his Nob"; and many a person today shudders slightly when referring to "The Talkies". I wonder what the final word will be that slips into an Oxford Dictionary of the future to express the combination of Television and Talkie.

CAVES AND CAVERNS: THEIR INTEREST FOR CHEMISTS AND GEOLOGISTS.

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Caves, whether they be holes in the ground, gapes in the mountain side, or wounds in the rocky face of a sea cliff, have always played a romantic part in the history and literature of the world; mystery dwells about their thresholds, while their pitchy halls and hidden ways are the home of fairies, gnomes and sibyls, of dwarfs that toil at Vulcan's bidding. From caves, too, spake the oracles, voices of destiny heard beside the cradle and the death-bed of pagan nations.

Primitive man made caverns his home, peoples of early civilization made then their burying-places. In many parts of the world caves are natural museums which gathered through the ages relics not only of man and his tools and weapons, but of many varied kinds of animals and birds. Who would imagine the hyena, tiger, bear, rhinoceros, elephant or hippopotamus roaming in England? Yet English caves hold the bones of these animals besides those of a more familiar kind. Caves have been used successfully as hiding-places, retreats and strongholds for bandits, smugglers, pilgrims, prophets, kings.

During the Great War certain English caves were used for the storage of ammunition. During the war between Great Britain and the United States in 1812 the Mammoth Cave of Kentucky played its part in the crude manufacture of one of the essential ingredients of gun-powder. Calcium nitrate from cave deposits was leached in vats within the cave itself, and the solution pumped to open-air boilers. The concentrated liquor was run through wood ashes, boiled again, and cooled in wooden troughs. The crystals of potassium nitrate so formed were packed for transportation by primitive methods to the seaboard. The war would have ended in complete failure for the

United States had it not been for the resources furnished by American caverns for the home manufacture of saltpetre at a time when by a general embargo the States were cut off from foreign sources of supply.

Today caves and caverns have an important economic significance, since their interest and beauty attract large numbers of tourists to those countries that are fortunate enough to possess them and wise enough to advertise them as a scenic feature. It has been said that the possession of caves more than any other scenic feature tends to make a country famous.

Types of Caves.

Large caverns are limited to regions favourable to one or other of the different processes of cave-making. Certain conditions of topography, of rock structure, or of rock composition, must be satisfied. By the destructive action of the battering breakers and grinding shingle the sea, with great mechanical power, carves jointed granite or basalt into natural tunnels, or spouting horns, or fantastic arches. These products in turn are broken down, being transformed into chasms, embayments or straits. This destructive agency has been so vigorous along the Atlantic coast that not a cavern can be found, from the Bay of Fundy to the Gulf of Mexico, deep enough to exclude the daylight. The beautiful Blue Grotto of Capri is perhaps the best known of marine caves. Fingal's Cave on the island of Staffa and our own Blow Hole at Kiama are other examples.

Lava caves may result from the expansion of steam and other gases in molten rock, or from the formation of a solid crust on a lava stream, portions of the molten interior sinking from the solid roof as they flow on. Such caverns are often of great size and beauty. The finest lava caves are found in Iceland, where the best of all, the Surtsheller, was formed by the outpouring of lava from Skaptar Jökull in 1783.

In rock-salt districts large caves are formed owing to the free solubility of the sodium chloride in water. Saline layers dissolved away have resulted in the formation of small caves in the vicinity of Burrinjuck Dam. In France and Switzerland large caverns often attractively decorated with icicles have been formed under glaciers by the shifting of ice. The warmth of the earth is often responsible for ice caves. But all such caves are by no means so numerous as those formed by the solution of

limestone and dolomite. These rock masses are widely distributed, and are the most common formations in which caves are found.

The Calcium Carbonate Cycle.

It is a fascinating story that tells of the origin of limestone and the carving and decorating of the caves found in it. Carbonic acid, which is present in most waters, derived either from the air, the earth's crust, or from decaying organic matter, dissolves rocks in minute quantities, especially those containing much lime. Streams containing carbonic acid make their way to the sea, where they distribute the various compounds with which they are laden. Reef corals whose banks fringe the coast secrete the lime so brought, and with it build the fragile coatings that protect them. The living coral forms a narrow fringe about each reef, which becomes more and more massive as storm-hurled fragments and coral sand are cemented to the constant accumulation of dead corals. After long geological periods some climatological or other change causes the destruction of coral life. Now other deposits accumulate over these dead corals, which are crushed and folded into banks of coral rock. Earth movements elevate and submerge this consolidated limestone rock perhaps several times, till at last it becomes part of dry land, to be exposed to the action of wind and water.

