

THE LURAY CAVERNS BY ELECTRIC LIGHT.

BY H. C. HOVEY.

The facilities now furnished by the Shenandoah Valley Railroad have drawn twelve thousand visitors to the Caverns of Luray since last June. The majority of these have had to grope their way by candles, with occasional flashes of red lights or magnesium tape; and, on special days, the galleries have been illuminated by fixed chandeliers, ten thousand candles having been thus consumed on a single occasion. The unavoidable result has been the dropping of a great amount of melted tallow among the crystals and into the springs and pools, the smoking of some of the more delicate stalactites, and the change of those bright colors that attracted the admiring gaze of visitors who saw, as the writer did, the cave in its unsullied purity, just after its discovery, in 1878, by Messrs. Campbell and Stebbins. It may be added, in self-defense, that some of the beautiful objects, described by me in articles then written for the SCIENTIFIC AMERICAN, have been thus transformed beyond recognition—a remark especially true of the alabaster grotto known as "The Bridal Chamber," and the scale-covered column called "The Mermaid."

There are, however, attractions enough remaining to justify the boast of the proprietors that they have the most beautiful cave ever found; and new rooms are being frequently opened, so that the local residents in the vicinity imagine that these are discovered to order, whenever the curiosity of the public begins to flag. Whatever may be true as to this, it is well that the law is most stringently enforced against mutilating the formations or taking specimens; because, famous as the cave has become, its proportions are limited, and it might quickly be spoiled of charms that centuries were required to produce.

In order to the better preservation of the cave, and also that its wonders might be seen to the best advantage, the company have lately had electric lights introduced with admirable success; and as this is the first attempt of the kind, the particulars may be of general interest.

When I say that thirteen electric lights are kept burning in Luray Cave, the statement may not seem extraordinary, now that lights of this description are common in every city. But a moment's reflection will show that it is quite different to run wires along poles or over house-tops, and to run them underground, under perilous masses of dripstone, through nearly inaccessible galleries and across profound chasms. The hard carbonates into which holes had to be bored for the insulators proved to be so very hard as repeatedly to snap the drills. There were also unusual magnetic disturbances, and the difficulties of perfect insulation were such that some of the workmen received severe shocks while testing the wires.

The engine is more than a mile from the cave, being the same that is used to supply water for the Luray Inn, and for the tank at the railroad station. The power required for each light is three-fourths of one horse power, and the expense of putting in the works, aside from the engine, was about \$3,500. The length of the single wire used is three and a half miles, which, with the return current through the earth, makes an entire circuit of seven miles, and is supposed to be the longest current yet attempted with one engine. Automatic regulation is of importance in managing so extended a circuit; and this was secured by using the Thomson and Houston system, the special advantage of which, in this case, as explained to me by the electrician, Mr. T. H. McCollin, is that it allows any number of lamps to be turned on or switched off, without any change in the running of the engine. The current regulator is actually an electric governor. By rocking the brushes on the commutator the current is increased or decreased automatically. Otherwise, when some of the lights were extinguished, the same amount of electricity would continue to be generated as if all were burning, unless specially checked by hand; and consequently the machinery would become heated unless slowed down or else a proper means of wastage provided. But here the excess above the quantity of electricity generated for actual use is provided for, without diminishing the number of revolutions of the generator or the speed of the engine itself. The decrease of resistance, however, in case lights are extinguished, is immediately felt by the engine, and results in less consumption of fuel and steam.

The lamps, with a single exception, are used without shades, there being little draught except near the entrance, and the shades only serving to intercept the rays. From 2,000 to 2,500 nominal candle power is claimed for each lamp, which ought to give for each about 1,000 for available use in illumination. But I observed that the amount of light actually obtained was much less than what would be expected in the ordinary atmosphere. I found the explanation of this in the fact that the cave atmosphere, being optically pure, does not carry the rays as effectually as would be done by air in which motes were floating. This theory was verified by me last summer, in other caverns, by burn-

ing blue lights and magnesium tape. Returning to the same localities about an hour later, the increased light from our torches was very perceptible, and was accounted for by the fact that particles had thus been set afloat in the air that served as vehicles for spreading the rays.

The lamps in Luray Cave are in a measure movable, that is, they may upon occasion be swung from one point to another. But as they are at present placed they throw light on points of most interest to the visitor. The first is in the Vestibule, and finely lights up Washington's Pillar and the entrances to Stebbins' and Specimen Avenues. The next is in the Fish Market, making the long strings of bass and mackerel glisten as if they were real fish instead of stone.

