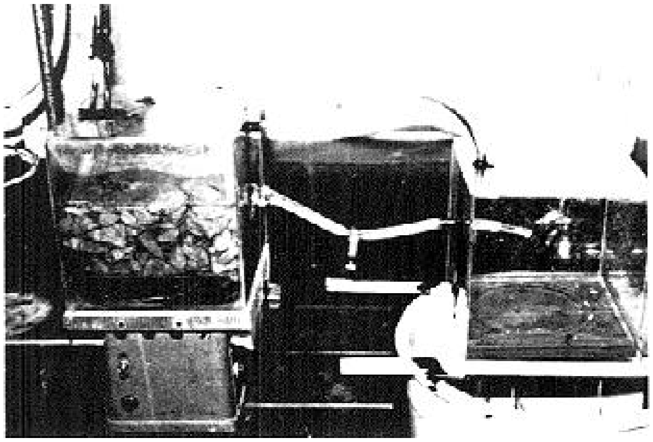

Figure 1. Two-part experimental apparatus (Figure 1 of Reference 1 was a schematic representation of this apparatus.)

Adams and Swinnerton[2] have claimed that air from humus-poor soil contains at least 25 times as much CO_2 as atmospheric air. Air from humus-rich soil contains 90 times, and that from recently manured soil 250 times that of atmospheric air.

It was found in India[2] that under monsoon conditions, CO_2 in soils rose 16-20% in cultivated, forest, or swamp soils. This suggests that CO_2 may be selectively absorbed by soils. When the air supply to soil is cut off by excessive rain the CO_2 content may rise to very high percentages. It has been noted that CO_2 content of soil rose 167% after a rain.[2] Adams and Swinnerton concluded that ". . . soil generates CO_2 in sufficient abundance to yield enriched CO_2-water solutions of the appropriate dissolving effectiveness."[3]

In investigating the CO_2 content of water at three separate cave locations, Holland, et. a1.[4] found that soil water adsorbed large amount of CO_2. At Luray Caverns water entering the cave contained so much calcium and magnesium that, if solubility data for dolomite was correct,[5] it would require impossibly high CO_2 pressures in the soil zone. It was felt that the capacity of rain water to dissolve limestone increased by more than two orders of magnitude during passage through the soil zone.[6]

Water has been analyzed in Luray Caverns after a rainstorm had occurred the night before. The water contained one-half of the maximum amount of calcium and magnesium ever observed in a sample during the study.[7] Bögle[8] has stated that soil air contains 10-100 times as much CO_2 as atmospheric air. He felt that CO_2 was supplied by plant respiration and decay of humus. Free air contains 0.45mg of CO_2 per liter at 25°C

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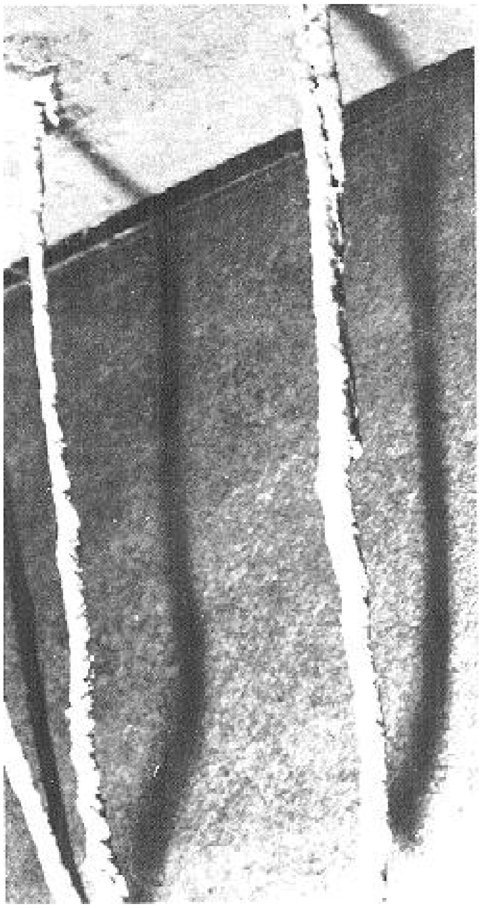

Figure 2. Strings exposed to a dripping solution for 700 hours.

whereas air near the surface of the earth has been found to contain 2.5mg CO_2 per liter at 22°C.[9]

It is clear that water percolating through soil can pick up enormous amounts of CO_2. Such water can dissolve large amounts of limestone and precipitate it later. Therefore the laboratory apparati used in this study may not supply enough quantities of CO_2 to duplicate natural conditions. Certainly there is not an overabundance of CO_2 in the test water.

