The Stalactites of G.B. Cave.

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G.B. Cave is adorned with stalactite growths in great profusion, and is especially remarkable for the abundance of those otherwise rare "erratic" forms, or helictites. The deposits may be dealt with under the two familiar divisions: Stalactites (including Helictites) and Stalagmites.

STALACTITES

These have commonly been formed by the deposition of concentric layers of calcium carbonate around a central core. This core is usually a "straw" stalactite, a thin-walled cylinder, of diameter about 5 mm., which is composed of crystallographically continuous calcite, the axis of the crystal lying along the length of the straw. The central channel of the straw has often been more or less filled with calcite at the same time as exterior enlargement was taking place. In broken specimens the core may then be seen as a circular area of clear calcite. In some cases, the core is formed of aragonite, the other crystalline form of calcium carbonate, in a fibrous condition, the fibres being elongated along the length of the stalactite. These are also fed by a central channel, but the walls are initially thicker than in the calcite straws. In some cases the stalactite has no definite core.

In all cases where there has been subsequent enlargement of a straw, this takes the form of cylindrical layers, or lenticular bands, of calcite, in a fibrous or granular condition, and aragonite, in a fibrous condition (see diagrams, *Fig.* 5). The presence of aragonite is an unusual feature in Mendip stalactites. The bands of aragonite are quite sharply defined, indicating that both calcite and aragonite are primary.

As already mentioned, this cave is noteworthy for the abundance of helictites. These small, irregular branches commonly arise from the sides, or around the bases of ordinary stalactites. They also grow on the surface of the stalagmite sheets which often cover the walls of the cave, but not on walls of bare rock. Close examination shows them to be circular in cross-section, except where they have suffered subsequent enlargement, with a minute, almost capillary, channel running down the centre. They are all composed of aragonite. Every stage of the transition between stalactites and helictites may be found.

The mode of formation of helictites has long been a matter of speculation among spelæologists, and many theories, some fantastic, have been put forward. One of the best known states that they are formed under the influence of air-currents. Greater evaporation is said to occur on the exposed side of the stalactite, which therefore grows more rapidly. This hypothesis is not supported by the fact that members of a bunch of helictites may grow out in all directions ; also, air currents would have to be of appreciable force, such as are seldom found in caves. Finally, the effect of air-currents on stalactites has been described by J. Smith.[1] Their effect is found to be to force the depositing solution on to the leeward side of the stalactite, where it forms " shrubby looking growths of calcite." The illustration given in the monograph shows them to be stumpy efflorescences, quite unlike helictites.

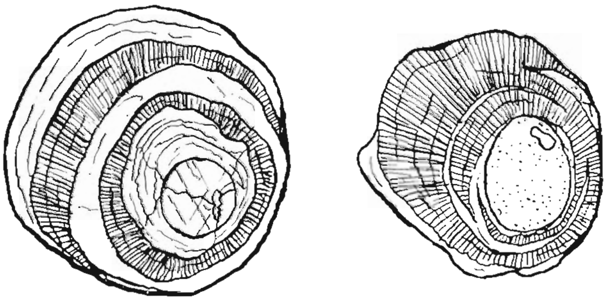

FIG. 5.—Transverse sections of typical stalactites from the First Grotto in G.B. Cave. (× 2.)

A. The core of this specimen is a " straw " filled with crystalline calcite. Enlargement has occurred by the addition of layers of calcite and aragonite. The latter is shown shaded.

B. A specimen with an aragonite core (dotted) subsequently enlarged by material in which aragonite (shaded) predominates.

In 1882, Hovey, in America, suggested that helictites grew on fungi. The webs of cave spiders have been called in to guide the drops of water : these, however, are far more often mentioned than seen. Impurities have also been supposed to affect the growth.

A study of the G.B. helictites supports the theory advanced by Huff in 1940.[2] He concluded from experiments that the erratic growth of helictites is due to a very slow rate of flow of the solution which forms them, which is supplied through the central channel. When the rate of flow is equal to, or less than, the rate of removal of water by evaporation, a true helictite is formed. When it is only a little greater, a stalactite is formed which is still irregular, but shows a predominantly vertical direction of growth. Such forms are also found in G.B.

The experimental evidence for this is as follows. Stalactites may be grown in many common salts, sodium thiosulphate, sodium chloride, copper sulphate, and others, by the simple process of allowing a saturated solution to drip from the end of a glass tube. If now the flow of solution is reduced, by using a suitable valve, it is found that irregular branches will grow at the end of the tube. Branches can be obtained of all varieties, closely simulating the natural formations. They also resemble them in having a small central channel. The experiments can be successfully performed under conditions where air-currents, cave spiders, fungi, and impurities in the solution are definitely excluded.