Two lamps cast their beams into Pluto's Chasm, a pit said to be 500 feet long and 70 feet deep. Another is amid the alabaster scarfs and brilliant stalactites that embellish Hovey's Hall. Others light up to advantage Oberon's Grotto and the diversified and curiously beautiful bronze, pink, blue, and white formations in the Cathedral, the Giant's Hall, and the Ball Room. The most remote points reached by the lights are Collins' Grotto and Campbell's Hall. The last object of interest usually exhibited, and which the visitor carries away as something to be cherished in memory as long as memory shall endure, is the Imperial Spring and Brand's Cascade. The "Spring" is not properly a spring, but a limpid pool, overarched by a grotto 25 feet across, and

the examination of the entire cavern without one's being obliged to retrace his steps, but emerging from his underground journey at an exit to be made about five hundred feet south of the entrance.

The pick and crowbar are the main reliance for enlarging narrow passages, but an occasional charge of dynamite has been fired in places where other galleries were not endangered by the explosion. Among the huge blocks thus dislodged I noticed some that were remarkable for size and also for fineness of texture. Experimenting on a few fragments given me for the purpose, I find that, on being cut into slabs and polished, they are quite equal to the celebrated Mexican onyx, from which they differ mainly in vividness of color.

A correct map of Luray Cave has long been wanted by persons interested in subterranean regions. A sketch was prepared by Mr. A. Y. Lee, for the *Herald*, in 1878; and another, embodying certain improvements, was made in 1880, by Mr. S. Z. Ammen. It is no disparagement to these gentlemen to say that their maps were imperfect, for they could hardly have been otherwise under the circumstances.

Since the electric lights have been put in a new survey has been made with the greatest care, resulting in the accurate map that accompanies this communication. It is published by the consent and approval of the company, and can be depended on as to its details. It was found impossible to indicate every object of interest; but a list of the more important ones serves to explain the map. Nearly all the points indicated are now exhibited to visitors; and others will be opened to the public during the next season.

Should the reader desire more full particulars concerning this wonderful series of caverns, he will find them in the files of the SCIENTIFIC AMERICAN for 1879, in the reports of the Smithsonian Institution, and in various magazines.

The Expanding Power of Ice.

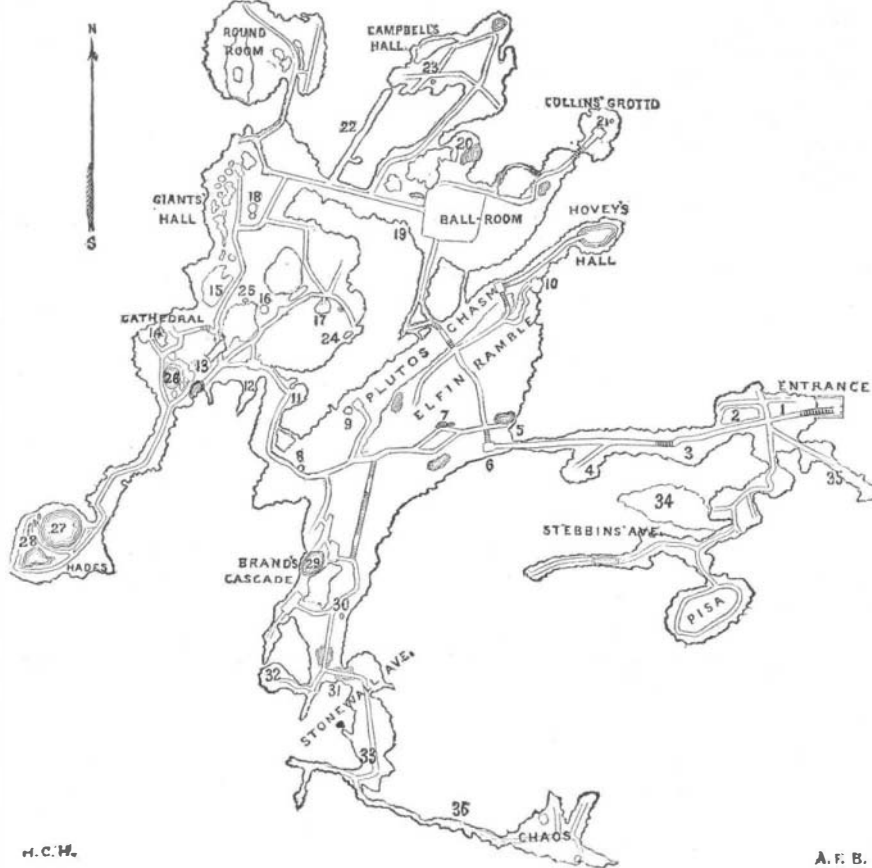
In a recent number of *Nature*, Hr. Bergh has drawn attention to the powerful agency exerted by ice in severing rocks, of which he gives a striking instance occurring on the Aalesund in West Norway, where a low ledge rising out of the fjord is all that remains of a once extensive fjæld promontory, which, in the year 1717, was suddenly blown up and precipitated into the water by the force of the ice within the interstices of the stone. The winter had been mild, and during a rapid thaw a considerable stream had welled up from the ice covered summit of the fjæld, and carried its waters into every crevice of the rock, when a sudden change of wind brought about a sharp frost, which turned the descending waters of the newly formed stream into ice, arresting their course within the interstices of the rock. The result was the explosion of the entire mass of the fjæld below the outbreak of the stream, and its projection from a height of more than 1,500 feet into the neighboring fjord, which engulfed the whole of the promontory, with its cultivated fields and farmstead. Simultaneously with the disappearance of the land below the surface of the fjord, a huge mass of waters was propelled against the opposite shore, carrying with it rusty anchors, boat rafters, and numerous other objects which had long lain at the bottom. The disturbance extended a mile beyond the point at which the land was submerged, and the waters in retreating carried with them a wooden church which had stood fifty feet above the fjord, besides sweeping away all the fishing boats for a distance of two and a half miles. Before this occurrence, which was attended by loss of life to about a score of persons, the headland had been much resorted to on account of the halibut which abounded in the neighborhood, but since that period the fish has never returned, a circumstance which, according to local popular belief, is due to the covering up by the infallen rock of certain submarine cavities and springs frequented by the fish.