Cave Formation

Although the original purpose of this project was to determine the conditions under which stalactite and stalagmite-like structures could form rapidly in the laboratory, it became obvious that cave formation must be considered also. Therefore both cave formation and $CaCO_3$ precipitation will be discussed in this article and a tentative model will be proposed to include both.

Jointed Limestone and Cave Formation

As mentioned earlier, it is assumed that as water moves through jointed limestone it enters a cave and $CaCO_3$ precipitates from the water. Moneymaker[10] observed from his studies in the Tennessee Valley that limestone formations extensively jointed were more cavernous than the less jointed limestone a few miles away. Swinnerton[11] claimed that the absence of joints in limestone does not allow the concentration of water flow to one particular area and accounts for the absence of caves in porous rocks.

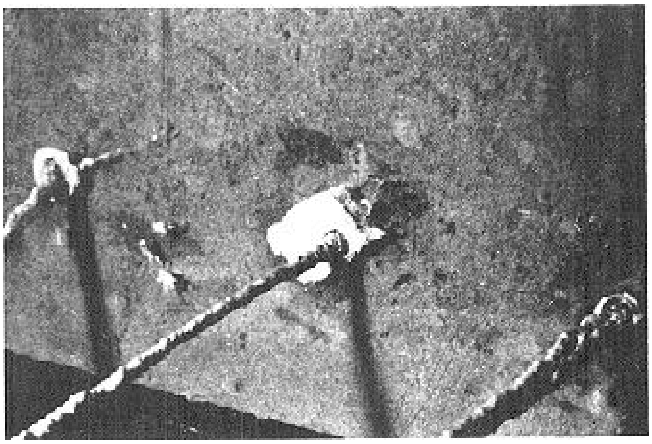

Figure 3. Precipitate on plastic box around strings.

It may be considered questionable that water-filled conduits in limestone leading to a cave would not eventually be closed because of the precipitation of $CaCO_3$ in the conduit itself. Bogli[12] stated that the gas phase (CO_2) is not present in the conduit; and all of the materials in solution, even if it is highly concentrated in $CaCO_3$ remain in internal equilibrium. So $CaCO_3$ does not precipitate.

Went[13] reported that stalactite growth is only possible in a ventilated cave because the CO_2 concentration in the cave atmosphere must be lowered to get the bicarbonate-carbonate equilibrium shifted so that the carbonate will precipitate. Obviously, if this is true, there would be no chance of $CaCO_3$ precipitation in water-filled limestone conduits.

Precipitation of Calcium Carbonate

The use of demineralized water and CO_2 as a test solution resulted in the solution of some of the Indiana limestone and the subsequent precipitation of $CaCO_3$ on and above the strings in the precipitation box.[14] Some of the precipitate can be seen on the strings and on the plastic box in Figure 2. A close-up of the precipitate on the plastic box is seen in Figure 3. No photographs are available of the strings that were used with the NaCl-CO_2-H_2O test solution.

Use of Acetic Acid Solution

A series of experiments was run using 1% acetic acid, CO_2, and water to simulate humic acid solutions. It is known that humic acid can dissolve concrete.[15] Murray and Love[16] claimed that organic acids formed by bacterial decomposition of humus have the same effect as carbonic acid ($CO_2 + H_2O$) in developing caves in limestone. They allowed dry leaves inoculated with bacteria to stand in water for several days.[17] By the seventh day the solution tested acid by litmus paper and had the odor of sour milk or stale butter. A small amount was poured over powdered calcite which effervesced readily.

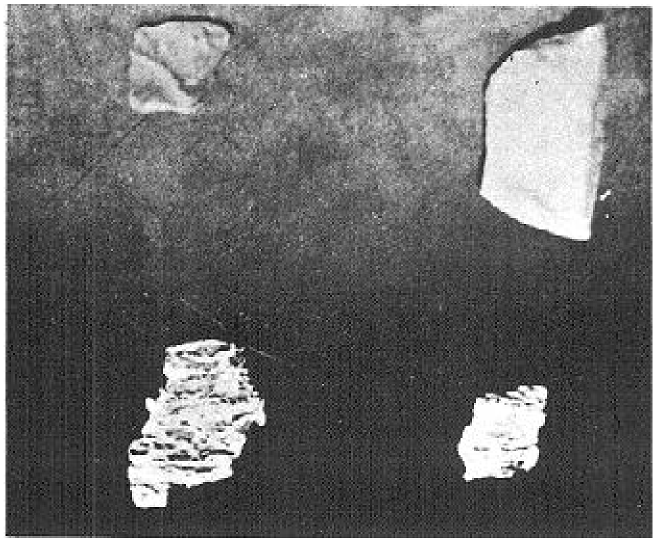

Figure 4. Pieces of mineral not tested (above) and pieces of mineral after exposure to acid solution (below).