And now the process is repeated. Acidified water soon discovers the weaknesses in the limestone rock, and excavates, by wearing and solution, tunnels that zig-zag from crack to crack, from level to level. The subterranean rivers are particularly active as cave makers when in flood. Rising, falling and sweeping under overhanging ledges, they hollow out long horizontal passage ways, sway to and fro like liquid battering-rams, hammer down weak walls, and undermine arches, thus making, through the ages, those successive tiers or galleries for which some caves are noted. Enlargement proceeds, and may be repeated for each stage of the topographical development of the district. Such an example of the repeated enlargement of subterranean galleries and channels at different levels is afforded by the Jenolan Caves, where probably five stages in the erosion of the district were accompanied by the excavation of extensive solution-cavities, in the limestone, immediately above the water level. Such a group of features adds largely to the attractiveness of caves.

The holes through which a subterranean river has descended during its cave-making are known as sink-holes. The direction of caverns and channels can often be ascertained above ground by examination of these entrance holes or depressions. Fine specimens are found in Kentucky and Florida, and they may be seen at places between Naracoorte and Mount Gambier and on the Nullarbor Plain.

Cave Decoration.

The excavation of a cave necessarily precedes and is, in general, very much older than, the decoration, or re-decoration, now existing. The decoration of a cave is the outcome of a double chemical process. Firstly the carbonic acid in the water trickling through limestone dissolves the limestone by reason of the formation of the *soluble* bicarbonate of calcium. Secondly when water laden with calcium bicarbonate comes trickling through the roof of a cave, and lingers, some of the soluble calcium bicarbonate is converted into *insoluble* calcium carbonate by the escape of carbon dioxide and of water. The calcium carbonate is precipitated as a thin translucent film on the surface of the drop. While evaporation is good this film is repeatedly broken, and the pieces go spinning up to add their quota of mineral to the tip of the pendent tube which is being formed from the roof. These roof-pendants are called stalactites, and when newly-formed may be crushed between the fingers, but as calcium carbonate is deposited on the inner and outer surfaces, they get stronger, and may attain a length and thickness of many feet. The drop of water at the tip of an active stalactite is very much "alive," and fascinating to watch closely. The spinning motion of the pieces of its mineral skin is due to surface tension, and also to the fact that the water current is down-flowing in the centre of the drop and up-flowing at the periphery.

Stalactites show many varieties of form. Some, as in the Jillabenan Cave at Yarrangobilly, are many feet in length, yet no wider than the water drops at their tips. They sway as one passes by, and are wisely protected from the flights of big bush flies. Others are irregular in outline. Where the water emerges from the cave roof along a crack or crevice and explores its way down the wall the stalactites develop into forms commonly called, for want of a better terminology, "shawls", "curtains", "blankets", or "wings". When illuminated from the side away from the observer they are, in many cases, translucent, and

many present the appearance of a fabric into which bands of colour have been woven. Many are of great beauty, and none more so than the Angel's Wing in the Temple of Baal Cave at Jenolan.

Helictites, or " mysteries ", are bizarre forms which seem to defy the control of gravity, twisting and convoluting irregularly until they simulate anything from a hair-pin to a bird's nest. They seem never to be coloured, only discoloured, and for some unknown reason are singularly prolific at Jenolan Caves.

The water solution that drips or runs on to the floor of a cave deposits there, again by evaporation, calcium carbonate which slowly assumes the massive form of a stalagmite. Sometimes stalactites and stalagmites may become united, so forming pillars that appear to support the roof. Pools on the floors of caves are often surrounded by walls of calcium carbonate, and the overflow from one of these may form successive " basins " at lower levels, building up a series of terraces. These are well developed in the Wombeyan Caves.

The mere height of a stalagmite does not indicate its age, and any estimate of age based on height is idle. The important factors controlling stalagmitic growth are rate of drip, concentration, air circulation, relative humidity and temperature. These factors taken together at their upper and lower limits give rise to thirty-two basic types of stalagmite. If the values of the factors are determined in the case of a given stalagmite in a cave it is possible to estimate approximately the present rate of vertical growth, and therefore the approximate age of growth of the stalagmite. Results so obtained do not exceed one hundred thousand years for the largest stalagmites, an estimate surprisingly less than the millions of years of popular belief.

CONTRIBUTIONS.

Contributions must be typed with double spacing, on one side of the paper only.

Contributors are also requested to be certain of all statements given as facts and, as in any scientific article of standing, to quote their authorities and references.

Articles should be in English, and so set out, phrased, and punctuated as to be intelligible and interesting to a reader other than the author himself.