MISCELLANEOUS INVENTIONS.

An improved dentist's broach has recently been patented by Mr. Olof Johanson, of New York city. The object of this invention is to improve the construction of the ordinary dental broach for cleaning hollow teeth and extracting nerves by rendering it equally flexible in all directions, so as to reach every part of a hollow tooth, and making it stronger, so that when revolved it shall be less liable to break than the ordinary broach.

Mr. Charles Royle, of New York city, has patented an improvement in that class of lamps in which the oil chamber is surrounded by, supported upon, and connected with the pedestal by a body made of ornamented porcelain. The invention consists of the body made of cement moulded into shape and covered with a shell of ornamented sheet metal or paper.

An improvement in desks has been patented by Mr. Joseph H. Burrows, of Boise City, Idaho. The invention consists in combining with a main section and writing board two hinged bars pivoted to the lower ends of two slide rods and a block.



H. C. H.

A. F. B.

1. The Vestibule.—2. Washington's Pillar.—3. The Flower Garden.—4. The Amphitheater.—5. Natural Bridge over Muddy Lake. 6. The Fish Market.—7. The Crystal Spring.—8. Proserpine's Pillar. 9. The Spectral Column.—10. Hovey's Balcony and Scarfs.—11. Oberon's Grotto. 12. Titania's Vail. 13. Saracen's Tent, and Fallen Column.—14. The Organ and Throne.—15. The Tower of Babel.—16. The Empress Column.—17. The Hollow Column.—18. Henry Baird (or Double) Column.—19. Chalcedony Cascade.—20. The Coral Spring.—21. The Dragon of Luray.—22. Bootjack Alley.—23. The Mermaid, or Scaly Column.—24. The Lost Blanket.—25. Helen's Scarf.—26. Chapman's Lake.—27. Broadus Lake.—28. The Castles on the Rhine.—29. The Imperial Spring.—30. The Skeleton.—31. The Twin Lakes.—32. The Engine Room.—33. Miller's Room.—34. Hawes' Cabinet.—35. Specimen Avenue.—36. Proposed Exit Avenue.

MAP OF LURAY CAVERN.

so thickly studded with bronze stalactites from three inches to three feet in length, that after several trials at counting the number on a square foot, we estimated the entire number in the vault to be about fifty thousand, each tip gleaming with a crystal drop. The light is so placed as to cause all these sparkling pendants to be reflected from the face of the pool.

Brand's Cascade, it should also be understood, is not a real one of water, but a mass of alabaster, seeming to gush from the side of the Imperial Spring, and to have been frozen in the act of falling down into the ravine below. Imagine a cataract of milk suddenly caught in mid air and polished to a wax-like luster, and beyond it another as yellow and golden as amber, and the whole mass flooded by electric light, and you will see that the scene could not be painted by pencil or pen.

During my last visit to Luray, a few days ago, a photographer from Philadelphia, Mr. C. H. James, was trying to fix on paper some of these indescribable visions. The experience of those who have hitherto attempted underground photography has not been very encouraging, but this gentleman has overcome many of the difficulties in the way, and hopes to get good pictures. Those he has already secured certainly surpass any taken by calcium or magnesium light, both in sharpness of outline and distinctness of detail.

Wisely the guides show to visitors only those parts of the cave that have been made easily accessible by concrete pavements, plank walks, bridges, and stairways. Places that can only be reached by creeping and wading are not open to any but explorers who cannot rest until they have seen all that can be seen. Work is constantly in progress to facilitate