It was hoped that once the CH_3COOH-CO_2-H_2O solution dissolved limestone and was exposed to the atmosphere, $CaCO_3$ would precipitate from it. The dissolving power of the acid solution is absolutely amazing. One experimental apparatus had to be filled three times because all of the chunks of limestone were completely dissolved. Of the three types of material tested, Indiana limestone, dolomite from the Beekmantown formation, and dolomitic material from Pennsylvania (formation unknown), all dissolved excessively. An interesting comparison of materials exposed to the test solution is shown in Figure 4.

The acid solution appeared to channel through the material. One of the rigs used in this series of tests was equipped with strings hung from holes drilled into Indiana limestone. As the acid water solution dripped through the holes around the strings, the holes were enlarged considerably.

If the holes were partially plugged to slow down the flow of solution through them, within just a few hours they would have to be plugged again to slow the flow of water. The solution continually enlarged the holes until the completion of the test. Any acidic water going into natural limestone joints would certainly cause enlargement. If this process continued naturally the formation of large joints and eventually a cave could be imagined to occur *quite rapidly.*

However no $CaCO_3$ precipitate could be obtained using the acetic acid solutions. The solubility for calcium in the solution was so high that the loss of CO_2 upon exposure to air, did not result in any precipitation. At the end of each drying period (100 hour intervals), some precipitate did form on the strings. An interesting helicite-appearing formation is shown in Figure 5. The precipitate was found to be calcium acetate as suspected.

Murray and Love[18] stated that calcium acetate will break down into $CaCO_3$ and CH_3COOH by the action of ground water and contacting rocks. The continued action will eventually cause the acid to be decomposed into CO_2 and water. If this is true, some $CaCO_3$ should have precipitated in our apparatus. Possibly the test solution was too concentrated. However, McCauley and Abdullah[19] stated that $CaCO_3$ fails to deposit in pipes in the presence of organic inhibitors such as sewage or decayed vegetable matter. Our experimental results agree with this observation.

Clay Formation

During the tests with the CH_3COOH solutions, large amounts of insoluble colloidal material formed in all of the experimental rigs.* The insoluble material was particularly plentiful in the apparatus filled with Indiana limestone. Some of the insoluble material trapped in a flask in shown in Figure 6. A chemical analysis of the material is given in Table 1.** This is a typical clay composition.

Table 1. Insoluble Residue From Indiana Limestone*

SiO_2	45.9%	Ni	~ 100 ppm
Fe	2.9%	Pb	~ 100 ppm
Ca	2.6%	Zn	~ 100 ppm
Mg	0.4%	B	~ 20 ppm
Na	0.11%	Ag, Cr, Cu, Mn	< 10 ppm ea.
Ti	> 1000 ppm	Sn, V	trace
Al	1000 ppm		

*Spectroscopic and wet chemical methods used.

Obviously the clay was trapped in the limestone when it hardened. Large amounts are present in the samples used in this experiment. Three samples of Indiana limestone were dissolved in a solution of 50% glacial acetic acid and 50% water. The insoluble material was filtered and washed several times with demineralized water. The amount of clay in the samples is given in Table 2.

Table 2. Percentage by Weight of Clay in Indiana Limestone

Sample Weight (g)	Weight % Clay
102.63	1.2
110.81	2.3
117.29	2.1

An average of 1.9% by weight of clay is present in the stone. The effect of this material on the subsequent precipitation of $CaCO_3$ would be great because of the large surface area of the collodial particles. It has been claimed[20] that the presence of collodial dispersions stabilize calcium bicarbonate solutions and prevent the precipitation of $CaCO_3$. Observations from this study tended to verify this; so it was decided not to use Indiana limestone in the tests again.