The above theory, in the light of features shown by the helictites themselves, and of experiences performed as described, appears to account for the formation of these fantastic growths in a satisfactory way. The rate of flow will depend on the size of the channel feeding the formation, and on the head of water available ; it can easily be seen how these conditions may vary greatly during the history of a cave.

Although helictites of aragonite only are known from G.B., calcite ones are found in America (Luray Caverns, Virginia), Belgium (Grotte de Tilff), and elsewhere. It may be noted that as early as 1910 Martel[3] was aware of the essential points of the mode of formation of helictites. In describing the Grotte de Tilff, he mentions how these are formed when the main channel of a stalactite becomes blocked and the water oozes through pores in the walls to form branches fed by capillary channels, the supply of water being so slow that the growth is independent of gravity.

The stalactites of G.B. are remarkable for their whiteness ; coloured examples are rare, and even the brown staining so common in the Mendips is seldom seen. This purity of colour does not necessarily indicate purity in the chemical sense.

The profusion of formations in the first and second grottos is probably to be accounted for by the fact that these caves are cut in a mass of conglomerate filling an older cavity. This conglomerate forms the roof of the present first and second grottos, and naturally affords a much easier passage for percolating water than the limestone which normally forms the roof of the cave.

STALAGMITES

Both calcite and aragonite occur, sometimes in considerable thickness, sometimes in layers as little as a millimetre thick, in the stalagmite sheets and columns. The finest stalagmite occurs in the branch which joins the main gorge just beyond the " bridge " ; the floor of this cave is formed of hummocky stalagmite with pillars rising out of it, and containing cave pearls in its hollows. Cave pearls are formed by the deposition of calcareous material around a small nucleus of rock ; they are said to be rotated by the impact of dripping water, this process giving them their rounded shape and preventing them from becoming cemented to the floor. Some examples in G.B. only fit into their corresponding hollows in the floor in one position ; the process of their formation may not, therefore, be so simple as is usually believed.

A variety of stalagmite also found in G.B. consists of numerous small projections covering the surface of the rock, up to 10 mm. high and several millimetres in diameter at the widest part, but often attached by a slender base. These when sectioned are found to show growth lines as indicated in the diagram (*Fig.* 6). This is possibly the same phenomenon described by Balch as coral stalagmite[4] though unfortunately I have not seen any of the occurrences mentioned by him.

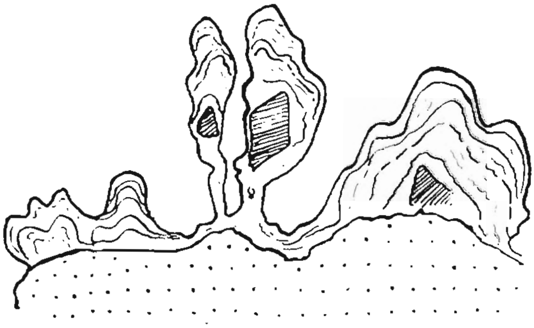

FIG. 6. A section of "coral" stalagmite from the White Passage, G.B. Cave. Calcite crystals are shaded, limestone dotted. (× 4.)

It is usually regarded as being formed by the splash from dripping water ; there is support for this view at the Coral Cave, Compton Bishop, where the little growths form concentric patterns. I have not noticed such patterns in G.B., though they may exist. Certain G.B. specimens sectioned were found to have cores composed of translucent calcite, probably crystals of the common dog-tooth form, which are shown shaded diagonally on the diagram. This indicates that in this occurrence at least these forms are due to the coating of calcite crystals by thin layers of stalagmite.

NOTE ON ARAGONITE AND CALCITE

Calcite is the common crystalline form of $CaCO_3$, belonging to the hexagonal crystal system, with a perfect cleavage which may sometimes be seen on the broken surfaces of stalactites. The hardness is 3 and specific gravity 2.71. Aragonite is the other crystalline form of $CaCO_3$, which belongs to the orthorhombic system, with poor cleavage. It is a little harder than calcite, and has a specific gravity of 2.94. It is the less stable form of $CaCO_3$. While calcite occurs in stalactites in both both fibrous and granular condition, and also in straws showing crystallographic continuity for a considerable length, aragonite occurs only in fibrous form. Aragonite may be distinguished from calcite by boiling the specimen in a solution of cobalt nitrate for 15 minutes. The aragonite is stained pink, the calcite is unaffected. This test was used for the G.B. material.

REFERENCES

[1] Smith, J., *Monograph of the Stalactites and Stalagmites of the Cleaves Cove, Near Dalry, Ayrshire*, London, 1894.

[2] Huff, " Artificial Helictites and Gypsum Flowers," *Journal of Geology*, XLVIII, Chicago, 1940.

[3] Martel, E. A., *Les Cavernes et les Rivières Souterraines de la Belgique*, Brussels, 1910.

[4] Balch, H. E., *Netherworld of Mendip*, Clifton, 1907.