the same manner as glows are produced in neon signs. The energies of these particles also ionize the atmospheric gases and render them electrically conducting so that large electric currents flow through the upper atmosphere. These produce the magnetic effects recorded by magnetic instruments and also induce electric currents in power and telegraphic lines. This electrification of the upper atmosphere is irregular in formation and consequently destroys the reflecting properties of the smooth but lesser conducting layers normally present which are responsible for reflection back to earth of radio waves traversing long distances. During the magnetic storm of September 18–19 electric currents flowing in the earth's atmosphere probably attained values of several million amperes.

Magnetic storms of intensity comparable with the recent one are extremely rare, occurring as a rule only once or twice during each sunspot-cycle. Since the present sunspot-cycle is now well on the decline, it is extremely unlikely that so great a magnetic storm accompanied by a spectacular auroral display will occur again for a considerable number of years.

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MOSSES IN THE VIRGINIA CAVERNS[1]

RECENTLY when on a visit to Luray Caverns in the Shenandoah Valley of Virginia I was surprised to see a pronounced green color appearing on many of the drip-stone formations that I had not noticed many years previously. It was evident that this green coloration was related in some way to the illuminating system, for it showed at its best on the rocks brilliantly lighted by the reflecting projectors. On close examination it was found to be a chlorophyl plant. A specimen submitted to the Farlow Herbarium of Harvard University was determined as an atypical sterile moss of the Order Hypnobryales.[2] More recently a collection of these mosses has been submitted to the Harvard herbarium for more specific identification.

Before the electric illuminating systems were installed in the Virginia caves no sign of moss or other green plant life had been seen in their dark interiors. The lighting systems were installed in most of the caves about 1922 or shortly thereafter. The moss is variously reported to have appeared in two months to two years time after the lights were put in service. With the introduction of larger bulbs and more efficient reflectors, the moss has spread over wider areas to the extent that the green tone is almost as much a part of the coloration of the cavern as the natural browns, buffs and white of the drip-stone formations. This greenish color is not objectionable but rather adds a pleasing variation to the natural color scheme.

Apparently the spores of mosses living on the surface of the ground above the caves are carried by the ground-water seepage into the caves. If they are fortunate enough to lodge within an intensely illuminated area the spores germinate and develop into mosses as much as two to three inches in length. Even ferns have been reported to grow in the caves.

Whether these mosses require the light and heat from the visible range of the spectrum or whether they can develop in total darkness under the influence of infra-red radiation is not known. But certain it is that they have not been able to germinate in these caves without the support of radiation from the electric lamps. The amount of light, or rather the extent of the time of illumination, may range from an hour or two to fourteen hours a day, depending upon the season of the year. In summer, the busy tourist season, the plants in the caves may be bathed with artificial light for as many hours a day as if they were living outside. In winter when the periods of illumination are short the plants may turn yellowish or brown and die.

As mosses are land plants their introduction into caves by the vadose waters is a relatively simple process. The wind is not a likely means of transportation of the spores, more particularly in the Luray Caverns where no noticeable air circulation is reported. The spores of mosses are apparently present at all moist places and are awaiting only sufficient light to germinate, and they in turn provide a means of support for animal life which exists with them. Algae on the other hand are water plants and their continuous introduction into areas above the water table is not so likely. Where surface streams become cavern streams there is apparently no reason why algae may not grow in caverns under the influence of sufficient artificial illumination.

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STONE MAN CAVE, SHASTA COUNTY, CALIFORNIA

INVESTIGATION of cave deposits in northern California was initiated in 1903 by Dr. John C. Merriam, and excavations were carried on up to and during 1905, principally in the Potter Creek and Samwel Caves. One cave, the Stone Man Cave, approximately 30 miles north of Redding, was examined by Dr. Merriam and the writer, but some doubt existed as to its antiquity, owing to the paucity of animal remains in the cave.[1]

[1] Published by permission of the Director, U. S. Geological Survey.

[2] Through the kindness of Dr. Franz Verdoorn, the specimen was subsequently forwarded to Professor W. C. Steere, of the University of Michigan. He pronounced it to be *Leptobryum pyriforme*.

[1] *Am. Anthropologist* (NS) 8: 2, April–June, 1906.