Large amounts of clay are present in most limestone caves. How it got there has been the subject of scientific speculation. Davis[21] suggested that clay on cavern floors may not be due to deposition by inflowing

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*Insoluble material formed in the bottom of all of the rigs no matter what type of test solution was used.

**All chemical analyses were done by Dr. Lee Kent of Commonwealth Laboratories of Greenville, S. C. His help is gratefully acknowledged.

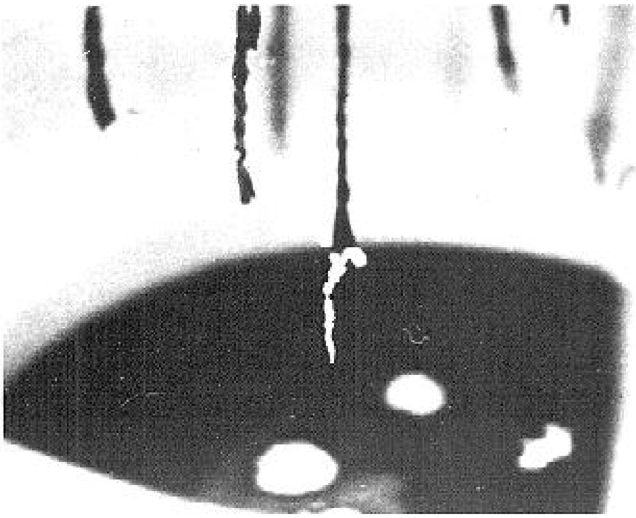

Figure 5. Calcium acetate precipitate on the end of a string.

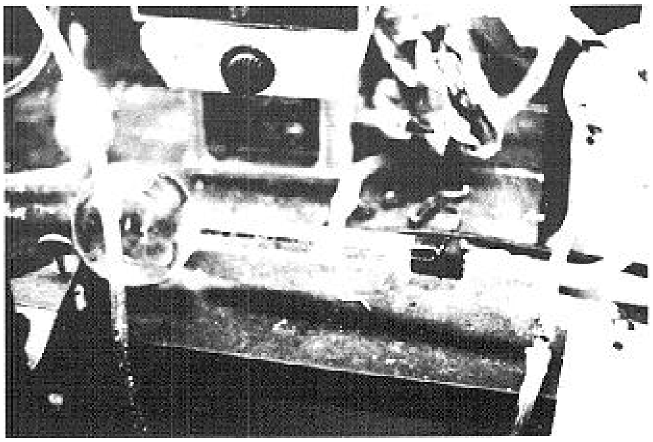

Figure 6. Insoluble material from Indiana limestone.

streams but are of local origin and were possibly deposited when the cavern was water-filled. Bretz,[22] after investigating many caves, postulated a separate epoch of clay filling between the formation of the cave and before the formation of dripstone. Hack and Durloo[23] found stratified deposits of mud in Luray Caverns and such statification is not uncommon in limestone caves.

It seems possible according to this experiment, for the clay to come from the limestone that is being dissolved rapidly by corrosive solutions forming a cave. However, Bretz considered it impossible to completely account for clay fills from the insoluble material in limestone.[24]

There was not as much insoluble material from Beekmantown dolomite as from the Indiana limestone, but rapid attack by the acid solution produced large amounts of dark insoluble material. Chemical analysis of the insoluble material from Beekmantown dolomite is given in Table 3.

Table 3. Insoluble Residue From Beekmantown Dolomite*

SiO_2	67.4%	Zn	0.62 %
Ca	7.05 %	Cu	.0098%
Fe	5-10%	Pb	<.0035%
Ti	< 5%	Mn	< 0.2%
Al	3.4%	Cr	< 0.1%
Na	0.52%	K	< 0.07%

*Scanning electron microscope and wet chemical methods used.

Simpler Laboratory Apparatus

Starting with tests employing CH_3COOH-CO_2-H_2O solutions a simple apparatus was used. A typical rig is shown in Figure 7. The solution and precipitation box have been combined as one. CO_2 and test solution were fed into the apparatus as before. However, the solution dripped directly onto the strings through holes in the bottom of the box. All tests reported in subsequent sections of this article were obtained from an apparatus similar to this one. No stirring was used in the plastic box and no fan was used to blow air across the strings.

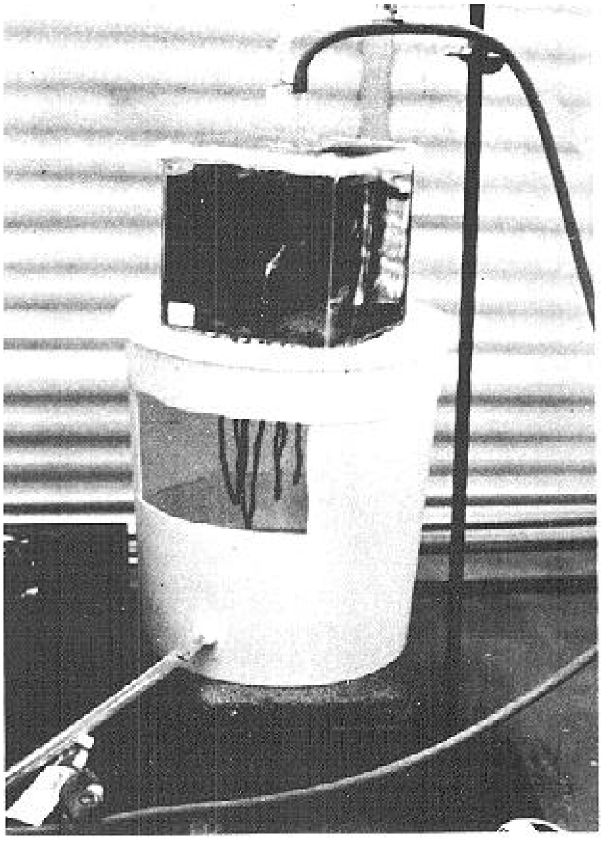

Figure 7. Simpler test apparatus.

Temperature Difference as a Mechanism for Precipitation

A series of tests was run using a heat lamp directed toward the area around the strings underneath the plastic box. the experimental arrangement is shown in Figure 8. A top view of the apparatus is shown in Figure 9.

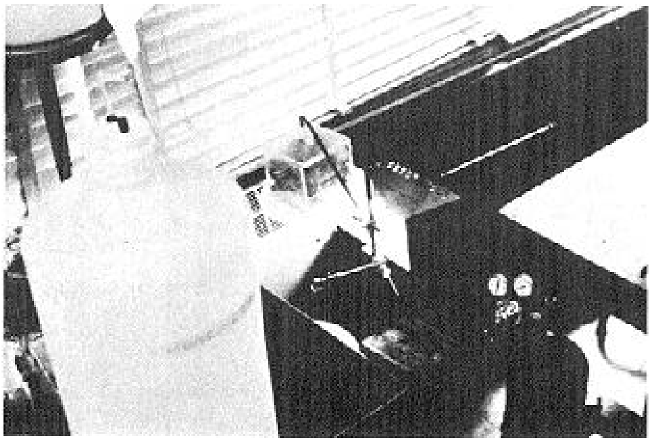

Figure 8. Experimental apparatus with heat lamp.

The precipitation reaction of $CaCO_3$ from bicarbonate solutions is endothermic.[25] Thus, heating the solution increased $CaCO_3$ precipitation as CO_2 was driven out of the solution. Such a natural mechanism is possible where cold solution waters enter the warmer atmospheres of the cave or in an area where there is unusual geothermal activity. The latter possibility was suggested by R. H. Brown.[26] also, it may have been possible that, if a cave formed as the Flood waters receded from the earth, considerable plant and animal remains could have been washed into it. Decomposition of the remains could have generated considerable heat in the cave, and this could have aided in stalactite growth.

The experiment was very successful. Massive amounts of white calcite were deposited on the strings (See Figure 10). Many of the strings had growth layers of calcite on them, similar to what is found in natural stalactites.[27]

Demineralized water entered the plastic box from a reservoir at a temperature of 25°C. The water and limestone in the box remained at 45°C. The temperature around the area of the strings was 50°C. Thus droplets falling down the strings went through no more than a 5°C temperature gradient. Actually the drops moved so rapidly that it is unlikely that an individual droplet even attained a temperature of 50°C. The flow of water to the apparatus was shut off every 100 hours as a drying cycle in the first run. The flow of water was not shut off during the second run. Test results are recorded in Table 4.

It may be thought at first that the heat would cause a great deal of precipitation by evaporation of the solution. However, it is felt that actually very little evaporation took place. The limestone chunks were weighed before and after testing. It was found that the rocks lost 32.8g of weight in run 1, and 30.8g in run 2, for a deposition efficiency on the strings of 19.6 and 26.7%) respectively. Also during run 2 a limestone slab was placed under the strings for a period of 13 days. This slab increase in weight 3.4g due to the formation of flowstone on it from the solution dripping from the strings.

Evaporation is considered responsible for the formation of "moonmilk" in caves.[28] Evaporation as a

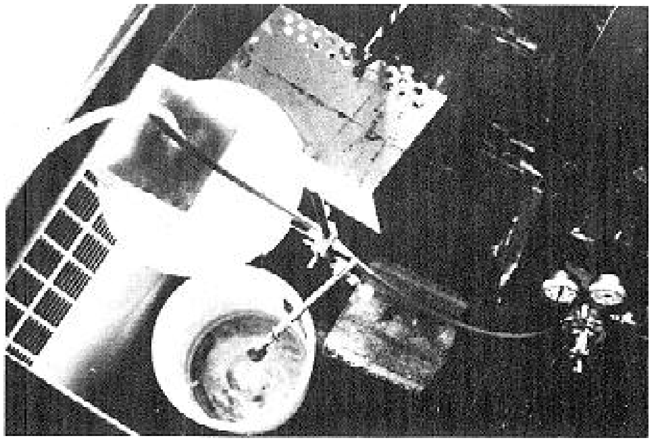

Figure 9. Top view of experimental apparatus.

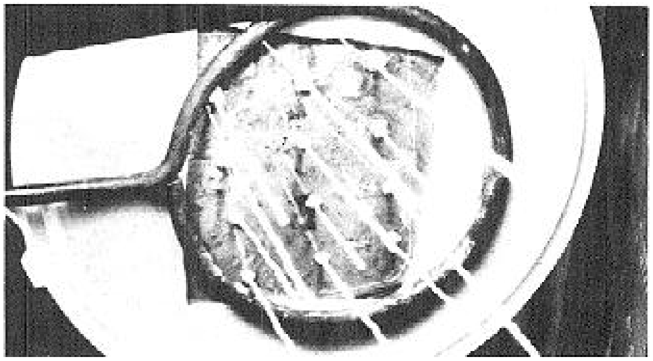

Figure 10. Calcite precipitate on strings.

Table 4. The Deposition of Calcite Under a Temperature Gradient From Solution Intended to Simulate Ground Water

Run 1		Run 2	
String	Weight of Deposited $CaCO_3$ (g)	String	Weight of Deposited $CaCO_3$ (g)
1	0.3494	1	0.5429
2	0.2651	2	0.3734
3	0.6017	3	0.9779
4	0.4835	4	0.7133
5	0.6225	5	0.7930
6	0.3453	6	0.4037
7	0.5520	7	0.9050
8	0.6638	8	1.3107
9	0.4132	9	0.5722
10	0.8443	10	0.8216
11	0.3282	11	0.6622
12	0.9723	12	1.3529
Total	6.4413	Total	9.4288

Run 1 - 450 hours of water flow, 65 liters of water passed through apparatus

Run 2 - 600 hours of water flow, 63 liters of water passed through apparatus mechanism for the growth of stalactites can be checked experimentally. If the corrosive solution comes through dolomitic material both magnesium and calcium carbonates are taken into solution. As the solution enters the cave only the $CaCO_3$ precipitates out* and subsequently the magnesium content of the solution rises. Evaporation would cause the precipitation of both magnesium and calcium. Therefore the magnesium content of the water dripping from the strings is a good indicator of evaporation as a mechanism of formation.[31] A chemical analysis of the water will be performed in later experiments.

Experiment Using Cold Water

To investigate further the idea of temperature gradient as a mechanism of $CaCO_3$ precipitation, it was decided to conduct an experiment using a cold water and CO_2 solution to dissolve the limestone. The cold water dissolved more CO_2 which in turn increased the solubility of limestone in the water.[32] Rain water at 0 °C dissolved twice as much $CaCO_3$ as rain water at 25 °C.[33] Also melt water from snows[34] and glaciers moving into limestone and hence into a warmer cave would satisfy the experimental conditions.

The string length was increased to 18 inches in this experiment to increase surface area over which the drops flowed. Initially the water in the plastic box was at a temperature of 8 °C while the area around the strings was at 25 °C. However, as the experiment proceeded, a deposit formed on the strings and clay settled in the bottom of the plastic box. These conditions restricted the flow of water down the strings causing the water temperature to rise slowly until it corresponded to room temperature. Although $CaCO_3$ was deposited on the strings the effect of the experiment was nullified. The results are given in Table 5.

Table 5. The Deposition of $CaCO_3$ from a Solution Intended to Simulate Melt Water* (500 hours of water flow, 141 liters of water passed through apparatus)

String	Weight of Deposited $CaCO_3$ (g)
1	0.8827
2	0.7817
3	2.1181
4	0.2891
5	0.6776
6	0.5593
7	1.2784
8	0.4953
9	0.3654
10	0.7313
11	0.3274
12	1.3944
Total Deposition	9.9007

*Water actually varied from 8-25 °C.

Tentative Model for Formation of Dripstone

A. Scope of Model. This discussion will include the formation of limestone, caves in the limestone, and the precipitation of $CaCO_3$. The entire discussion will center around the assumed conditions of the Flood and the aftereffects.

B. Deposition of Limestone. It is assumed that the majority of limestone layers were deposited during the Flood. The authors liken the deposition of limestone to the setting of Portland cement. Both are based on the chemistry of calcium. One can imagine dead organisms particularly those with shells, and various forms of debris such as stones, as an aggregate upon which calcium compounds precipitated. In other cases a cementing-precipitation reaction out of water could possibly have occurred. Deposition of limestone may be a chemical rather than a geological problem.[35] Johnson and Williamson claimed that precipitation of calcium carbonate can occur when a current of water saturated with calcite is warmed.[36]

Also the decomposition of organic materials during the Flood could have generated conditions favorable for the precipitation of $CaCO_3$. Weeks[37] cited evidence to show that decomposition of nitrogen-bearing substances, such as proteins, by releasing ammonia or amines, increased the pH of the water. This would favor deposition of $CaCO_3$.

Creationists need to do research on the formation of sedimentary materials from a chemical standpoint. The uniformitarian concept involving millions of years of deposition has stultified any research efforts in this direction. It would seem that an inexpensive project could easily prove fruitful.

C. Cave Formation. As the Flood waters began to recede off the earth, it is postulated that they would contain humic acid and CO_2 from the decomposition of living organisms. The solution would attack recently-consolidated jointed limestone causing cave formation in many areas. Immediately after the formation of limestone, water could seep through the joints enlarging conduits and forming larger passages. Davis[38] discussed the formation of certain caves under phreatic conditions. Many of the caves found in the Tennessee Valley were found under the water table.[39, 40]

As receding Flood water went through an ever-increasing opening in limestone the velocity of the water would have had an effect.[41] Considering a depth of water of only 1000 ft. above the cave and using Torricelli's theorem, $v = \sqrt{2gh}$, where v = velocity of fluid falling from a height (h) with g taken as 32 ft/sec^2, the velocity of water would be 80 ft/sec. Rapid erosion as well as corrosion could occur. It would seem that recently-consolidated limestone would not be as stable as it is today and the effects of moving water would have been much more damaging.

Swinnerton[42] considered the adequacy of water-table drainage as an adequate explanation for the formation of caverns. He cited evidence[43] that indicated rainwater tends to collect and flow through a selected drainage in limestone. If 15% of 40 inches of rain per year were available for limestone solution, then

$$5280\text{ ft/mile} \times 5280\text{ ft/mile} \times \frac{40\text{ in. of rain} \times .15}{12\text{ in/ft}}$$

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*There is evidence of dolomite speleothems in caves however.[29, 30]

$\approx$ 13,939,000 cubic feet of water/square mile is available to dissolve limestone. This means that in one year a cave of 3 ft. × 6 ft. cross section × 120 ft. long would be formed per square mile of surface.[43] Imagine the water available during and after the Flood available for limestone solution and cave formation! During this period it is felt that much clay filling of caves would have occurred.

D. Deposition of $CaCO_3$. Once the water-table falls below the level of the cave, deposition of stalactites and stalagmites could proceed. Again how rapidly structures like these grow in a cave depended primarily on the amount of water seeping through the jointed limestone into the cave.

Consider all of the results obtained so far, as tabulated in Table 6. These indicate a very rapid deposition of $CaCO_3$ if there were a continual supply of water dripping into the cave. Incidentally, some filling in with clay may have continued during this stage.

It is felt that the deposition of limestone, cave formation and subsequent precipitation of dripstone occurred rapidly in recent time. There is evidence to support such a claim.

In radiocarbon dating of calcite deposits in a cave[44] it was found that the material had an excessively high radiocarbon content. Considering the standard interpretation, CO_2 from decaying soil vegetation rich in radiocarbon combines with H_2O and $CaCO_3$ from limestone (supposedly free of radiocarbon) to produce bicarbonate ions.

If this material precipitated in a cave it would be expected that the radiocarbon content of a stalactite would be 50% of that of the decaying vegetation.[45] The stalactites tested contained about 90% of the radiocarbon content of modern vegetation! One possible interpretation is that the limestone is not very old, and it still has radiocarbon in it. This whole area could be very profitable for creationist research.

Conclusions

It appears that under certain conditions, $CaCO_3$ can be precipitated easily in the laboratory. More work needs to be done to investigate the variables involved. Various speculative aspects of the creationist model offered here need to be explored.

Appendix I

One kind of evidence offered for the quick growth of stalactites is that they are found under and around concrete structures. Moore[46] claimed that such measurements are not valid since the $Ca(OH)_2$ in cements is more soluble in water than $CaCO_3$ and will dissolve more readily in rain water. This brings up another interesting aspect that should be investigated by creationists. Would calcium-rich cements precipitated from the Flood waters contain $Ca(OH)_2$ which later combines with CO_2 to form $CaCO_3$ as it ages, just as Portland cement does?

If the sedimentary layers contained any of the more soluble $Ca(OH)_2$ in certain areas one could imagine an even faster rate of cave formation and subsequent dripstone formation.

Table 6. Experimental Results of Deposition Rates of $CaCO_3$ Under Various Conditions

Test Conditions	Total Weight of $CaCO_3$ deposited on strings (g)	Time of Test (hrs)	Amount of Water (1)	Rate of Deposition (grams of $CaCO_3$ per year per liter of water)
Demineralized Water + CO_2 at 25 °C	1.7962	700	?	?
5% NaCl solution + CO_2 at 25 °C	4.4554	500	209	0.373
1% CH_3COOH solution + CO_2 at 25 °C	none	—	—	—
Demineralized Water + CO_2 at 45 °C — strings at 50 °C	6.4413	450	65	1.929
Demineralized Water + CO_2 at 45 °C — strings at 50 °C	9.4288	600	63	2.185
Demineralized Water + CO_2 at 8-25 °C — strings at 25 °C	9.9007	500	141	1.230

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GOD DOES NOT DECEIVE MEN

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Those who hold the doctrines of uniformitarianism and evolution usually do so because of such things as the fossil record, or other supposed evidence for a very old earth. Those, moreover, who want to combine evangelical Christianity and uniformitarianism may argue that if the earth is not very old, God would be deceitful in making it appear so. It is maintained here, however, the God does not deceive men; it is much more likely that they deceive themselves. Moreover, the essence of deceitfulness lies in the intent. God, in creating the world as it is, did not make it thus for the purpose of deceiving men, but for very good reasons, which, of course, may or may not be apparent to men at the present.

Introduction

One of the questions that continually comes to the forefront in discussions among evangelicals about science and scientific findings is the question of the age of the earth. Members of the evangelical community are the most concerned with this question and similar types of questions because evangelicals are most concerned with the accuracy of the Biblical accounts. Accuracy at this point means literal rather than mythological accuracy.

Thus, given the Genesis account, an elementary knowledge of mathematics, and a little guessing about the age of Terah at the time of Abraham's birth, one may well arrive at the conclusion that the age of the earth is not a very advanced age when compared with the age that many scientists declare. Herein lies the crux of the evangelical's dilemma: Biblical data and geologic data are in apparent conflict. But if the Bible is true and God is author of both the Word and the world, then this apparent conflict must be resolved.

There have been many attempts to reconcile this rift between geologic and biblical data: the so-called gap theory, flood geology, day age concepts are but a few of the attempted reconciliations made by persons of conservative theological persuasion. More radical approaches have attempted reconciliation by such hermeneutical devices as mythological interpretations.

The latter approach, it would appear, is more of a radical bifurcation between spiritual and empirical statements than it is a reconciliation. The purpose of this study, however, is not hermeneutical nor is it the purpose of this paper to discuss relative merits or limitations of such interpretations.

It can be generalized however that the approaches listed above either become too biblical to suit the scientist or too naturalistic to suit the biblicist. Thus, there is room for an approach that is more satisfactory to both sides. This is not a search for a compromise position, but rather for a more satisfactory position because it is a more accurate position.

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